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# **AQI Toolkit For Weathercasters**

U.S. Environmental Protection Agency  
Office of Air Quality Planning and Standards  
Research Triangle Park, NC 27711

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CDs

*CD#1*

    Electronic Copies of Presentations and Handouts

*CD#2*

    Forecast Earth: Air Aware Video (About Air Pollution and Health)



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## *Meteorologists:*

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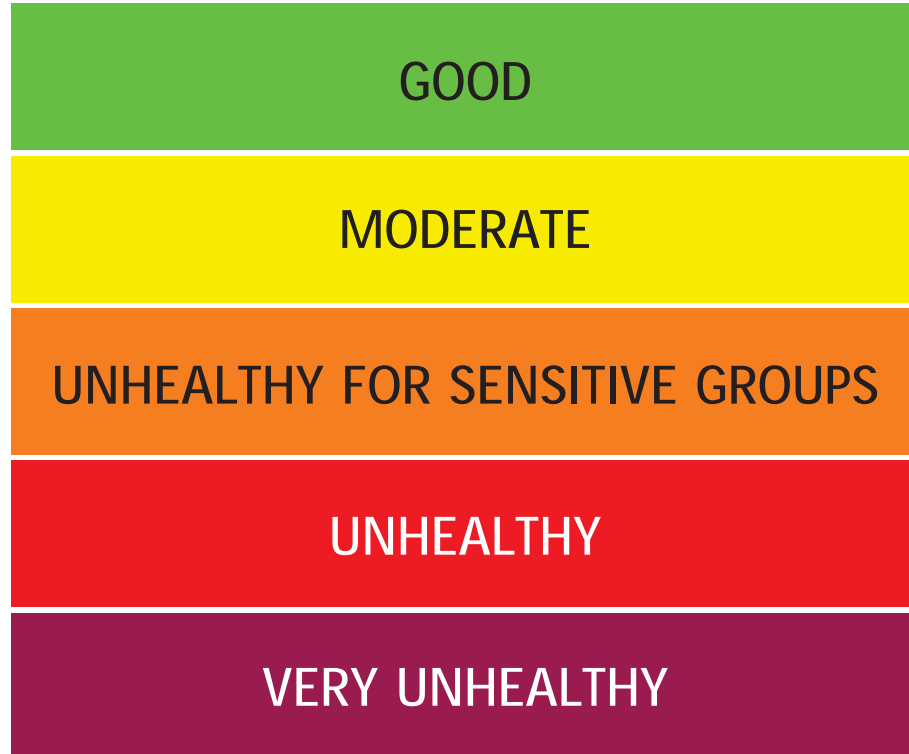
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## Notice

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# Toolkit Overview



# Toolkit Overview



Welcome to the Air Quality Index (AQI) educational toolkit for weathercasters. This toolkit was designed by the U.S. Environmental Protection Agency (EPA) for weathercasters who make educational presentations to schools and civic groups. The toolkit contains key materials to help audiences understand how they can use the AQI to find out about local air quality and how they can protect their health when the air is polluted.

## Your Role in Air Quality Awareness

Air pollution is a serious public health issue. Because of the linkage between weather and air pollution, weathercasters play an important role in raising air quality awareness. Like many weathercasters, you may be incorporating air pollution alerts and associated health messages into your weathercasts. Presentations by weathercasters offer another powerful venue for educating school children, families, teachers, and civic groups about air quality and health.

Two pollutants in particular, ozone and particle pollution, are often found at unhealthy levels in many parts of the United States. Real-time data and forecasts for ozone and particle levels, as well as messages about how to protect health, are now available to the public through many channels, including EPA's AIRNow web site ([www.airnow.gov](http://www.airnow.gov)). EPA and others are working to help educate the public about the resources they can use to protect their health from air pollution.

## What's In the Toolkit?

### *Presentations*

- **Key Messages** — Bullet point lists of key air quality messages for each presentation (for Grades 3-5, Grades 6-8, and Civic groups).
- **Notes Pages** — Printed black-and-white copies of slides and talking points for each slide. Long and short versions for civic groups are provided to accommodate available presentation time.
- **Handouts** - Simple one- or two-page, age-appropriate handouts for students and adults.
- **Transparencies** - A set of overheads (in both transparency and PowerPoint formats) for each presentation. Long and short versions for civic groups are provided to accommodate available presentation time.

### *Additional Resources for Weathercasters*

- **Fact Sheets** - Basic information on the AQI, air quality mapping and forecasting, the health effects of air pollution, and relevant publications and web sites for further information.
- **Optional Additional Activity** — For Civic groups.

### *Materials to Leave with Teachers*

- A set of **Classroom Activities**.
- **Background Information** on air pollution, health, and the AQI.
- **Other Resources** - Descriptions of additional curricula, classroom activities, publications, and web sites.

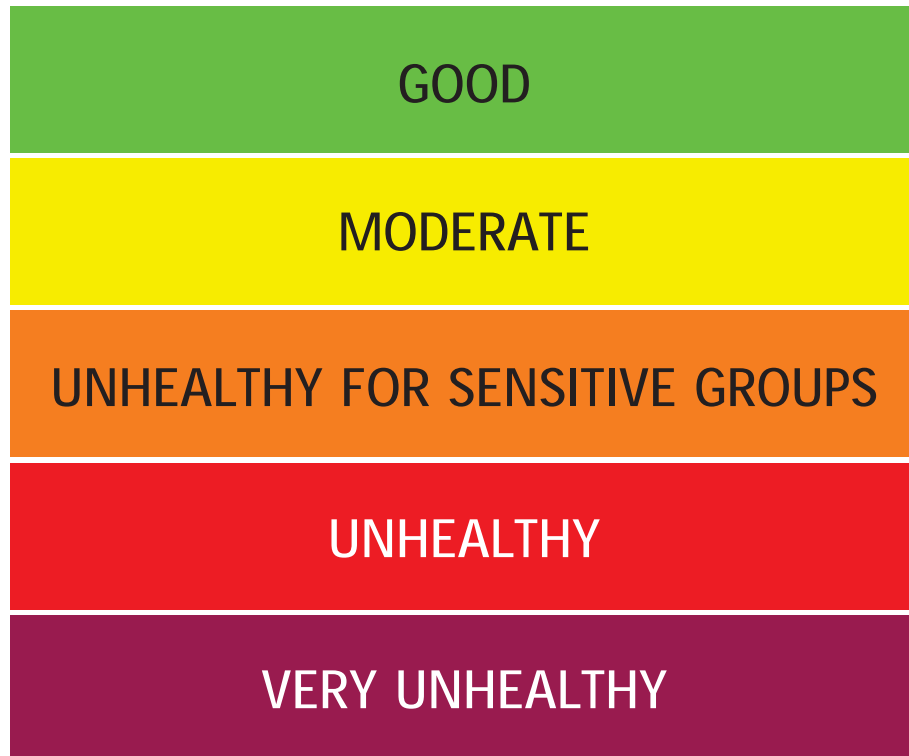
## CDs

- Electronic copies of the presentations and handouts in this toolkit.
- A copy of *Forecast Earth: Air Aware* video — Produced in 2004 by The Weather Channel and EPA.

## Quick Prep

- Read the fact sheets in this toolkit to familiarize yourself with the AQI, the health effects of air pollution, and air quality mapping and forecasting.
- 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.
- Use the Key Messages and Notes Pages in this toolkit to prepare for the presentation.
- *Checklist:*
  - ✓ Your presentation notes or script
  - ✓ CD or overhead transparencies
  - ✓ One copy of the appropriate handout for each participant
  - ✓ For schools, a set of the *Materials to Leave with Teachers*

# Presentations



# Grades 3-5

# Key Messages: Grades 3-5 Presentation



- 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.



# **Notes Pages: Grades 3-5**



- Now I'd like to talk about air, which is a big part of weather. K.C. Chameleon and his friends will help me do this.
- We're all breathing all the time. With every breath, what do we take in? (Response: "Air")
- You can feel the air right now on your hand if you just swing it gently back and forth.
- Most of the time, the air looks clear. But have any of you ever seen air when it wasn't clear? Sometimes the air can look a little dirty, or smoky, or hazy, like this. (*show next slide*)



- These pictures show the same place with clean air and dirty air.
- Sometimes when air looks dirty, that can be a sign that pollution is in the air.
- Does anyone know what pollution is?
- That's right. Pollution means that the air is dirty from things like dust, chemicals, or soot (soot is a black substance, like that in chimneys, that is formed from burning things like wood or oil).



- Here K.C. is showing us some of the biggest pollution sources: cars and trucks, factories that make things like desks and chairs, power plants that make electricity, some ordinary products like house paints, and many other things. Also, things in nature, like forest fires and volcanoes, can pollute the air.
- What do you think happens when people breathe air that is dirty?
- 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.
- How can you protect yourself from dirty air?



- Sometimes you can see when the air is dirty, but sometimes you can't. So we need another way to tell if our air is dirty.
- To do that, we can use something called the Air Quality Index, or AQI for short. Let's take a look at what that is.



- The AQI uses colors to tell us how clean or dirty the air is.
- Which color do you think means the air is clean? Green,  
the same color that traffic lights use to tell you it's OK  
to go, means the air is clean.
- Which color do you think means the air is really dirty? It's the  
darkest color: Purple.
- Maybe you're wondering: How can I find the AQI? Checking the  
AQI is like checking the weather report.



- You can always find the AQI on the Internet at a site called AirNow at: [www.airnow.gov](http://www.airnow.gov)



- When the air is polluted, sometimes you'll hear about it on TV during the weather forecast.

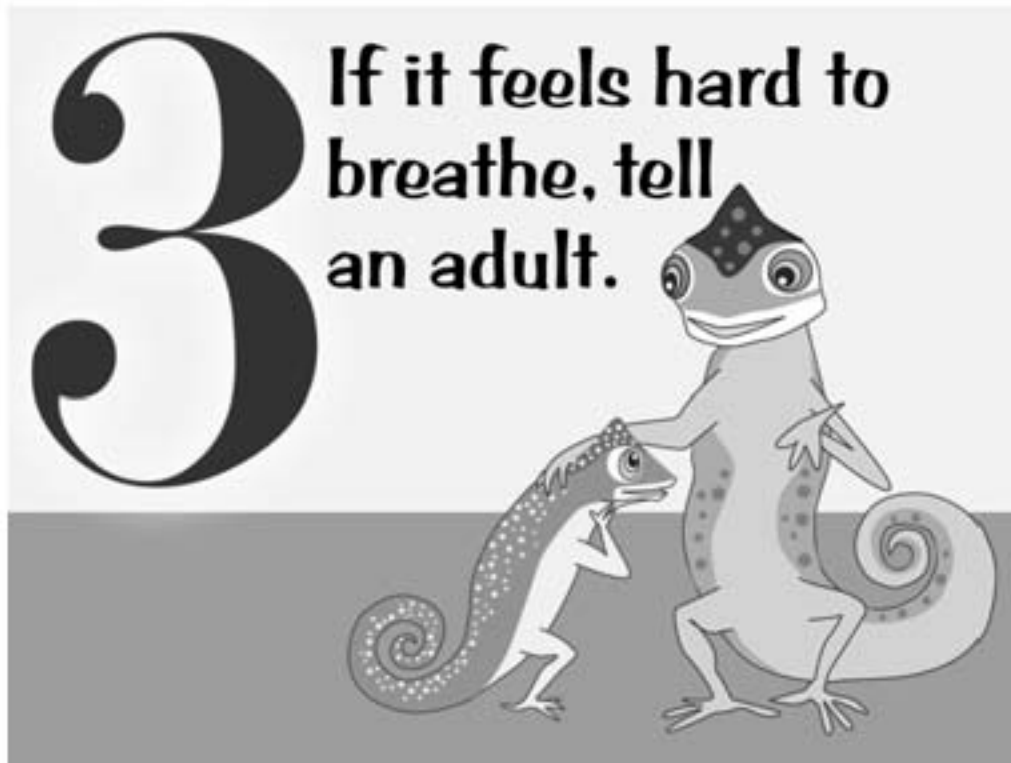




- Sometimes you, or your parents, can find it on the weather page in the newspaper.
- So finding out how clean or dirty the air is each day is one thing you can do to protect your health. Here's another thing you can do.



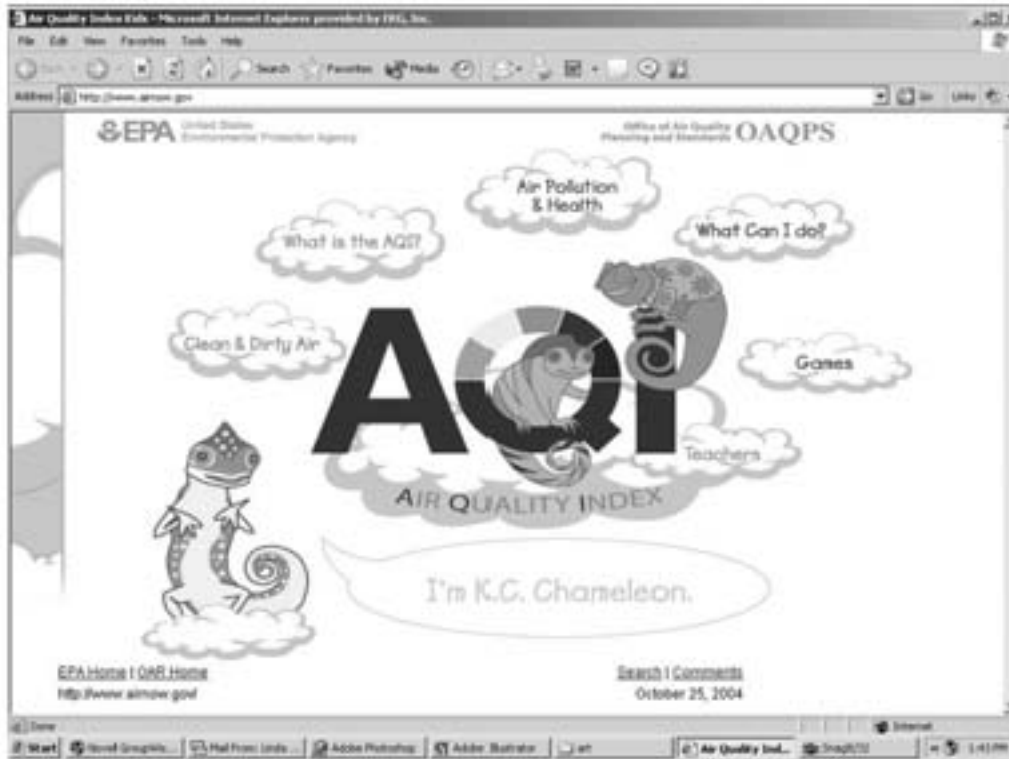
- Exercise and playing outside are good for you. But when the air is dirty, you should take some simple steps to protect your health.
- If you play outside when you *know* the air is polluted, you can take it easier. That could mean, for example, walking instead of running, taking frequent breaks, or planning to play outside at another time or on another day when the air is cleaner.
- Let's think why this makes sense. Do you breathe more when you're very active or when you're taking it easier?
- We don't breathe as hard when we're taking it easier, which is a good thing if the air is polluted.
- Here's another thing you can do.



- If you notice any signs when you are playing outside—like unusual coughing, pain when you take a deep breath, chest tightness, or wheezing—stop playing and tell an adult.
- If you have asthma, a lung condition that can sometimes make it difficult to breathe, pay special attention on polluted days. If you think you or a friend may be having an asthma attack, tell an adult.
- Let's review the three things you can do.



- If you can, find out what the air quality color is each day. You might want to tell your parents about the AQI colors so they can help you check how clean or dirty the air is.
- If the air is dirty, take it easier when you play outside, or change your play time to when the air is better.
- If you have a hard time breathing when the air is dirty, tell an adult.



- Here's a cool website where you can learn more about the air quality colors and what they mean.
- Here you can learn more about air pollution and the AQI and play some games.

*Pass out handout*

- This handout reminds you about what you can do. It also shows you where this kids' website is and where you or your parents can go to get AQI information.

# **Student Handout: Grades 3-5**

**Breathe Smart!**

# Three Things KIDS Can Do



1

**Find out what color day it is for air quality.**

- 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

**Visit the AQI kids' site at: [www.airnow.gov](http://www.airnow.gov)**  
(click on "Kids" on the left side of the web page)



# **Transparencies: Grades 3-5**



**Hi.  
What color is  
your air today?**











**You can find  
out how clean  
your air is.**





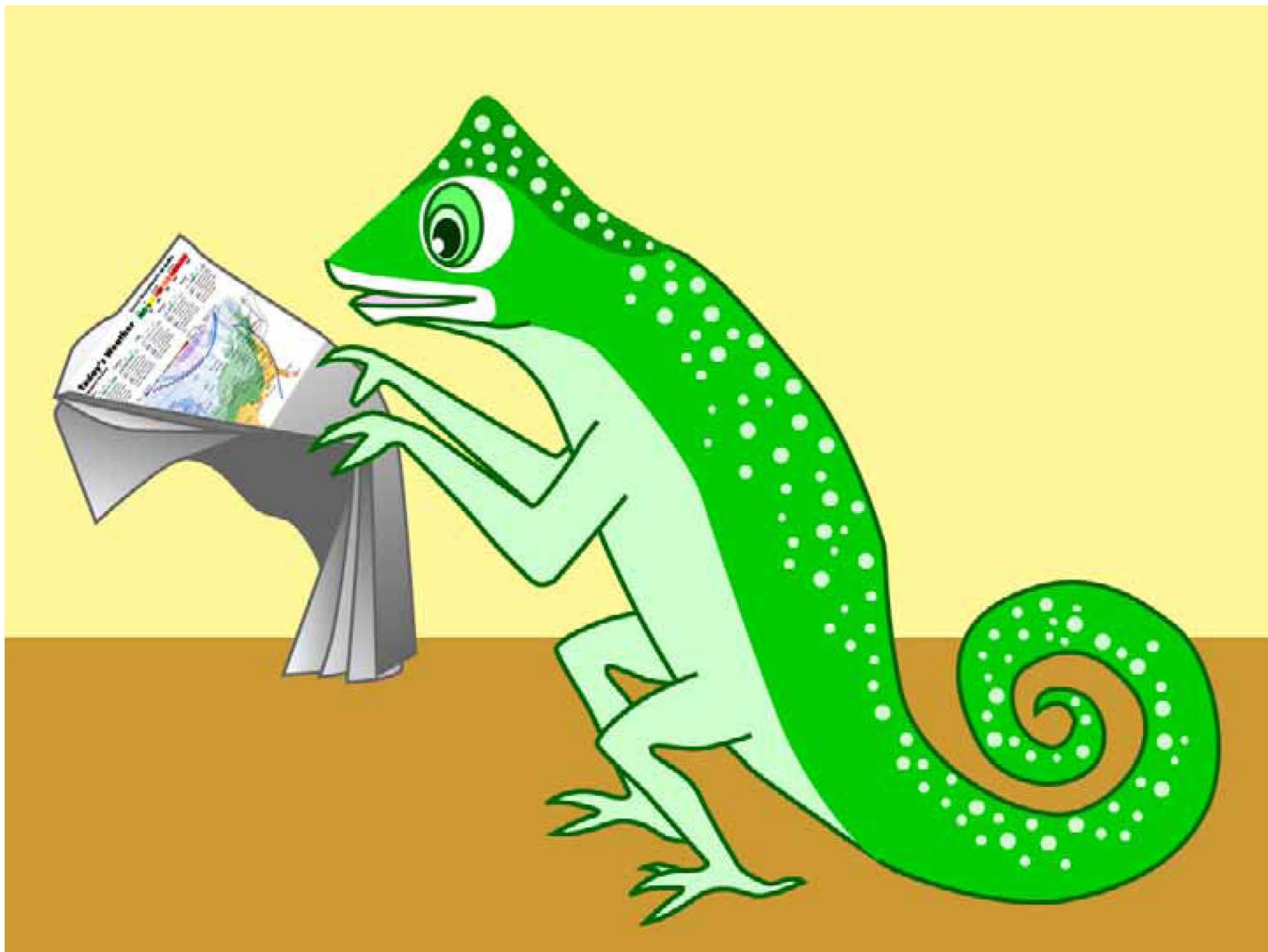
**AIR QUALITY INDEX**

**[www.airnow.gov](http://www.airnow.gov)**











2

Take it easier when  
you play outside.



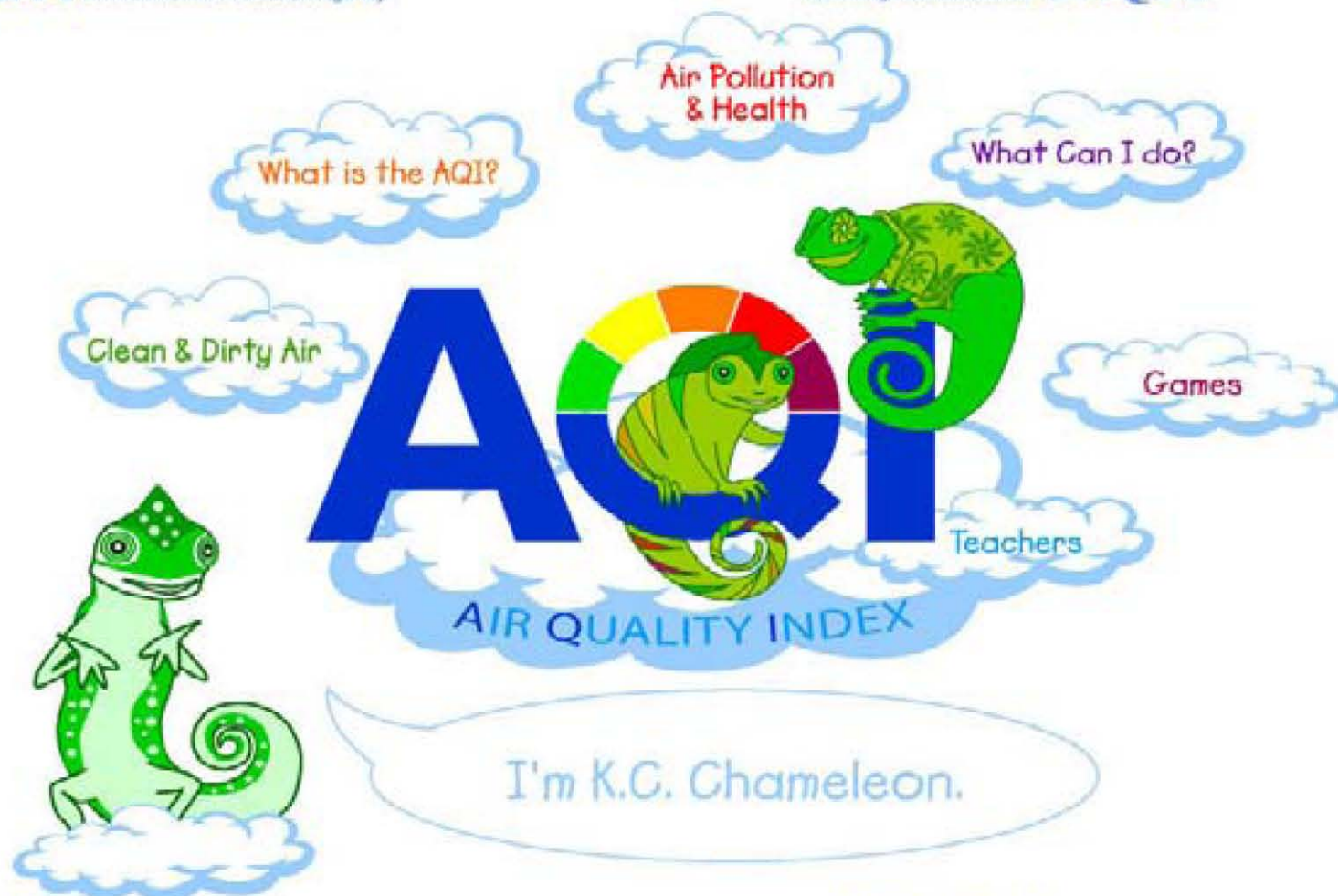
3

If it feels hard to  
breathe, tell  
an adult.









# Grades 6-8



# Key Messages: Grades 6-8 Presentation



- Breathing polluted air is unhealthy. For example, you might find it more difficult to breathe, you might cough or wheeze, or your chest might feel tight.
- You can't always tell if the air is polluted by how it looks. The Air Quality Index, or AQI, can help.
- Two main types of air pollution are ozone pollution and particle pollution.
- The ozone we breathe at ground level is bad. But very high in the atmosphere is a natural layer of ozone that is good because it protects us from the sun's harmful ultraviolet rays. A rhyme that can help you remember this is: "Ozone: Good up high, bad nearby."
- You can protect your health in three ways when the air is polluted:
  1. Find out the air quality each day.
    - You can do this by checking the AQI (the Air Quality Index), just like checking the weather report. The AQI uses color-coded maps and health messages to tell you how clean or polluted the air is. For example, green means the air is clean. Red means the air is unhealthy for everyone.
    - 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.
  2. If you're outside when you *know* the air is polluted, you can protect your health by taking it easier. It's important to exercise and be active to maintain good health. But when the air is polluted, you can reduce the time you spend exercising, walk instead of run, take frequent breaks, or go outside at another time or on another day when the air is cleaner.
  3. If you notice any symptoms when you're outside like coughing, pain when you take a deep breath, chest tightness, or wheezing, stop your activity and tell an adult. This is especially important if you have asthma.
- Both people's activities (such as transportation, energy use, and materials production) and nature (such as forest fires and volcanic eruptions) can cause air pollution.
- You can help reduce pollution. For example, turn off lights and equipment that use energy when you don't need them. Walk, bike, carpool, or use public transportation when possible instead of having someone drive you.

# **Notes Pages: Grades 6-8**



- Now I'd like to talk about how weather relates to air pollution, and how air pollution can affect your health.
- To do this, I'm going to begin by asking you some true or false questions.
- True or false: Rain can have an effect on air pollution. [*Correct response: true*]
- True. Rain can help to remove pollutants from the atmosphere. The intensity of the rain determines how much it actually cleans the air. The harder it pours, the more pollutants get removed from the air. But the rain deposits pollutants from the air onto the surface of the ground, which can contribute to water pollution.





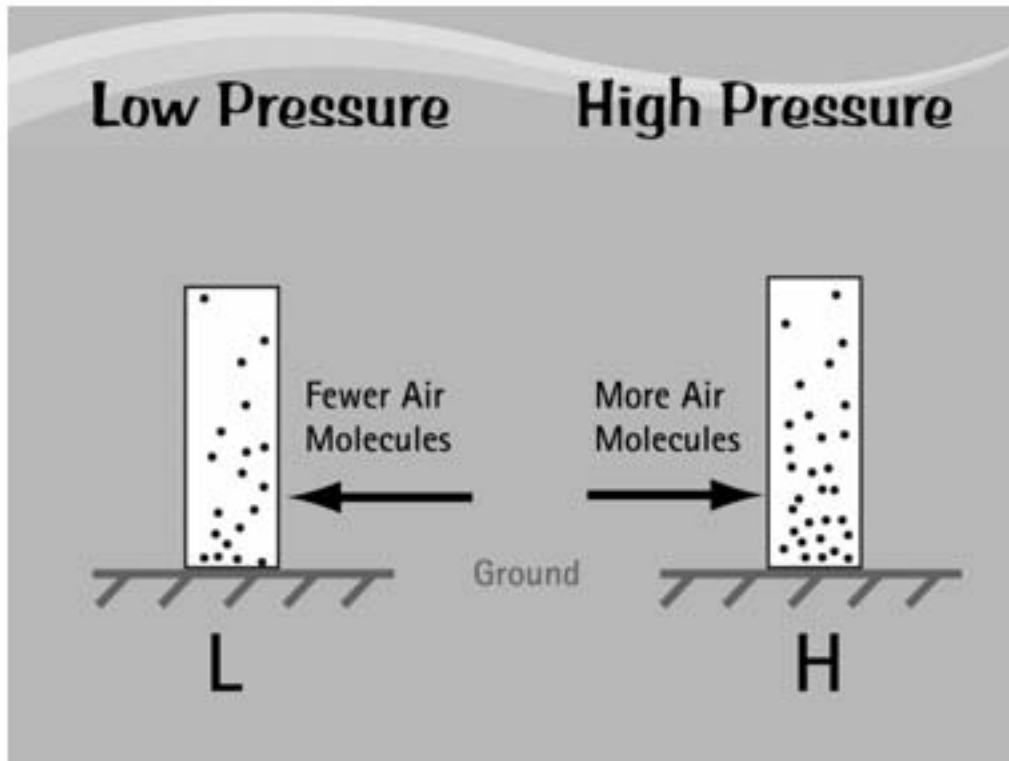
- True or false: Other types of weather can also have an effect on air pollution. *[Correct response: true]*
- True. Wind can affect air pollution. Wind can move air pollution to different places, sometimes hundreds of miles away.
- What other kinds of weather conditions do you think can affect air pollution? *[You may want to wait for a few responses]*

# Weather and Air Quality Basics

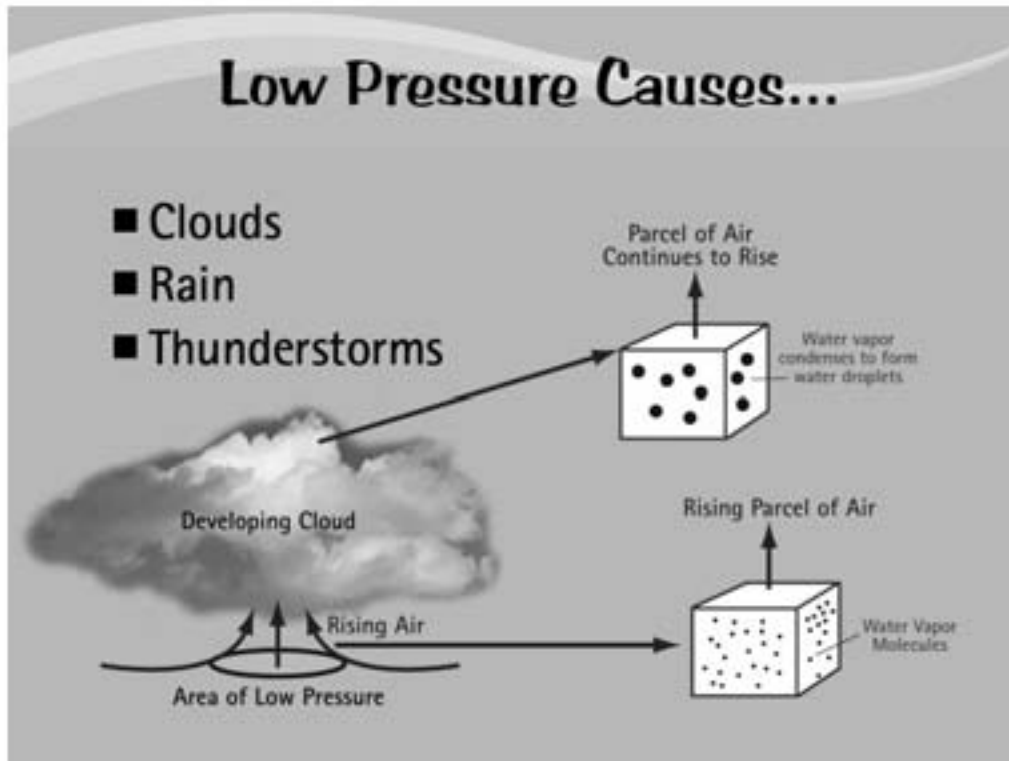
## ■ High Pressure vs. Low Pressure



- High and low pressure have a lot to do with the levels of pollution in the air.



- High pressure compresses more molecules of air into a smaller space.
- Low pressure allows molecules of air to occupy a larger area.



- In low pressure systems, rising parcels of air create motion and mixing in the atmosphere.
- This mixing generally keeps pollutants from building up.
- The rising air also often causes clouds, rain, and thunderstorms to form.

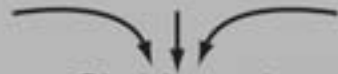
## High Pressure Causes...

- Sunshine
- Hot Temperatures
- Light Winds



- High pressure systems do not allow air – or pollutants – to rise, so pollutants stay where they are and build up.
- Sunshine, high temperatures, and light winds often occur in high pressure systems.
- On clear days, sunlight and high temperatures can “bake” certain chemicals, causing them to react and form ozone, one type of air pollutant.

## What about air quality?



- Sinking air + Hot temperatures + light winds + clear skies = stagnation and poor air quality



- Rising air+Clouds+Rain = moving air and good air quality

- These are the basic formulas for poor and good air quality.

**If the air can't move,  
pollutants are trapped.**



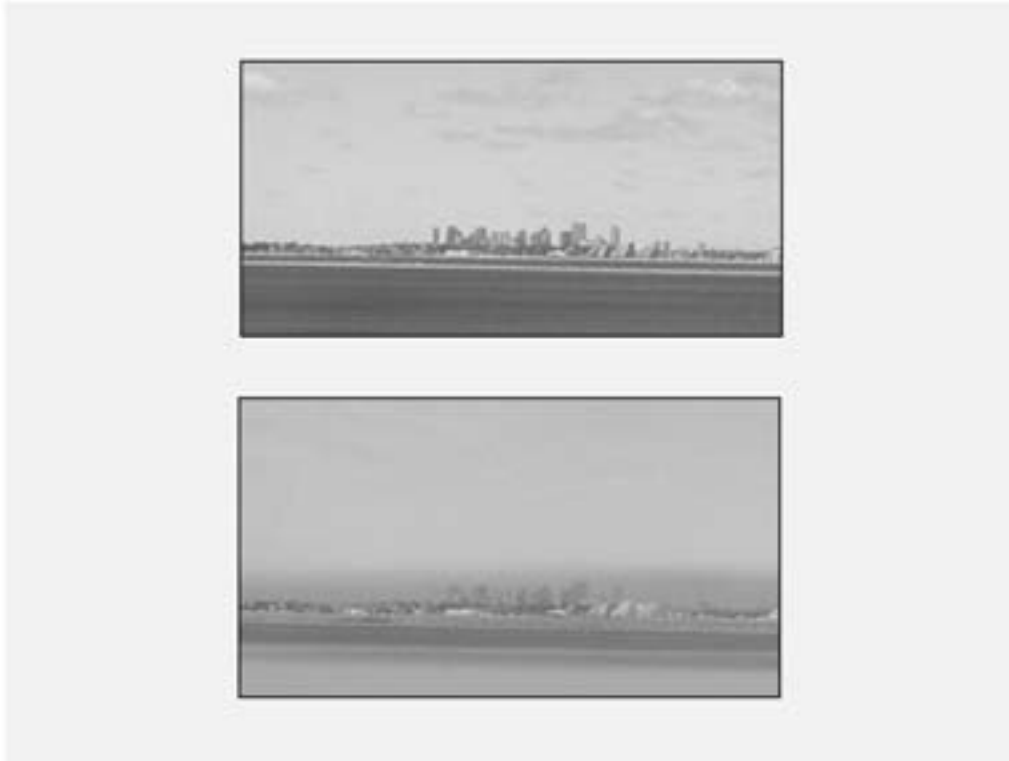
*Image courtesy of: Queensland EPA*

- This photo demonstrates pollutants being trapped in lower levels of the atmosphere. Why? Because if the air can't move, pollutants are trapped, stay where they are, and build up.



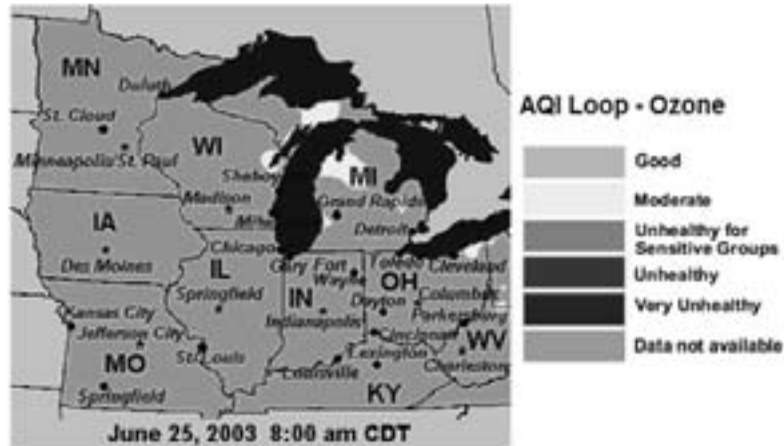
- There are many sources of air pollution, such as cars, factories, power plants that produce electricity, some ordinary products like house paints, and many other things.
- Sometimes nature can pollute the air. The bottom two photos show a forest fire and a volcano, both of which can pollute the air.
- If you lived near a forest fire, what do you think it would feel like to breathe the air that day? *[Wait for an answer or two.]*
- The air would be very smoky, and it might make you cough, or irritate your eyes, or you might find it harder to breathe.
- Forest fires and volcanoes put small particles into the air. Particle pollution is one type of air pollution that can come from both natural sources like these and from people's activities.





- Here's another type of pollution. The top picture shows Boston when the air is clean. The bottom picture shows Boston when the air is polluted with something called "smog."
- Smog is a combination of pollutants, two of which we've mentioned: ozone and particles. Both of these pollutants can affect our health.
- Here's another true or false question: Sometimes ozone in the air is a good thing. *[Correct response: true]*
- True. Ozone in the air we breathe here at ground level is bad. But very high up in the atmosphere (in the stratosphere, which extends up from about 6 to 30 miles), there's a natural layer of ozone that protects us from getting too much radiation from the sun.
- Here's another question—true or false: You can always tell when the air is polluted by how it looks. *[Correct response: false]*
- False. Polluted air often does look dirty. But sometimes air that looks clean might in fact be polluted.
- You can check the air quality each day by looking at color-coded maps and health messages, like the map on the next slide.

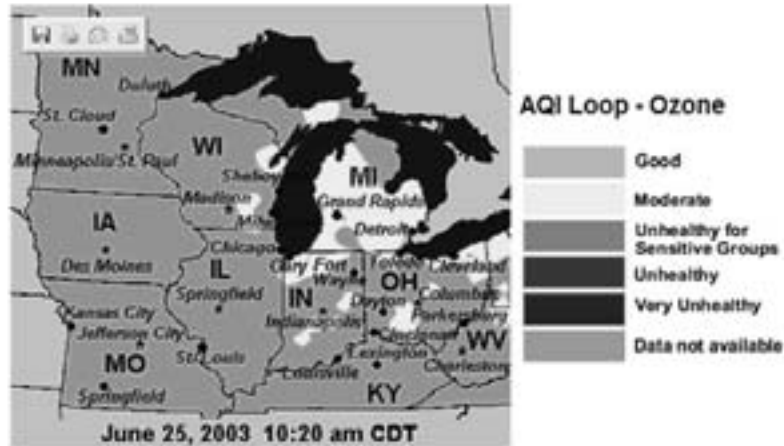
### Midwest Ozone Maps for June 25, 2003



[www.airnow.gov](http://www.airnow.gov)

- This ozone map comes from an Internet website called AIRNow where you can check daily air quality for many different locations. This particular map shows the air quality and related health messages for several Midwestern states at 8:00 a.m. on June 25, 2003.
- The color scale to the right of the map is called the Air Quality Index, or AQI, which is a way to report daily air quality. The AQI colors tell us how clean or polluted the air is.
- What is this map telling us about the air quality in the Midwest on this day at 8:00 a.m.? *[Wait for a response]*
- The map is mostly green, so the air quality is mostly “good” for ozone pollution at this location at this time.
- Let’s go forward in time on that same day and see whether the air quality has changed.

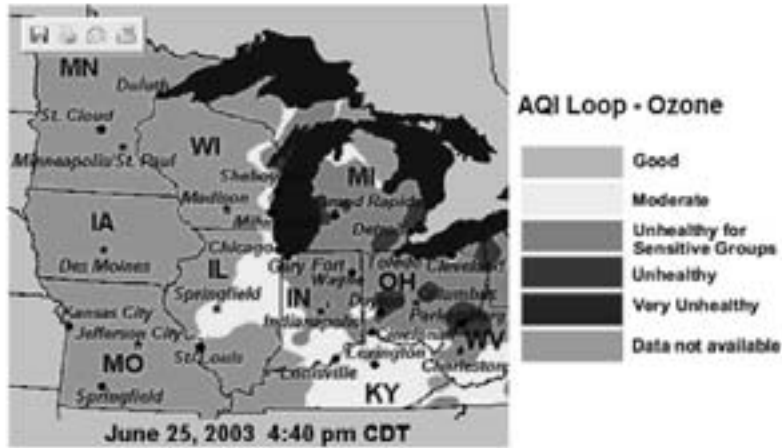
### Midwest Ozone Maps for June 25, 2003



[www.airnow.gov](http://www.airnow.gov)

- Now it's 10:20 a.m. on the same day. What's happening to the air quality in this area? [Point to yellow area] [Correct response: It's getting worse.]
- The color is yellow, so the AQI is telling us that the air quality is "moderate," which means just a little polluted.
- The health message that goes along with the yellow AQI color is: "Unusually sensitive people should consider reducing prolonged or heavy exertion outdoors."

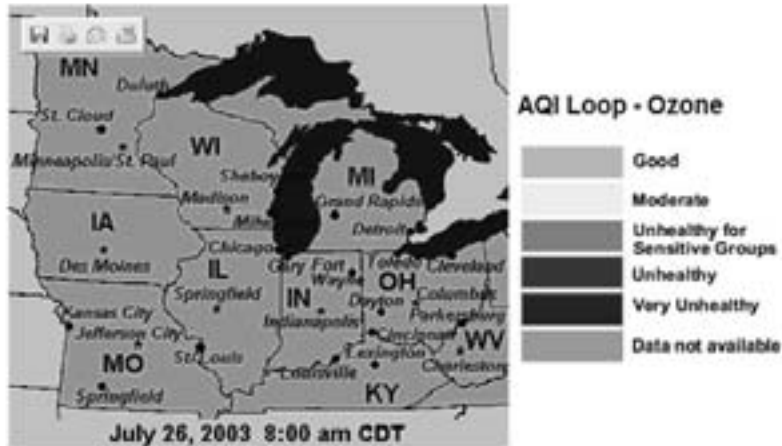
### Midwest Ozone Maps for June 25, 2003



[www.airnow.gov](http://www.airnow.gov)

- Now it's 4:40 p.m. on the same day. What is the air quality in these parts of the Midwest? *[Point to an orange area, then a red area.]*  
*[Correct response: "Unhealthy for sensitive groups" (orange), and "Unhealthy" for everyone (red)]*
- It's "unhealthy for sensitive groups" (for orange) and generally "unhealthy" for everyone (for red).
- "Sensitive groups" are people who are more likely to be affected by air pollution, which includes children, because you are still growing and your lungs are still developing.
- For ozone, sensitive groups include people with lung diseases (including asthma), and active adults and children.
- For particle pollution, sensitive groups include people with heart or lung disease (including asthma), older adults, and children.
- When the AQI is orange, the health message is that sensitive groups should reduce prolonged or heavy exertion outdoors. When the AQI is red, the air is unhealthy for everyone; all people should reduce such activities.

### Midwest Ozone Maps for July 26, 2003



[www.airnow.gov](http://www.airnow.gov)

- Now it's 8:00 a.m. the next day. The map is again green, showing us that the air quality is much better.
- The pattern we saw in the Midwest maps is very typical for ozone pollution: Ozone is often worse in the summer, and worse in the mid-afternoon to early evening, because sunlight and higher temperatures “bake” the pollution from sources such as car exhaust, gasoline vapors, factory emissions, and chemical solvents, and form ozone.



- There are several things you can do to protect your health.
- First, you can check whether the air is polluted each day. You can check out the AQI daily on the Internet at the AIRNow website. Also many newspapers and TV and radio weather forecasts include air quality reports.
- If you find out that the air is polluted, here are some things you can do.



- Exercise is important to staying healthy, so it's good to be outside. But when the air is polluted, take it easier when you're outside. That might mean not running around as much as you normally would, or for as long a time. Or take frequent breaks, or plan to be outside at another time or on another day when the air is cleaner.
- Let's think about why this makes sense. Do you breathe more when you're active, or when you're taking it easier?  
*[Correct response: when active]*
- We breathe harder when we're active, which means we can breathe in more dirty air if the air is polluted.
- Here's another thing you can do.

# Things You Can Do

1. Check the air quality.
2. Take it easier if you're outside when the air is polluted.
3. If breathing feels different when the air is polluted, tell an adult.

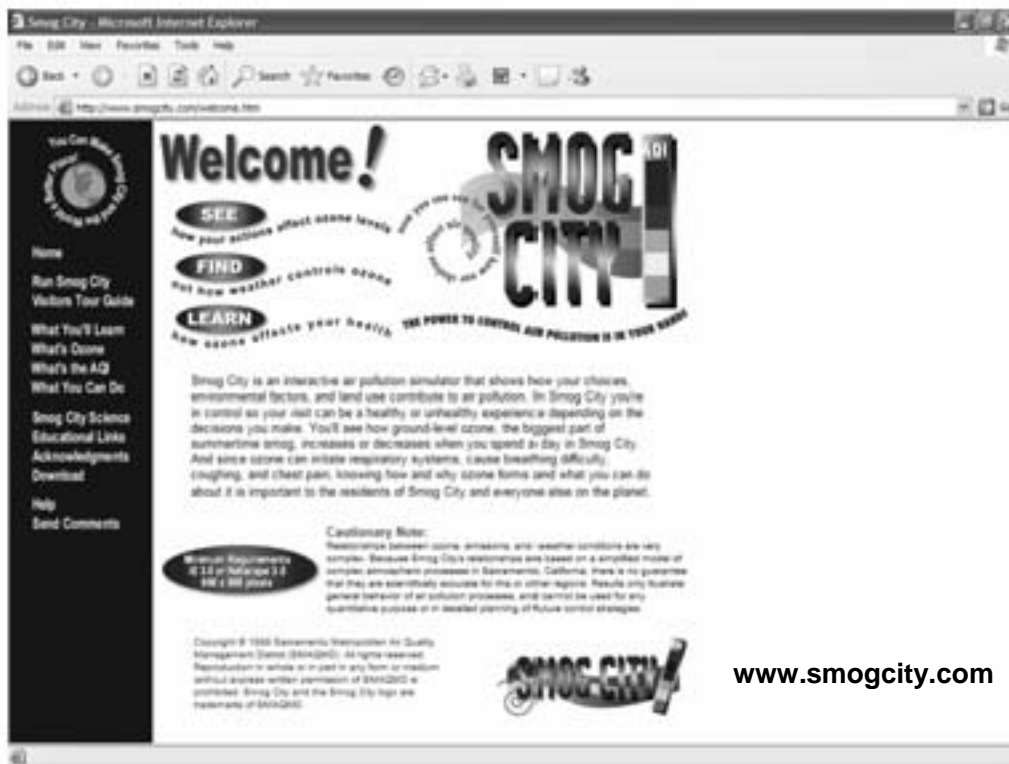
- If the air is polluted and you notice any symptoms like unusual coughing, or pain when you take a deep breath, or chest tightness, or wheezing, stop your activity and tell an adult.
- This is especially important if you have asthma, because air pollution can aggravate asthma.



# Things You Can Do

1. Check the air quality.
2. Take it easier if you're outside when the air is polluted.
3. If breathing feels different when the air is polluted, tell an adult.
4. Help reduce pollution.

- There are also things you can do to reduce air pollution, such as turning off lights and equipment that use energy when you don't need them. Cutting back on electricity helps power plants cut back their pollution.
- Also, instead of having your parents drive you all over the place - walk, bike, carpool, or take the bus, train, or subway if you can when the air quality is good. But remember, your safety always comes first!



- Here's a cool website called Smog City where you can learn more about how people and weather affect air pollution.

*Pass out handout*

- This handout tells you how you can visit Smog City on the Internet and how you can get to the AIRNow website to check air quality.
- It also reminds you about what you can do to protect your health when the air is polluted.
- In 2007, "Smog City 2" will be available, which will include particle pollution in addition to ozone.

# **Student Handout: Grades 6-8**

**Be Air Quality Smart!**

# Four Things You Can Do



**1**

## Check the Air Quality Index.

- Visit the AIRNow website at [www.airnow.gov](http://www.airnow.gov).
- Listen for air quality information on the radio or TV.

**2**

## Protect your health when the air is polluted.

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



**3**

## Help reduce pollution.

- Turn off lights and equipment.
- Walk, bike, carpool, or take the bus when the air quality is good. But remember, your safety always comes first!

**4**

## Have fun at the Smog City website: [www.smogcity.com](http://www.smogcity.com)



Coming in 2007—**Smog City 2**, which will include particle pollution in addition to ozone, at: [www.smogcity2.org](http://www.smogcity2.org)

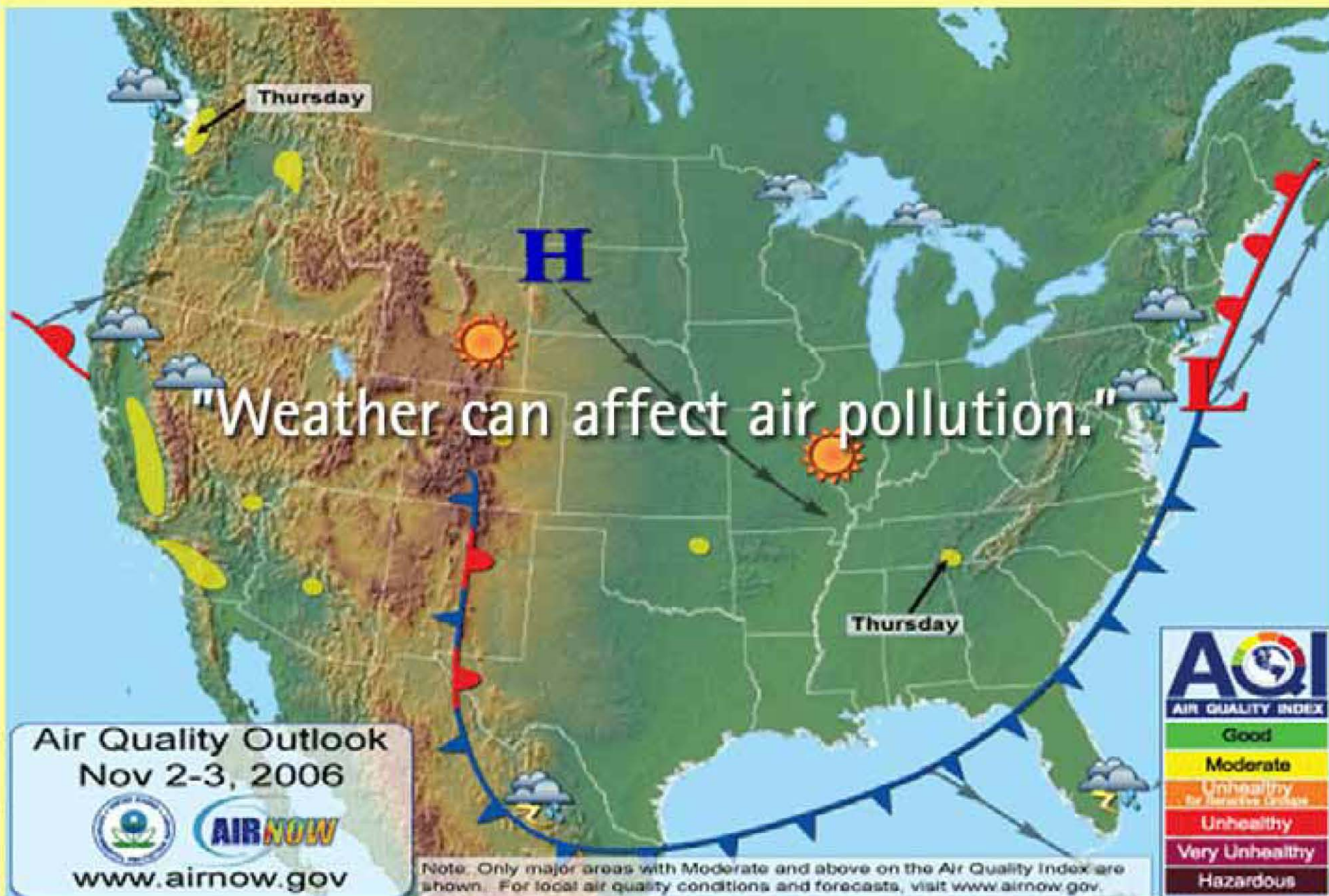


# **Transparencies: Grades 6-8**



**What  
Color Is  
Your Air  
Today?**

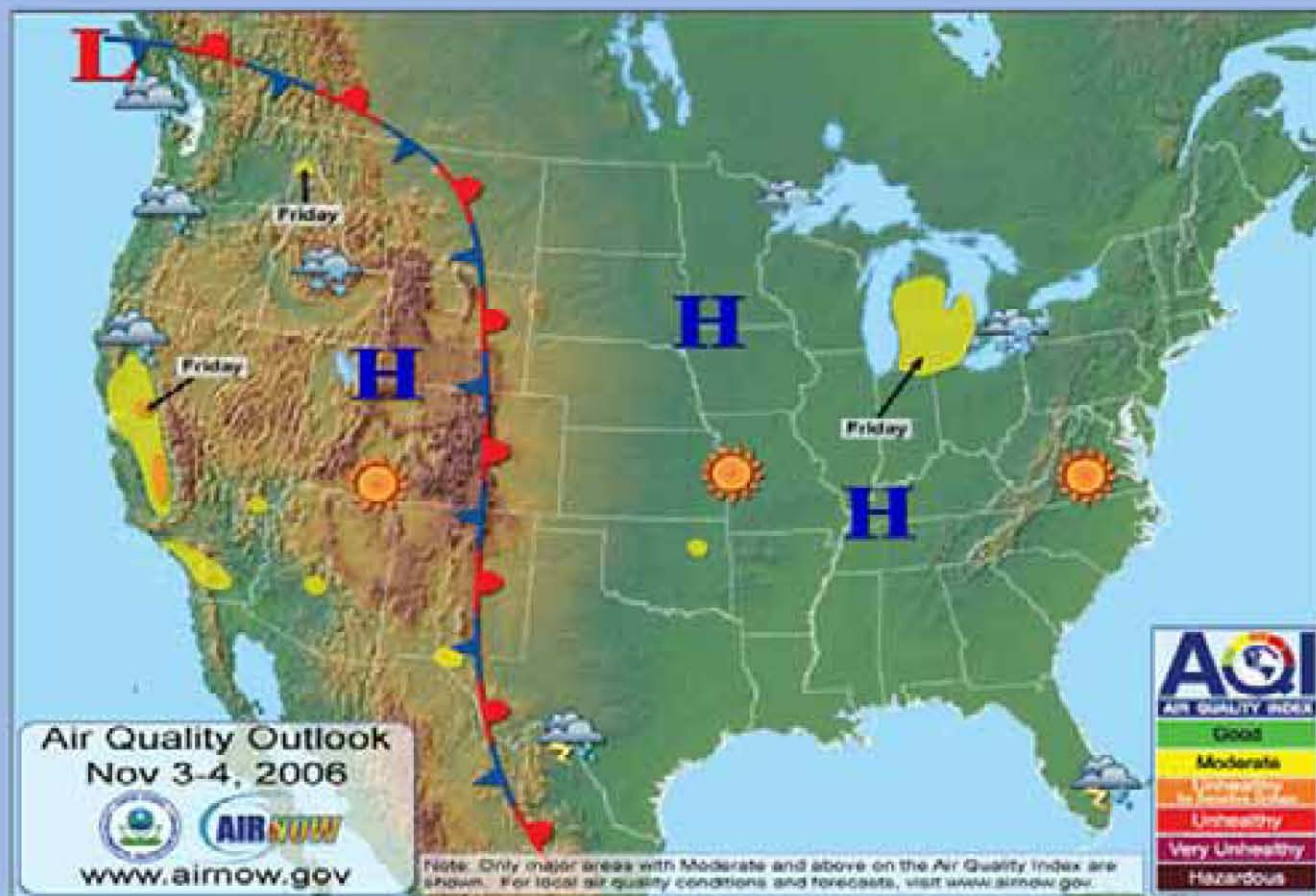






# Weather and Air Quality Basics

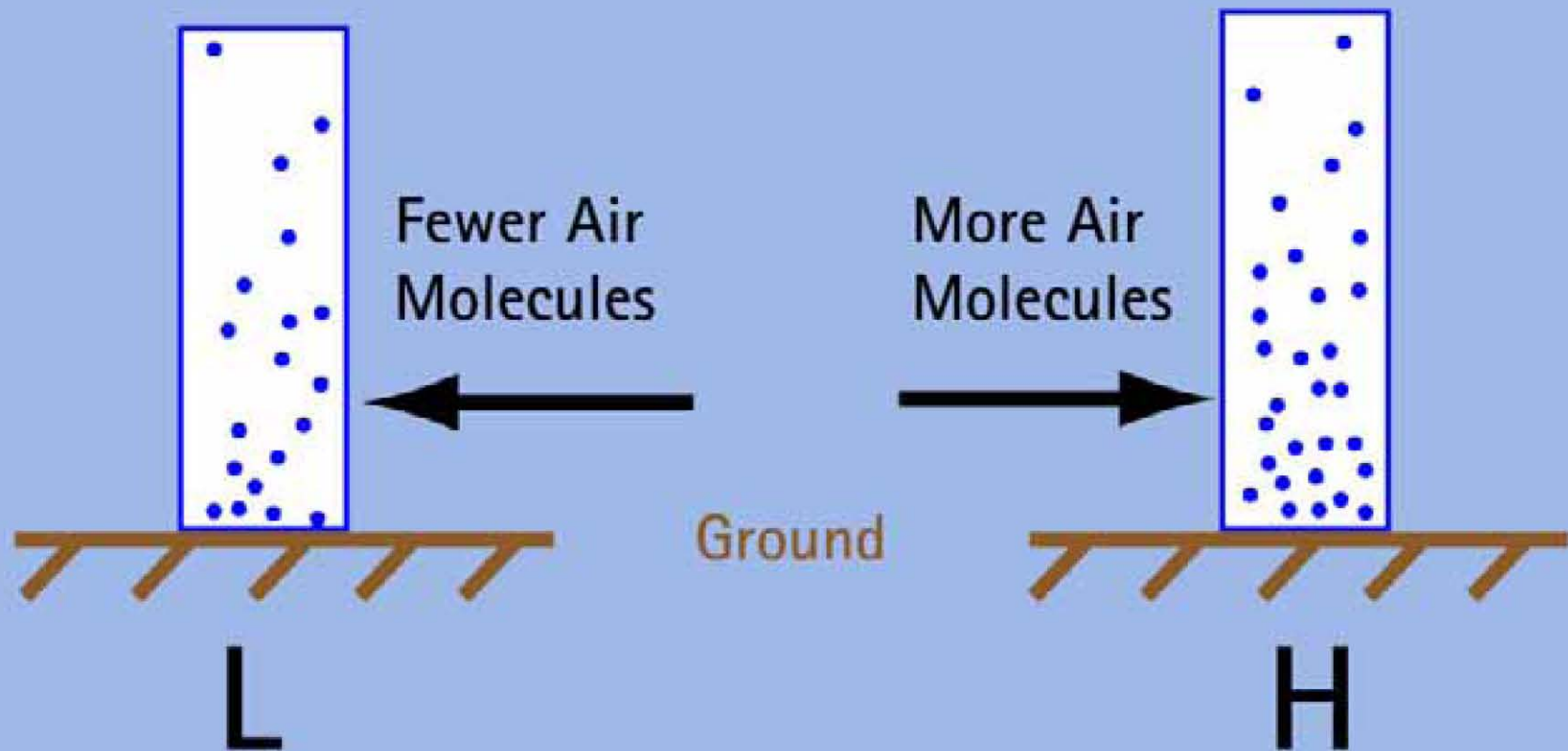
## ■ High Pressure vs. Low Pressure





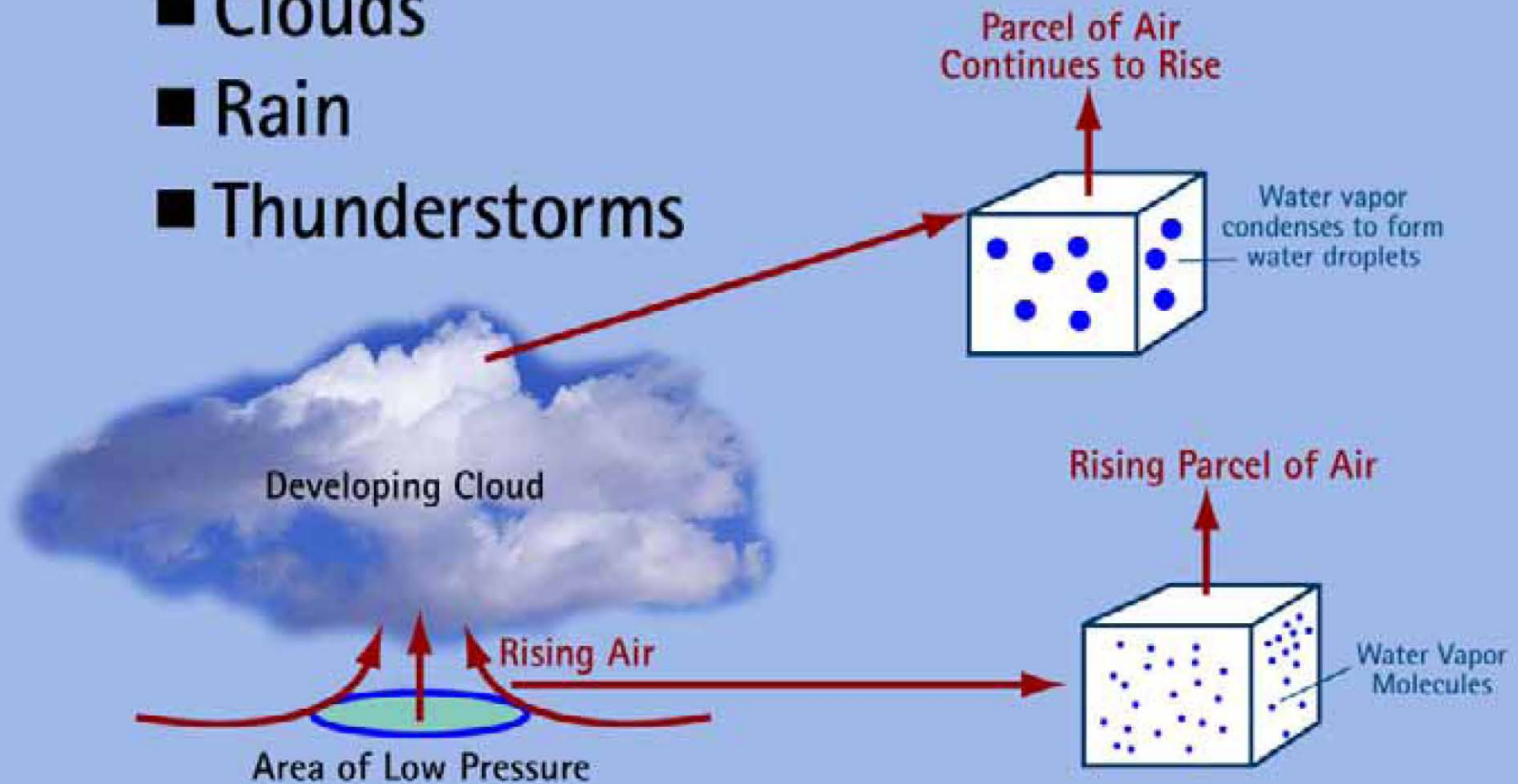
**Low Pressure**

**High Pressure**



# Low Pressure Causes...

- Clouds
- Rain
- Thunderstorms



# High Pressure Causes...

- Sunshine
- Hot Temperatures
- Light Winds





# What about air quality?



■ Sinking air + Hot temperatures + light winds + clear skies = stagnation and poor air quality

The diagram shows three red arrows pointing downwards from the top left towards the center, indicating sinking air. In the background, there is a bright yellow sun in a clear blue sky.



■ Rising air + Clouds + Rain = moving air and good air quality

The diagram shows three red arrows pointing upwards from the bottom left towards the center, indicating rising air. In the background, there is a blue cloud with raindrops falling from it.

**If the air can't move,  
pollutants are trapped.**



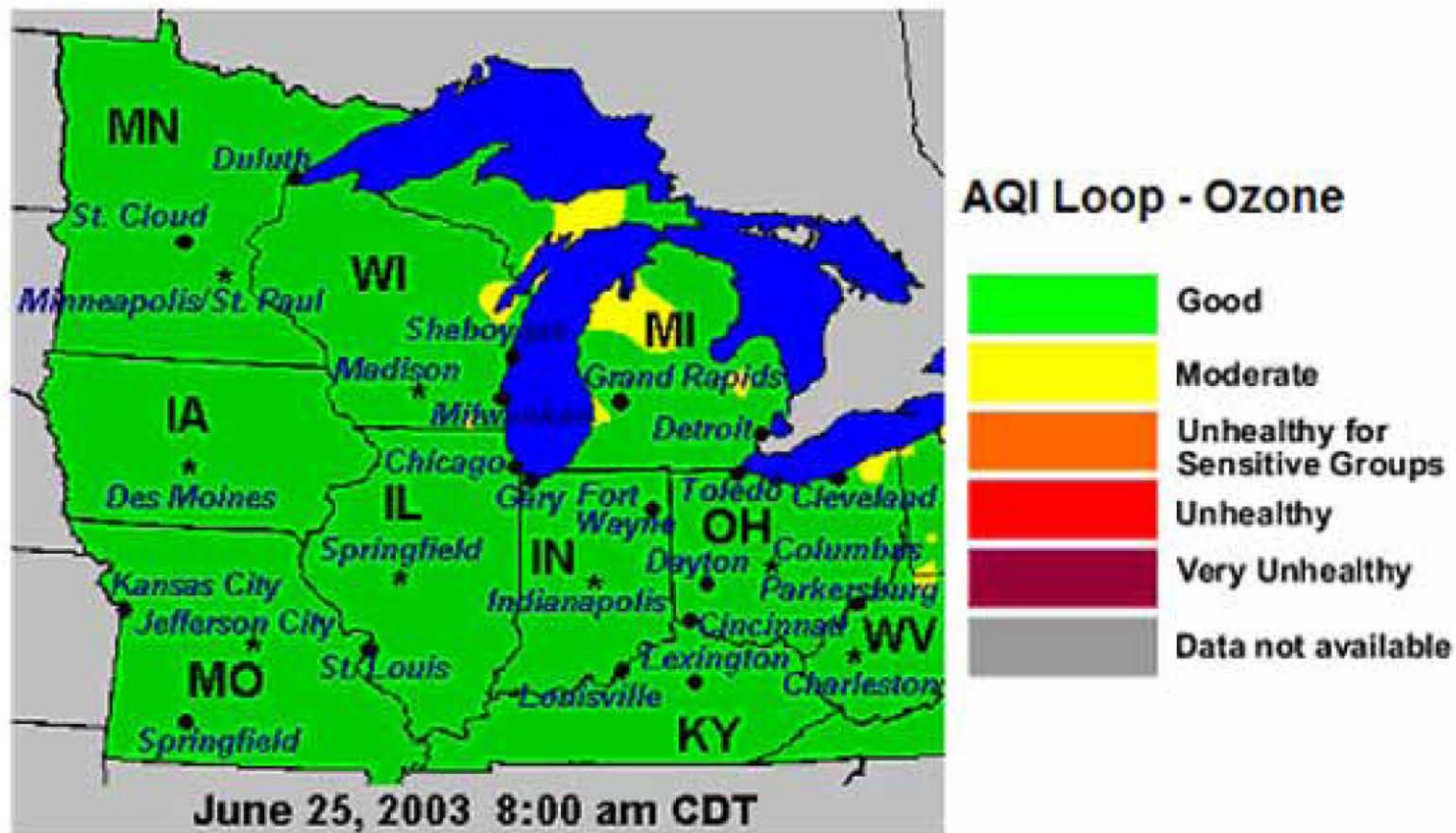
*Image courtesy of: Queensland EPA*







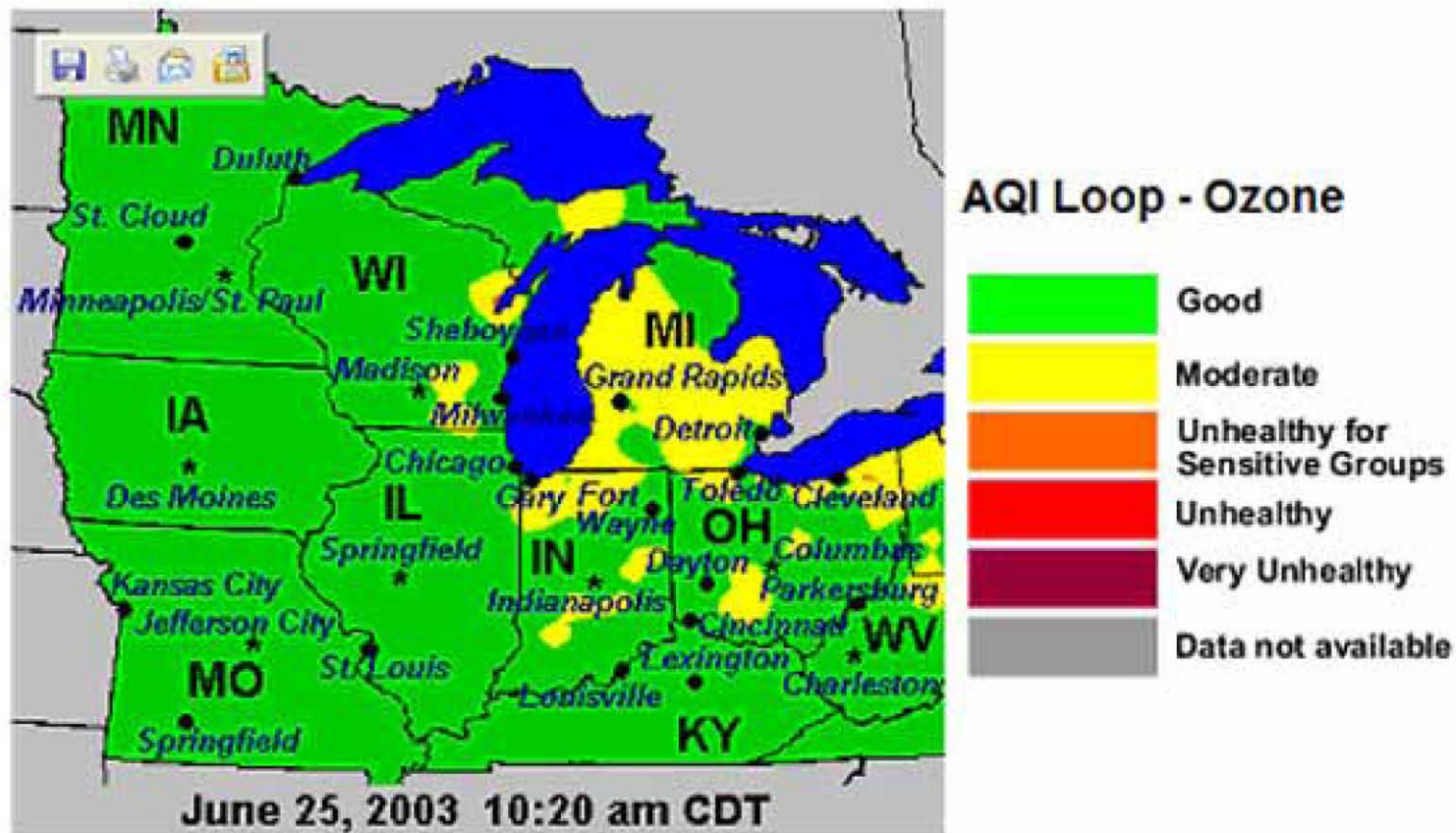
## Midwest Ozone Maps for June 25, 2003



[www.airnow.gov](http://www.airnow.gov)

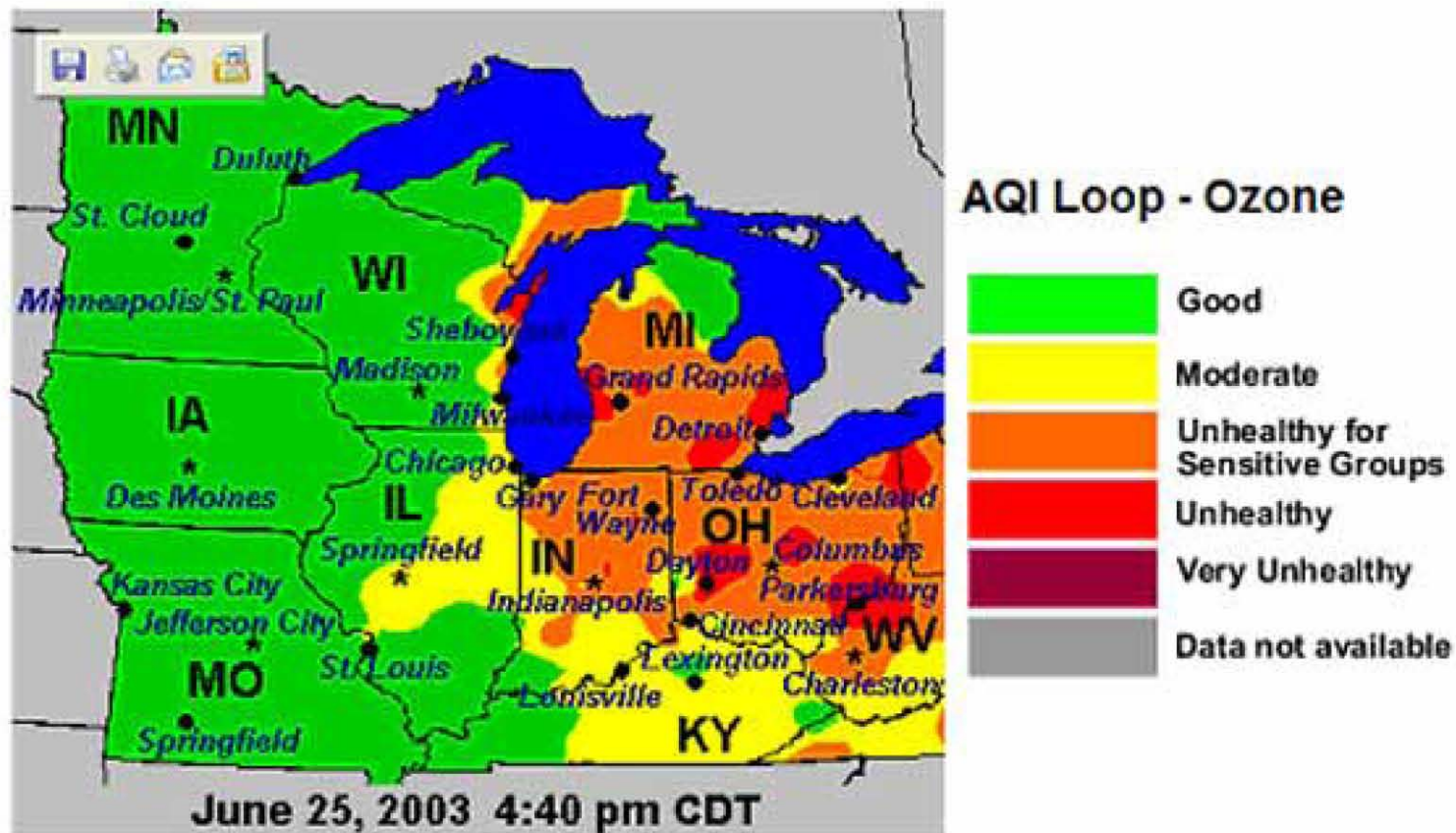


## Midwest Ozone Maps for June 25, 2003



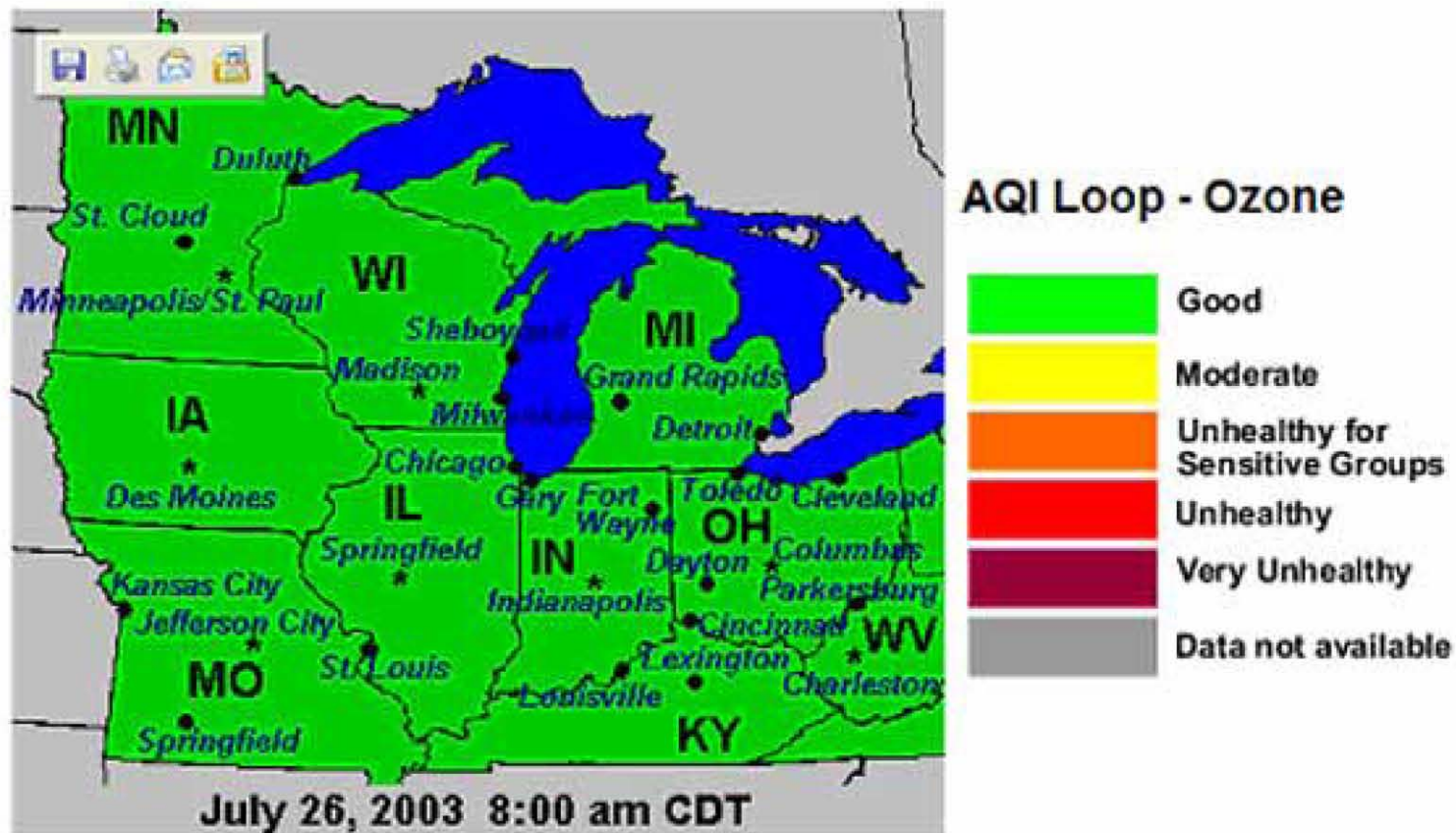
[www.airnow.gov](http://www.airnow.gov)

## Midwest Ozone Maps for June 25, 2003



[www.airnow.gov](http://www.airnow.gov)

## Midwest Ozone Maps for July 26, 2003



[www.airnow.gov](http://www.airnow.gov)



# Things You Can Do

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1. Check the air quality.

# **Things You Can Do**

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- 1. Check the air quality.**
- 2. Take it easier if you're outside when the air is polluted.**



# **Things You Can Do**

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- 1. Check the air quality.**
- 2. Take it easier if you're outside when the air is polluted.**
- 3. If breathing feels different when the air is polluted, tell an adult.**

# Things You Can Do

1. Check the air quality.
2. Take it easier if you're outside when the air is polluted.
3. If breathing feels different when the air is polluted, tell an adult.
4. Help reduce pollution.





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[What's the AQI](#)  
[What You Can Do](#)

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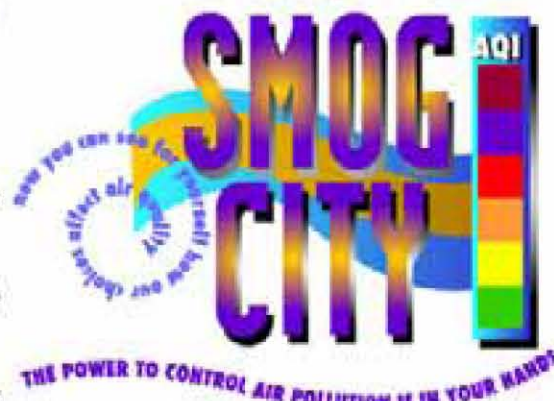
[Help](#)  
[Send Comments](#)

# Welcome!

**SEE**  
how your actions affect ozone levels

**FIND**  
out how weather controls ozone

**LEARN**  
how ozone affects your health



Smog City is an interactive air pollution simulator that shows how your choices, environmental factors, and land use contribute to air pollution. In Smog City you're in control so your visit can be a healthy or unhealthy experience depending on the decisions you make. You'll see how ground-level ozone, the biggest part of summertime smog, increases or decreases when you spend a day in Smog City. And since ozone can irritate respiratory systems, cause breathing difficulty, coughing, and chest pain, knowing how and why ozone forms and what you can do about it is important to the residents of Smog City and everyone else on the planet.

### Cautionary Note:

Relationships between ozone, emissions, and weather conditions are very complex. Because Smog City's relationships are based on a simplified model of complex atmospheric processes in Sacramento, California, there is no guarantee that they are scientifically accurate for this or other regions. Results only illustrate general behavior of air pollution processes, and cannot be used for any quantitative purpose or in detailed planning of future control strategies.

**Minimum Requirements**  
IE 3.0 or Netscape 3.0  
800 x 600 pixels

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[www.smogcity.com](http://www.smogcity.com)



# Civic Groups

# Key Messages: Civic/Adult Presentation



- Breathing polluted air is unhealthy, but you can't always tell if the air is polluted by how it looks. The Air Quality Index, or AQI, can help.
- Two main air pollutants are ozone pollution and particle pollution. Ozone pollution is invisible and is formed when certain chemicals react in the presence of heat and sunlight. Ozone pollution may aggravate asthma and bronchitis, and cause premature aging of the lungs. Particle pollution (microscopic particles of dust, dirt, smoke, and liquid droplets) can aggravate asthma and cause bronchitis or even premature death due to heart or lung disease. Symptoms from breathing polluted air can include coughing, breathing difficulties, and asthma attacks.
- There are two types of ozone. The ozone we breathe at ground level is bad. But very high in the atmosphere is a natural layer of ozone that is good because it protects us from the sun's harmful ultraviolet rays.
- Some people are at greater risk from breathing ozone pollution or particle pollution. Sensitive groups for ozone pollution include active children and adults, and people with lung disease. Sensitive groups for particle pollution include people with heart or lung disease, older adults, and children.
- You can protect your health in three ways when the air is polluted:
  1. Find out the air quality each day and the forecast for the next day by checking the AQI (Air Quality Index), like you would the weather report. The AQI uses color-coding to represent air quality ranging from good (green) to very unhealthy (purple). You can find the AQI and related health messages on the Internet at: [www.airnow.gov](http://www.airnow.gov). Some newspapers and TV or radio weather reports also include the AQI.
  2. If you're outside when you *know* the air is polluted, protect your health by taking it easier. For example, walk instead of run, exercise for half your normal time, or exercise at another time or on another day when the air is cleaner. Exercise away from busy roadways.
  3. If you notice symptoms when you're outside, such as coughing, pain when taking a deep breath, chest tightness, or wheezing, stop what you're doing and switch to a less strenuous activity. This is especially important if you are a member of a sensitive group—for example, if you have asthma or lung disease. Check with your doctor if you have these symptoms. People with heart disease should check with their doctor before engaging in vigorous outdoor exertion when particle levels are high.
- People's activities (such as transportation, energy use, and materials production) and nature (such as forest fires or volcanic eruptions) can cause air pollution.
- You can help reduce pollution: Drive less—walk, bicycle, carpool, or use public transportation when possible. Turn off lights and appliances when you don't need them. Cut back on heating and cooling when you can. Insulate your home. Only run full loads in your washing machine and dishwasher. Purchase energy-efficient products (look for the "Energy Star" label).

**Long version:**  
***Civic Groups presentation***

# **Notes Pages: Civic Groups**

## **Long version**



- I'd like to talk about how weather relates to air pollution, and how air pollution affects health.
- Air pollution can have a number of health effects, some of which can be quite serious.
- The good news is that there now are several things you can do to protect your health when the air is polluted. The best way to protect your health is to find out when pollutant levels are high in your area, using the Air Quality Index, or AQI, and take simple precautions to minimize your exposure.
- I'm going to start by making some statements about weather and air pollution and ask whether you think they are fact or fiction. First I will ask everyone who thought the statement was true to yell out "fact." Then I'll ask everyone who thought it wasn't true to yell "fiction."
- *[Note: Depending on the "personality" of the group you are talking to, you can also get their votes by asking them to raise their hands rather than using a voice vote if this feels more comfortable.]*

# Fact or Fiction?



- First fact or fiction statement: “When weathercasters give the weather forecast live on the evening news, they point to a blank screen, not a map, to show you what the weather is going to be.”
- If you think this statement is true, on the count of three, yell out “fact.” If you think this is false, yell out “fiction.”
- *[Elicit the “fact” and “fiction” responses from the audience.]*
- The statement is true. We weathercasters are always pointing to a blank screen when we give you the weather forecast. The maps you see are put into the image electronically. You get to see them, but we don’t.

# Fact or Fiction?



- Here's another statement. Fact or fiction?
- *[Elicit the "fact" and "fiction" responses from the audience.]*



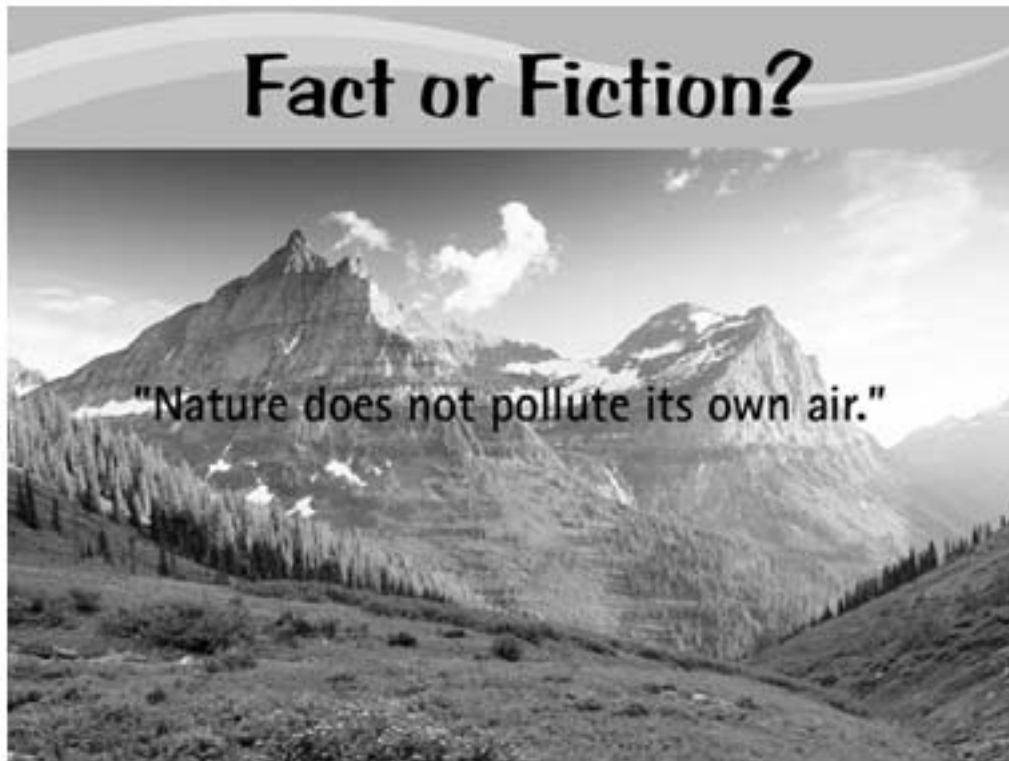
- True. Weather can affect air pollution in a number of ways.
- For example, the wind can move air pollution around, blowing it away from its source, and into areas hundreds of miles away - into other states and even other regions entirely, where it can have a significant impact on air pollution levels.
- One example of this is air pollution from power plants in Ohio, which often is transported to the New England and Mid-Atlantic states. This makes it a challenge for some New England and Mid-Atlantic cities to comply with air pollution regulations, because they can't control pollution from sources in other states.
- Weather can also affect air pollution in other ways. Sunlight and warm temperatures can contribute to the formation of certain types of air pollution.
- Also, during thunderstorms, the fast-moving air disperses pollutants, and the rain cleanses the air.
- High pressure and stagnant conditions can also affect air pollution. In a high pressure system, the air is stagnant, which keeps pollutants where they are.



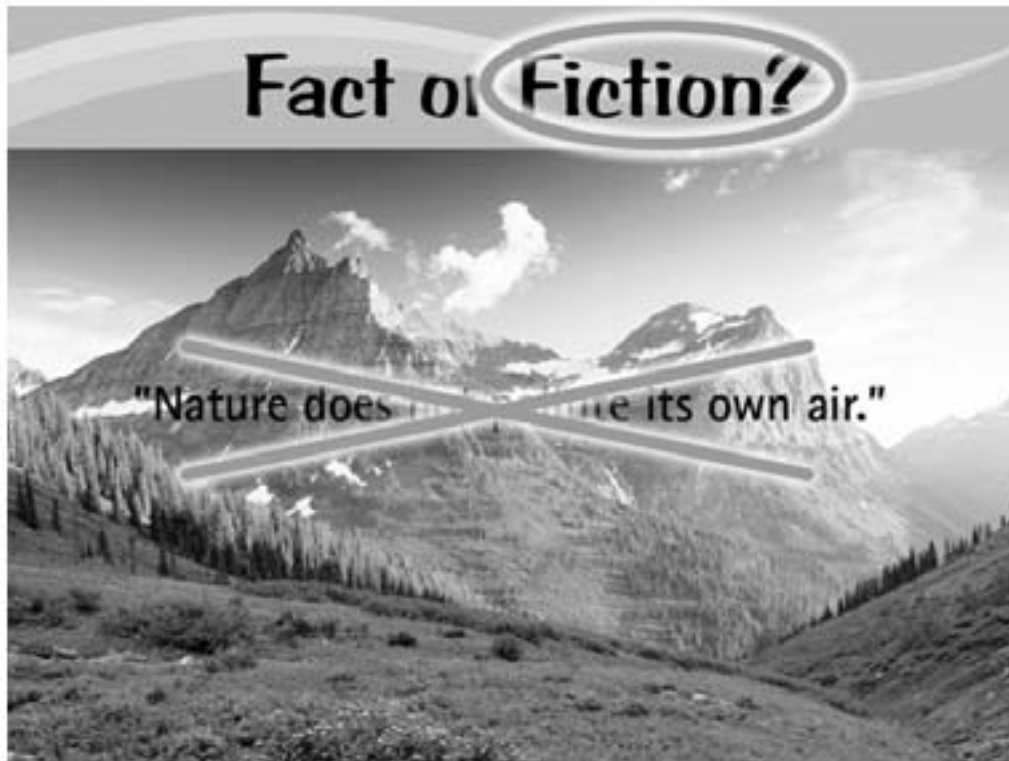
## Air pollution sources include:



- Air pollution comes from a number of different sources.
- Vehicles, power plants, and chemical plants are some of the biggest pollution sources.



- Here's another statement - fact or fiction?
- *[Elicit the "fact" and "fiction" responses from the audience.]*



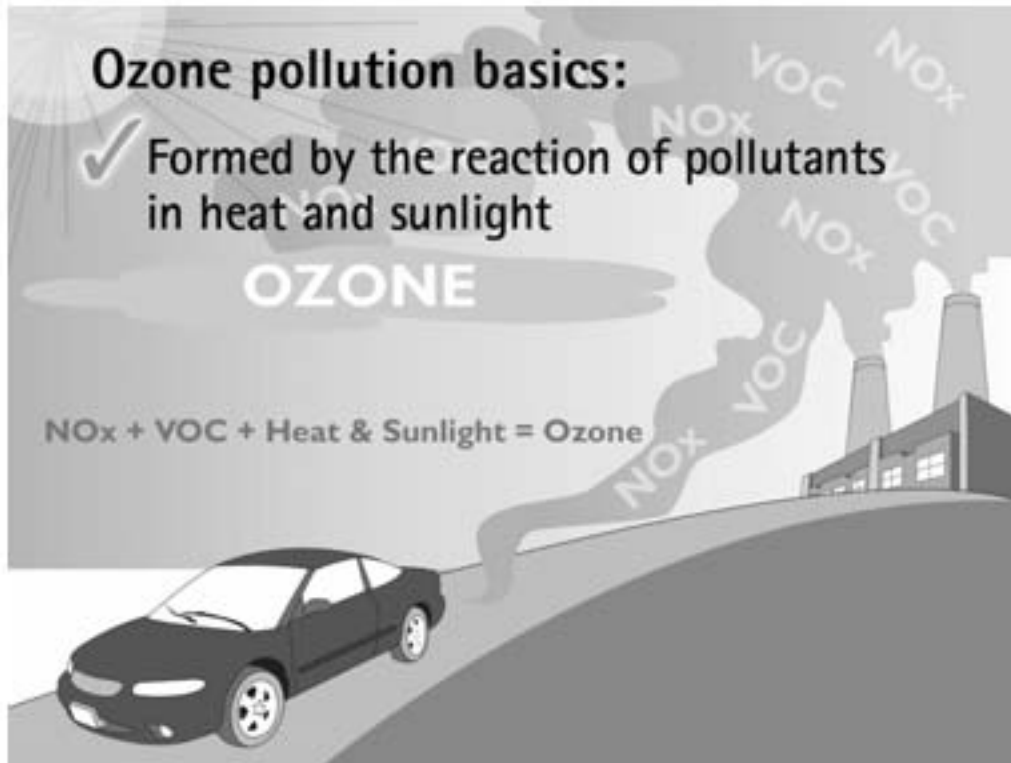
- Fiction.
- There are several natural sources of air pollution, including forest fires and volcanoes.

## Ozone Pollution

## Particle Pollution



- I'm going to talk about two types of pollutants today: ozone pollution and particle pollution.
- The Air Quality Index, or AQI, provides daily, color-coded maps and health information about these pollutants.
- The AQI can be found on EPA's AIRNow website, which looks like this.
- The AQI can also often be found in newspapers in the weather section, and also on TV and radio news reports.



- Ozone pollution is formed when pollutants called nitrogen oxides and volatile organic compounds, or VOCs, react in the presence of heat and sunlight.
- Vehicle exhaust, industrial emissions, gasoline vapors, and chemical solvents are some of the major sources of NO<sub>x</sub> and VOCs



# Fact or Fiction?

"Sometimes ozone in the air is a good thing."

- Here's another fact or fiction statement for you.
- *[Elicit the "fact" and "fiction" responses from the audience.]*



- Fact. Ozone in the air we breathe here at ground level is bad.
- But very high up in the atmosphere, there's a natural layer of ozone that protects us from getting too much of the sun's harmful ultraviolet radiation.

## Ozone pollution basics:

- ✓ Occurs in warmer months
- ✓ Found in urban and rural areas
- ✓ Can cause health effects
- ✓ A key ingredient of smog

- Because heat and sunlight are needed to form ground-level ozone, ozone levels are a concern in warmer months.
- This is another way in which weather influences air pollution.
- In fact, the length of the ozone season varies depending on the weather. Southern and southwestern states may have an ozone season that lasts nearly the entire year. For more northern states, the ozone season generally is limited to summertime.
- Wind can transport ozone hundreds of miles from where it formed, so it can be found in both urban and rural environments.



## Ozone can cause:

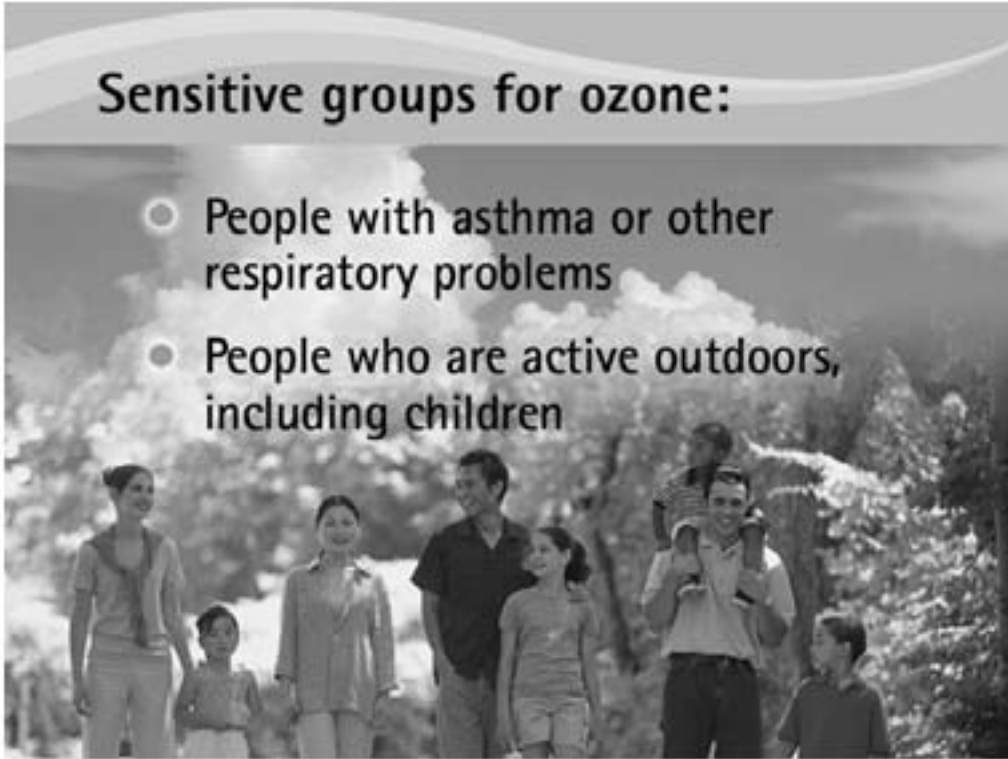
- Coughing
- Pain when taking a deep breath
- Breathing difficulties during outdoor activities
- Aggravated asthma
- Increased susceptibility
- Permanent lung damage



- Ozone can trigger a variety of health problems, including aggravated asthma and increased susceptibility to respiratory illnesses like pneumonia and bronchitis.
- Symptoms to watch for when ozone is at unhealthy levels in the air include: coughing, pain when taking a deep breath, and breathing difficulties, especially when you are active or exercising outdoors.
- But health damage from ozone can also occur without any noticeable signs. Repeated exposures to ozone can change the structure of the lungs, leading to premature aging of the lungs.

## Sensitive groups for ozone:

- People with asthma or other respiratory problems
- People who are active outdoors, including children



- Some people are more sensitive to ozone than others.
- Scientists estimate that about one in three people in the United States is at higher risk for experiencing ozone-related health effects.



- Ground-level ozone also is not good for the environment. It damages plants and trees and reduces crop and forest yields.
- So, ozone pollution often is not good for people and not good for our environment.

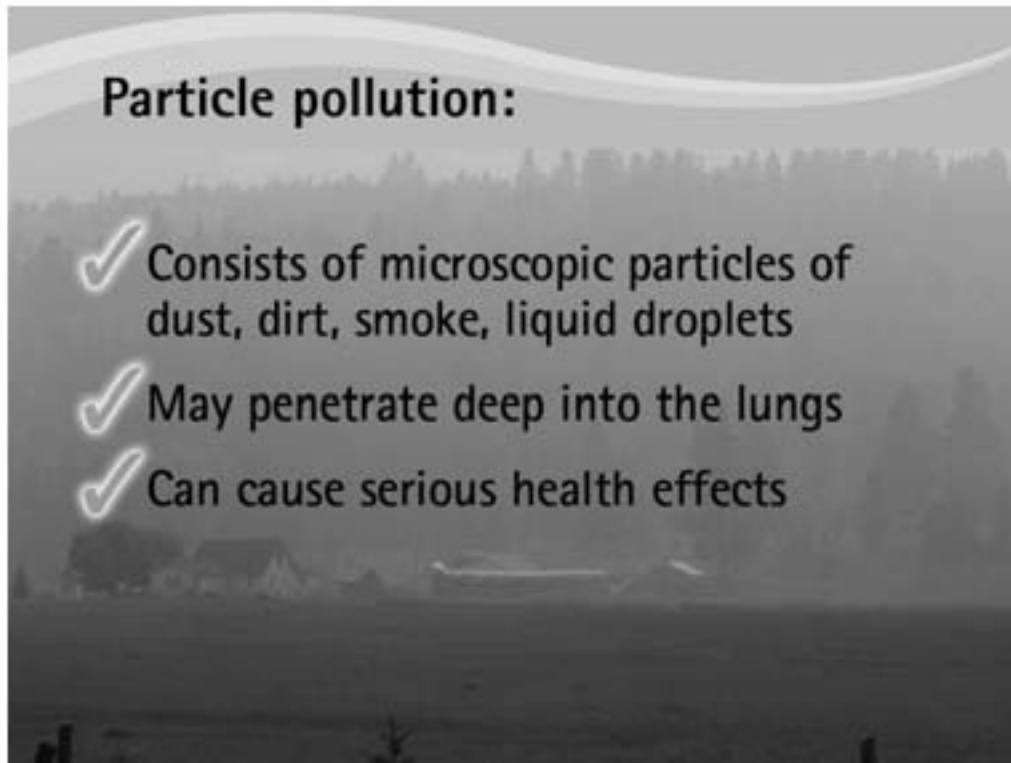
## Basic facts about particle pollution:

- ✓ Caused by human and natural sources
- ✓ May be bad near busy roads and factories
- ✓ May occur at any time of year
- ✓ May be especially bad in winter
- ✓ May be elevated outdoors and indoors

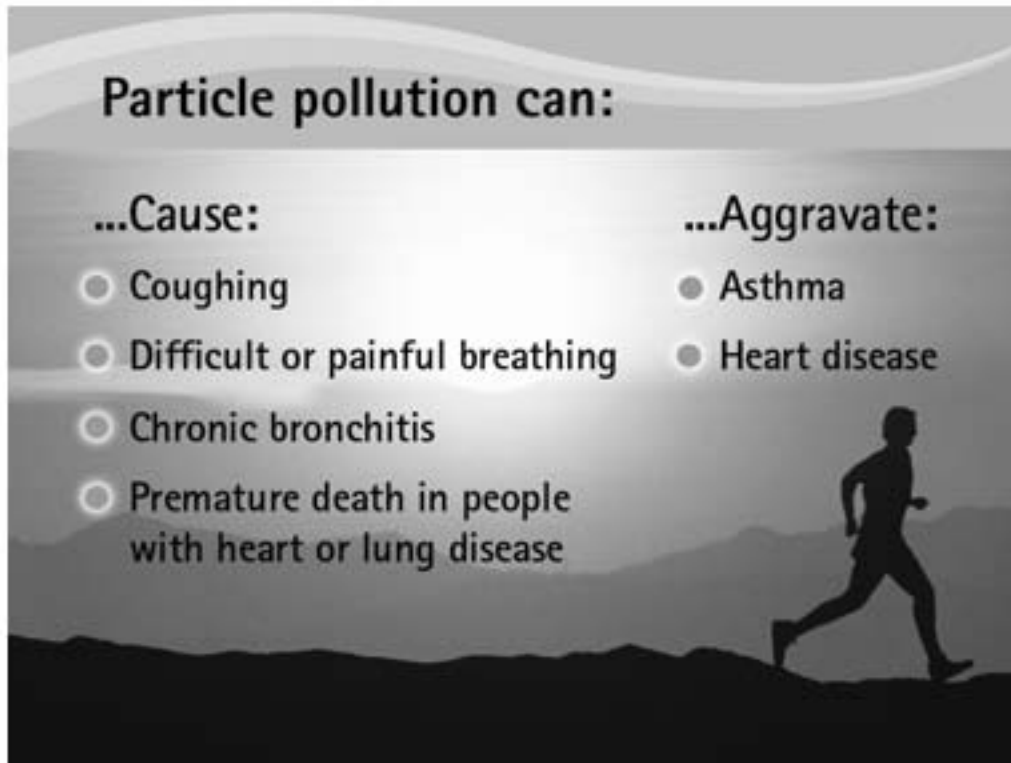
- Another key air pollutant that can affect people's health is called particle pollution.
- Particle pollution is caused by many human activities and by some natural sources.
- It's formed directly from sources such as vehicles, factories, power plants, and smoke from forest fires.
- Particle pollution can be higher near busy roads and factories.
- Particle pollution is also formed indirectly by weather-related conditions or events.
- Particle pollution can occur at any time of year, but it can be especially bad during winter, when the weather is calm, allowing particle pollution to build up.
- This phenomenon is called a temperature inversion.



- In a temperature inversion, cold air is trapped under warmer air above it.
- This is a reverse of normal conditions, in which temperature decreases as you go higher in the atmosphere.
- During an inversion, air pollution is also trapped under the warmer air.
- The photo on the left shows an inversion over the city of Boston.
- The photo on the right shows an inversion in a rural area.
- When particle pollution levels are high outside, as in these pictures, they are often high indoors as well.



- Particle pollution consists of tiny, microscopic particles of dust, dirt, smoke, and liquid droplets containing any number of chemicals.
- This photo shows particle pollution from Montana forest fires in the year 2000 in the Bitterroot Valley. This was actually a day of light smoke during the fires.
- The smaller particles are the greatest health concern because they can penetrate deep into your lungs and may even get into your bloodstream.



- You can see that particle pollution causes quite a range of health effects, from coughing and chronic bronchitis to aggravated asthma and heart disease, and even premature death in people with heart or lung disease.
- Many studies link particle pollution levels with increased hospital admissions and emergency room visits.



## Sensitive groups for particle pollution:

- People with heart or lung diseases
- Older adults
- Children



- As with ozone pollution, some people are considered to be at greater risk from particles than others.
- People with heart or lung disease are at risk because particle pollution can aggravate these diseases.
- Many studies show that when particle levels are high, older adults are more likely to be hospitalized, and some may die of aggravated heart or lung disease.
- Children are at risk because their lungs are still developing, they breathe more air per pound of body weight, and they are usually very active.



- Particles also affect the environment. They are a big part of haze, which reduces visibility.
- You may have noticed haze when visiting national parks. We often don't get the views we expect at our treasured natural areas due to haze.
- The left side of this slide shows the Great Smoky Mountains National Park on a hazy day; the right slide shows the same area on a clear day.
- Particles also make rain and other forms of precipitation more acidic, which harms the environment in a number of ways.
- So, as with ozone pollution, high levels of particle pollution often are not good for people and not good for our environment.

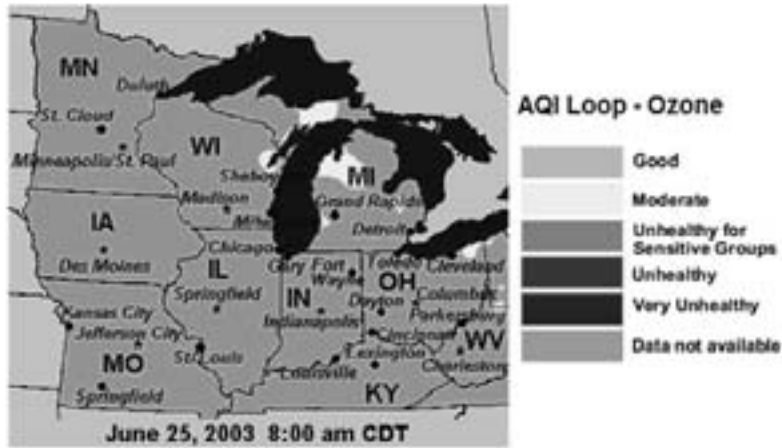


- Here's another fact or fiction statement for you.
- *[Elicit the "fact" and "fiction" responses from the audience.]*



- Fiction. Polluted air often does look dirty. But sometimes air that looks clean may be polluted.
- On EPA's AIRNow Web site, you can check whether the air is polluted and can get air quality forecasts for your area.

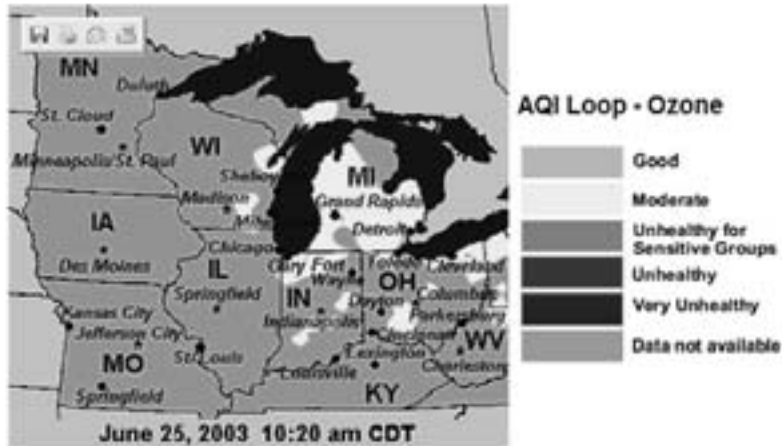
### Midwest Ozone Maps for June 25, 2003



[www.airnow.gov](http://www.airnow.gov)

- Here is an example of the type of maps and health messages you can get from the Air Quality Index on the AirNow Web site.
- Let's take a look at one of these maps and see what it tells us about ozone levels.
- This map shows the air quality in the Midwest at at 8:00 a.m. on June 25, 2003.
- The color scale to the right of the map is the Air Quality Index, or AQI, which is an index for reporting daily air quality.
- It tells us how clean or polluted the air is and whether there are any health concerns.
- What is this map telling us about the air quality in the Midwest on this day at 8:00 a.m.? *[Wait for response.]*
- The map is mostly green, so it's telling us that the air quality is mostly "good" all over this area of the Midwest.
- Let's go forward in time on that same day and see whether the air quality changed.

### Midwest Ozone Maps for June 25, 2003

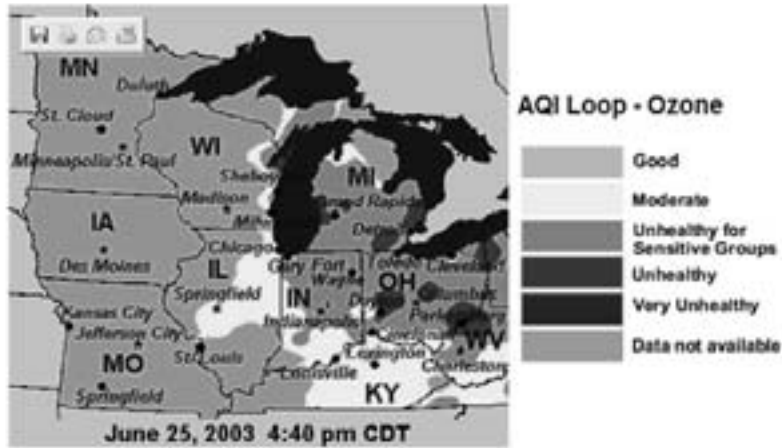


[www.airnow.gov](http://www.airnow.gov)

- On this map, it's now 10:20 a.m. on the same day in the Midwest. What's happening to the air quality in this area?  
*[Point to yellow area] [Wait for a response]*
- It's getting worse. The color is yellow, so the AQI is telling us that the air quality is "moderate," which means just a little polluted—a level that only unusually sensitive people need to be concerned about.
- Let's look at the air quality a few hours later.



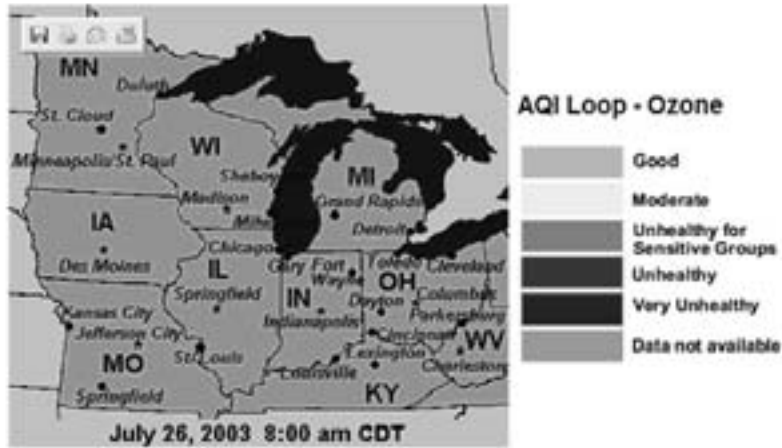
### Midwest Ozone Maps for June 25, 2003



[www.airnow.gov](http://www.airnow.gov)

- Now it's 4:40 p.m. on the same day. What is the air quality in these parts of the Midwest? *[Point to an orange area, then a red area.] [Wait for responses]*
- For orange, it's "unhealthy for sensitive groups" which, for ozone, are people with lung disease, and active adults and children. For red, it's "unhealthy" - everyone should limit prolonged or heavy outdoor exertion.
- Now let's look at the map the next morning.

### Midwest Ozone Maps for July 26, 2003



[www.airnow.gov](http://www.airnow.gov)

- The map is green again, showing us that the air quality is much better.
- Let's review what we saw about ozone levels on the Midwest maps: The air quality was good in the morning, it got worse in the afternoon and evening, and then it got better during the night.
- This is very typical for ozone pollution. Ozone is worse in warmer temperatures and often worse in the afternoon and early evening.
- This is because ozone needs warmth and sunlight to form.
- Also, increased traffic during the late afternoons and evenings can contribute to more ozone formation.



- If you have access to the Internet, you can visit the AIRNow website whenever you want to check the air quality and get air quality forecasts for your area, just like checking the weather.
- Or check your newspaper or listen to your local TV or radio station, which may include the AQI in their weather report.
- The AIRNow site also gives you specific health messages about how to protect your health when the air is polluted at the different AQI levels.
- *[Add local station information here, if applicable]*



- If you find out that the air is polluted, here are some things you can do to protect your health.
- Exercise is important to staying healthy, so it's important not to use air pollution as an excuse to avoid exercise!
- But when the air is polluted, it's a good idea to take it easier when you're active outside.
- That might mean, for example, walking instead of jogging, or exercising for half your normal time.
- That's because when we're taking it easier, we don't breathe in as much polluted air.



- Here's another thing you can do.
- You can reduce your exposure to polluted air by changing when or where you exercise.
- For example, when ozone is at unhealthy levels in the air, you can plan outdoor activities when ozone levels are lower, usually in the morning or evening.
- When particle pollution is in the air, you can plan outdoor activities when particle levels are lower. This can vary from place to place, so check AIRNow.
- To reduce your exposure to particle pollution, try to exercise away from busy roadways.



- Here's a fourth thing: Pay attention to your body.
- If the air is polluted and you notice any symptoms like unusual coughing, pain when you take a deep breath, chest tightness, or wheezing, stop your activity and instead choose a less strenuous activity.
- This is especially important if you are a member of a sensitive group—for example, if you have asthma or lung disease.
- If you have lung disease and notice these symptoms when the air is polluted, check with your doctor about what to do.
- If you have heart disease, check with your doctor before engaging in vigorous outdoor activities when particle pollution levels are high.
- If you have heart disease and notice symptoms, follow your doctor's advice.



- In addition to protecting yourself from pollution, you can also take steps to help prevent pollution.
- These steps include:
  - < When possible, reduce how much you drive by walking, biking, carpooling, or taking public transportation.
  - < Turn off lights and other appliances when you don't need them.
  - < Cut back on heating and cooling when you can.
  - < Insulate your home and run full loads in your appliances (washing machine, dishwasher, etc.) so you're only using the energy you really need.
  - < And, when purchasing a product that uses energy, whether a vehicle or an appliance, look for one that uses energy efficiently. For instance, look for the EnergySTAR label.





- Thank you. I hope you found this information useful.
- Here is a handout with more information about the AQI, and about air quality and your health.
- *[Pass out handout]*

**Short version:**  
***Civic Groups presentation***

# Short Version: Civic Groups Presentation

This presentation is an abbreviated version of the longer presentation for Civic Groups provided earlier in this toolkit. A longer and more detailed presentation than those for school-aged children is appropriate for civic/adult groups; however if time is limited, you can use this shorter version. The long version contains 33 slides; this short version includes 15 slides. The *Key Messages, Handout*, and *Optional Activity* provided for Civic Groups are relevant for both the short and long versions.

# **Notes Pages: Civic Groups Short version**



- I'd like to talk about air pollution and your health, and how weather can affect air pollution. Breathing polluted air is unhealthy, but you can't always tell the air is polluted by how it looks, like you can in these pictures.
- Air pollution can have a number of health effects, some of which can be quite serious.



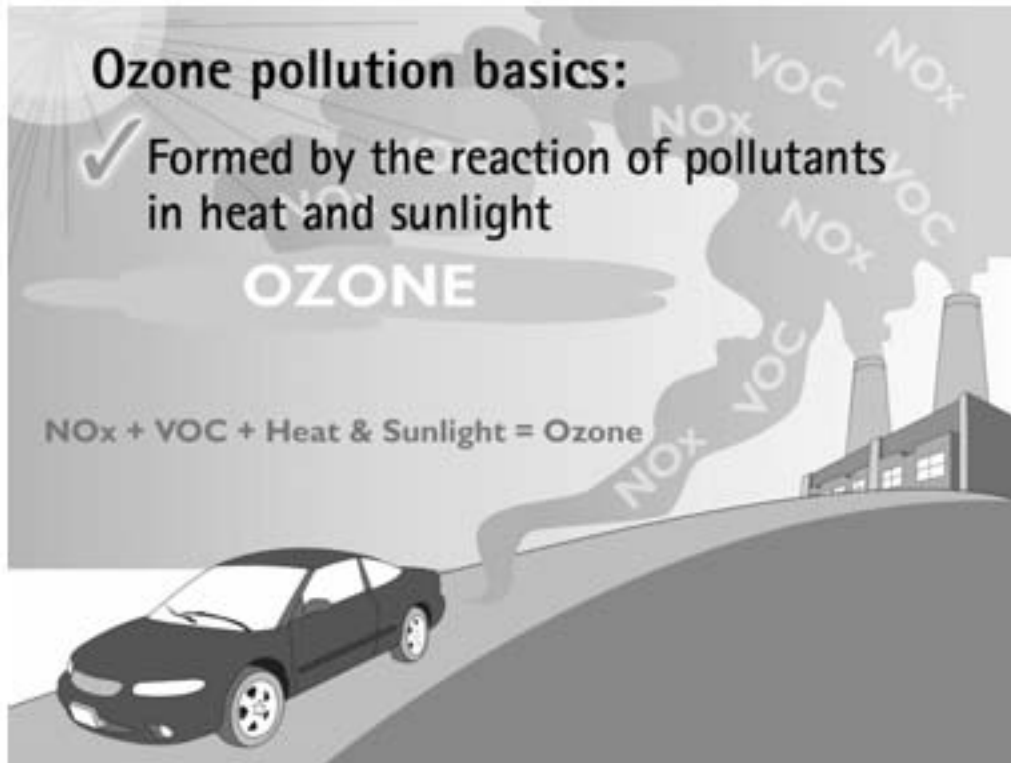
- The Air Quality Index, or AQI, can help you find out when pollution levels are high and could contribute to health problems. The AQI also provides related health messages.
- The AQI uses color-coding to represent air quality ranging from good (green) to purple (very unhealthy).
- You can find the AQI on the Internet at EPA's AIRNow website at: [www.airnow.gov](http://www.airnow.gov). Also, many local newspapers and TV and radio stations include the AQI as part of the weather report.

## Air pollution sources include:



- Air pollution comes from a number of different sources.
- Vehicles, power plants, and chemical plants are some of the biggest pollution sources. Some things in nature, like forest fires or volcanoes, also can cause air pollution.





- I'm going to talk about two types of air pollutants today: ozone pollution and particle pollution.
- Ozone pollution is formed when pollutants called nitrogen oxides and volatile organic compounds, or VOCs, react in the presence of heat and sunlight. This is one way that weather affects air pollution.
- Vehicle exhaust, industrial emissions, gasoline vapors, and chemical solvents are some of the major sources of NO<sub>x</sub> and VOCs.
- Weather can also affect air pollution in other ways. For example, the wind can move air pollution around, blowing it away from its source, into areas hundreds of miles away, where it can have a significant impact on air pollution levels.



- Ozone in the air we breathe here at ground level is bad.
- But very high up in the atmosphere, there's a natural layer of ozone that protects us from getting too much of the sun's harmful ultraviolet radiation.

## Ozone pollution basics:

- ✓ Occurs in warmer months
- ✓ Found in urban and rural areas
- ✓ Can cause health effects
- ✓ A key ingredient of smog

- Because heat and sunlight are needed to form ground-level ozone, ozone levels are a concern in warmer months.
- This is another way in which weather influences air pollution.
- In fact, the length of the ozone season varies depending on the weather. Southern and southwestern states may have an ozone season that lasts nearly the entire year. For more northern states, the ozone season generally is limited to summertime.

## Ozone can cause:

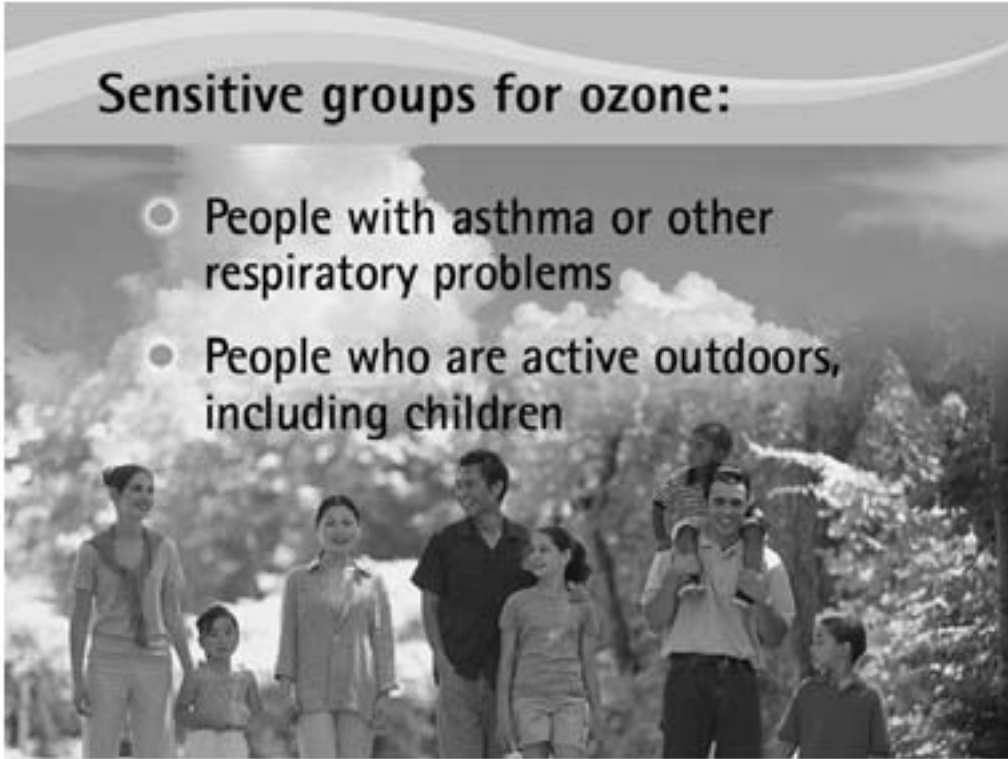
- Coughing
- Pain when taking a deep breath
- Breathing difficulties during outdoor activities
- Aggravated asthma
- Increased susceptibility
- Permanent lung damage



- Ozone can trigger a variety of health problems, including aggravated asthma and increased susceptibility to respiratory illnesses like pneumonia and bronchitis.
- Symptoms to watch for when ozone is at unhealthy levels in the air include: coughing, pain when taking a deep breath, and breathing difficulties, especially when you are active or exercising outdoors.
- But health damage from ozone can also occur without any noticeable signs. Repeated exposures to ozone can change the structure of the lungs, leading to premature aging of the lungs.

## Sensitive groups for ozone:

- People with asthma or other respiratory problems
- People who are active outdoors, including children

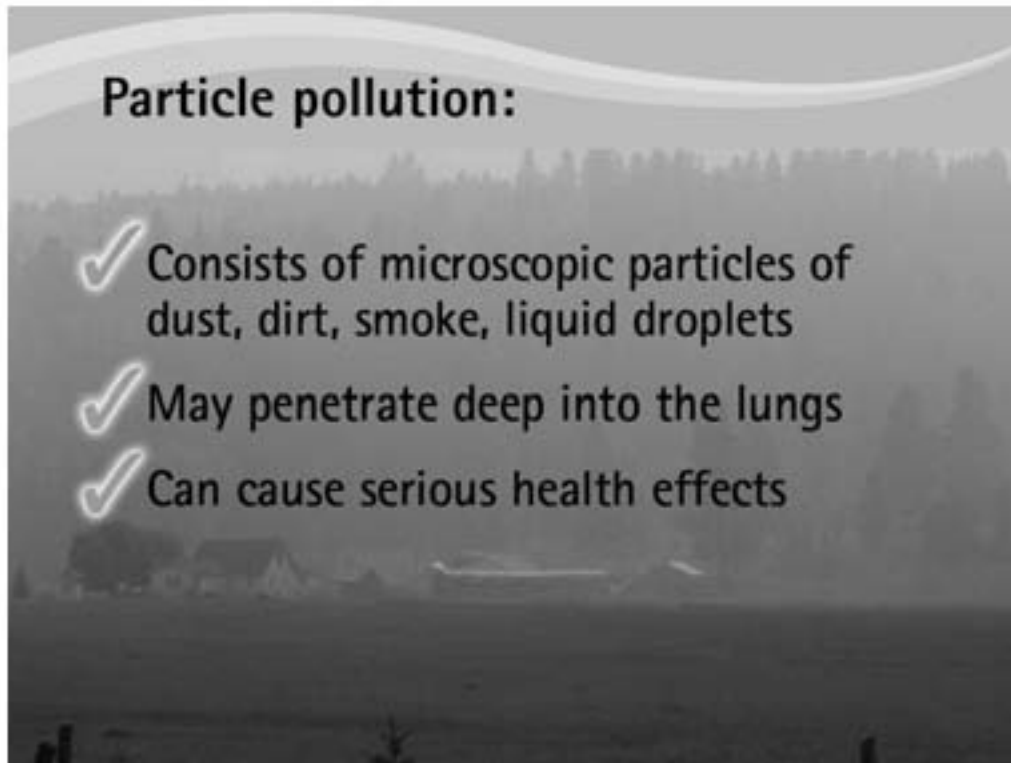


- Some people are more sensitive to ozone than others.
- Scientists estimate that about one in three people in the United States is at higher risk for experiencing ozone-related health effects.

## Basic facts about particle pollution:

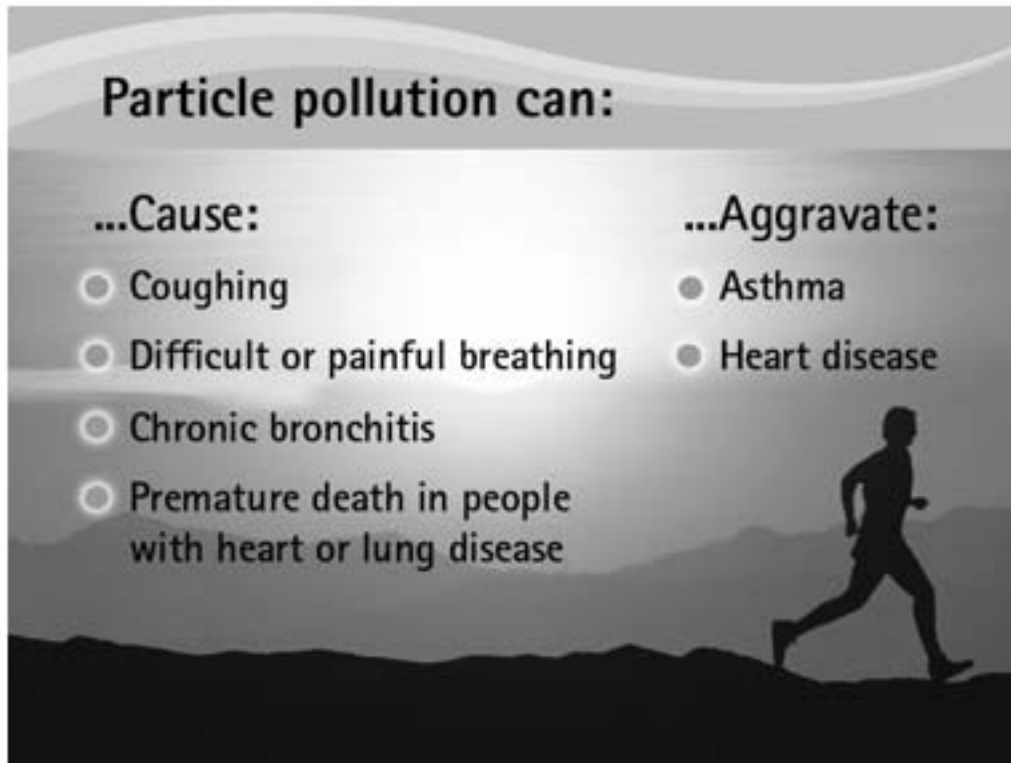
- ✓ Caused by human and natural sources
- ✓ May be bad near busy roads and factories
- ✓ May occur at any time of year
- ✓ May be especially bad in winter
- ✓ May be elevated outdoors and indoors

- Another key air pollutant that can affect people's health is called particle pollution.
- Particle pollution is formed directly from sources such as vehicles, factories, power plants, and smoke from forest fires.
- Particle pollution can be higher near busy roads and factories.
- Particle pollution is also formed indirectly, for example, by weather-related conditions or events. Particle pollution can occur at any time of year, but it can be especially bad during winter, when the weather is calm, allowing particle pollution to build up often due to high pressure systems and stagnant conditions. In a high pressure system, the air is stagnant, which keeps pollutants where they are.
- Also during thunderstorms, the fast-moving air disperses particle pollution, and the rain cleanses the air.



- Particle pollution consists of tiny, microscopic particles of dust, dirt, smoke, and liquid droplets containing any number of chemicals.
- This photo shows particle pollution from Montana forest fires in the year 2000 in the Bitterroot Valley. This was actually a day of light smoke during the fires.
- The smaller particles are the greatest health concern because they can penetrate deep into your lungs and may even get into your bloodstream.





- You can see that particle pollution causes quite a range of health effects, from coughing and chronic bronchitis to aggravated asthma and heart disease, and even premature death in people with heart or lung disease.
- Many studies link particle pollution levels with increased hospital admissions and emergency room visits.

## Sensitive groups for particle pollution:

- People with heart or lung diseases
- Older adults
- Children

- As with ground-level ozone, some people are considered to be at greater risk from particles than others.
- People with heart or lung disease are at risk because particle pollution can aggravate these diseases.
- Many studies show that when particle levels are high, older adults are more likely to be hospitalized, and some may die of aggravated heart or lung disease.
- Children are at risk because their lungs are still developing, they breathe more air per pound of body weight, and they are usually very active.



- Visit the AIRNow website to check the air quality and get air quality forecasts for your area, just like checking the weather. Or check your newspaper or listen to your local TV or radio weather report, which may include the AQI. *[Add local station information here, if applicable.]*
- Exercise is important to staying healthy, so it's important not to use air pollution as an excuse to avoid exercise! But when the air is polluted, it's a good idea to take it easier when you're active outside. That might mean, for example, walking instead of jogging, or exercising for half your normal time.
- You can reduce your exposure to polluted air by changing when or where you exercise. For example, when ozone is at unhealthy levels in the air, plan outdoor activities for times when ozone levels are lower, usually in the morning or evening.
- When particle pollution is at high levels in the air, plan outdoor activities for times when particle levels are lower. This can vary from place to place, so check the Air Quality Index. To reduce your exposure to particle pollution, try to exercise away from busy roadways.
- Pay attention to your body. If the air is polluted and you notice symptoms like coughing, pain when you take a deep breath, chest tightness, or wheezing, stop what you're doing and find another, less intense activity. This is especially important if you are a member of a sensitive group—for example, if you have asthma or lung disease.
- If you have lung disease and notice these symptoms when the air is polluted, check with your doctor about what to do.
- If you have heart disease, check with your doctor before engaging in vigorous outdoor activities when particle pollution levels are high. If you have heart disease and notice symptoms, follow your doctor's advice.



- In addition to protecting yourself from pollution, you can also take steps to help prevent pollution.
- These steps include:
  - < When possible, reduce how much you drive by walking, biking, carpooling, or taking public transportation.
  - < Turn off lights and other appliances when you don't need them.
  - < Cut back on heating and cooling when you can.
  - < Insulate your home and run full loads in your appliances (washing machine, dishwasher, etc.) so you're only using the energy you really need.
  - < And, when purchasing a product that uses energy, whether a vehicle or an appliance, look for one that uses energy efficiently. For instance, look for the EnergySTAR label.

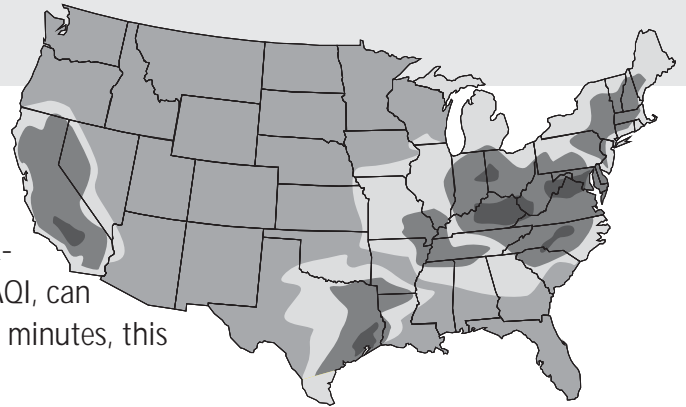


- Thank you. I hope you found this information useful.
- Here is a handout with more information about the AQI, and about air quality and your health.
- *[Pass out handout]*

# **Handout for Civic Groups/Adults**

# The AQI: Your Forecast to Breathe By

You probably check your local weather forecast every day, but there's another forecast out there you should be checking, too. This forecast, known as the Air Quality Index, or AQI, can help you plan your activities to protect your health. In just minutes, this important tool lets you know:



- What today's and tomorrow's air pollution levels are forecast to be in your community.
- Who's at risk from air pollution.
- Simple steps you can take to protect your health.

## How can air pollution affect my health?

- About 160 million Americans—over half the U.S. population—are exposed to unhealthy levels of ground-level ozone or particle pollution every year.
- Breathing ground-level ozone and particle pollution can cause serious health effects. Ozone pollution can cause respiratory symptoms and premature aging of the lungs. Particle pollution can cause bronchitis, heart problems, and even premature death due to heart or lung disease. Both ozone and particle pollution can aggravate asthma.
- Some people are at greater risk from breathing ozone pollution or particle pollution. Sensitive groups for ozone pollution include active children and adults, and people with lung disease. Sensitive groups for particle pollution include people with heart or lung disease, older adults, and children.

## What can I do to protect my health?

- You can reduce your exposure to air pollution by using AQI forecasts to plan your day. When the AQI predicts unhealthy air pollution levels, take it easier. By doing so, you will take less polluted air into your lungs. Choose a less vigorous activity (walk instead of jog, for example) or spend less time doing it. Or, reschedule your activities for times when air quality is expected to be better.





## Where can I find air quality information for my community?

- You can find daily air quality information and forecasts for ozone and particle pollution on the Internet at the AIRNow web site ([www.airnow.gov](http://www.airnow.gov)). This site also provides links to state and local air pollution agency web sites and air quality e-alerts.
- In many communities, you can also get air quality information on the television and radio, in your local newspaper, and on state and local telephone hotlines.

## How does the Air Quality Index (AQI) work?

The AQI is a simple, color-coded scale that tells you how clean or polluted your air is and how you can protect your health. Air quality forecasts use these color codes to help you quickly identify how polluted the air is.

When the AQI is . . .	. . . air quality conditions are:
Green	Good
Yellow	Moderate
Orange	Unhealthy for Sensitive Groups
Red	Unhealthy
Purple	Very Unhealthy

## Where can I get more information?

Visit AIRNow ([www.airnow.gov](http://www.airnow.gov)) for air quality information and forecasts for more than 300 cities across the U.S., links to state and local air quality web sites, and real-time air quality maps and visibility via webcams.

Visit [www.airnow.gov](http://www.airnow.gov) (click on "Publications" on the left side of the web page) for free U.S. EPA publications:

- *Air Quality Index—A Guide to Air Quality and Your Health*
- *Air Quality Guide for Ozone*
- *Air Quality Guide for Particle Pollution*
- *Particle Pollution and Your Health*
- *Ozone and Your Health*
- *Smog—Who Does it Hurt?*
- *Summertime Safety: Keeping Kids Safe from Sun and Smog*

# **Optional Additional Activity for Civic Groups: *Jeopardy Game***

# Jeopardy Game

*(followup to slide presentation if time allows)*

- Now let's play "Jeopardy" for a couple of minutes to review some of the key points about air quality. Following the typical Jeopardy format, I will give you the "answers." Raise your hand if you have a question that corresponds to that answer. The only rule is that the question has to have something to do with air quality or air pollution.

*[Note: Examples of questions are given below. The actual wording of the responses from audience members will vary. If someone gives a wrong response, ask for another response until you have a correct response from an audience member. ]*

- Here's the first answer: "AIRNow." Who's got a question for it?
- *[Take response(s). Example response: What is the name of EPA's web site that provides daily air quality information and forecasts?]*
- Here's the second answer: "Sensitive groups." Who's got a question for it?
- *[Take response(s). Example responses: What are people with asthma, heart disease, or lung disease; children; and/or older adults called with respect to air pollution? What is the term for people who are more sensitive to air pollution?]*
- Here's the third answer: "Take it easier when you're active outside." Who's got a question for it?
- *[Take response(s). Example response: What is a good thing to do when air pollution levels are elevated?]*
- Here's the fourth answer: "Ozone." Let's see if we can come up with several questions for this one.
- *[Take several responses if possible. Example responses: What pollutant can't be seen in air? What pollutant can harm health even at low levels and even after exposure has ended? What pollutant is formed by the reaction of VOCs and nitrogen oxides in sunlight and heat? What pollutant is worse in warm months?]*
- And the final answer is "Green."
- *[Take response(s). Example response: What AQI color means the air is healthy?]*

# **Transparencies: Civic Groups**

## **Long version**



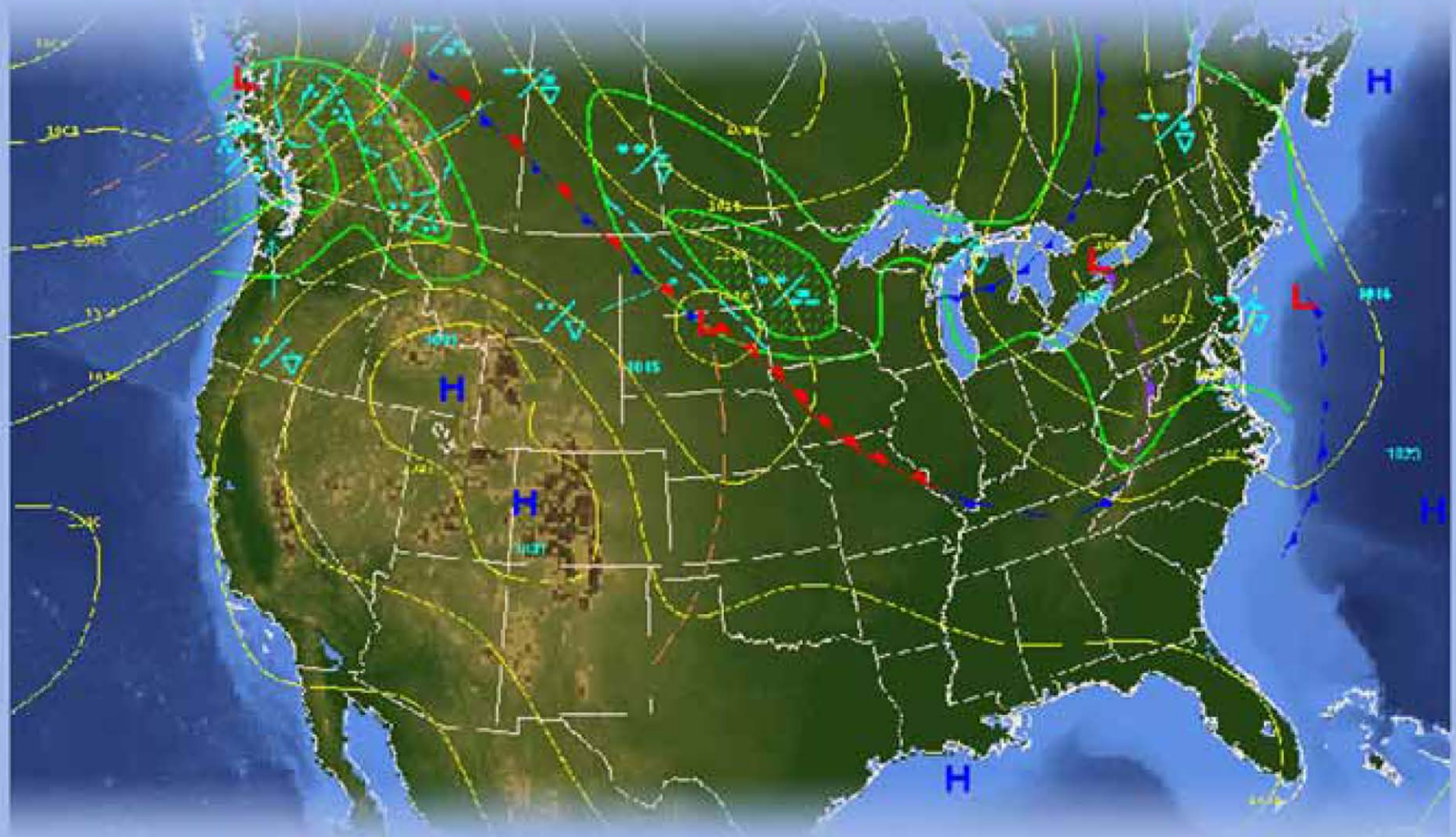
**AIR QUALITY INDEX**

[www.airnow.gov](http://www.airnow.gov)

***Your forecast  
to breathe by***

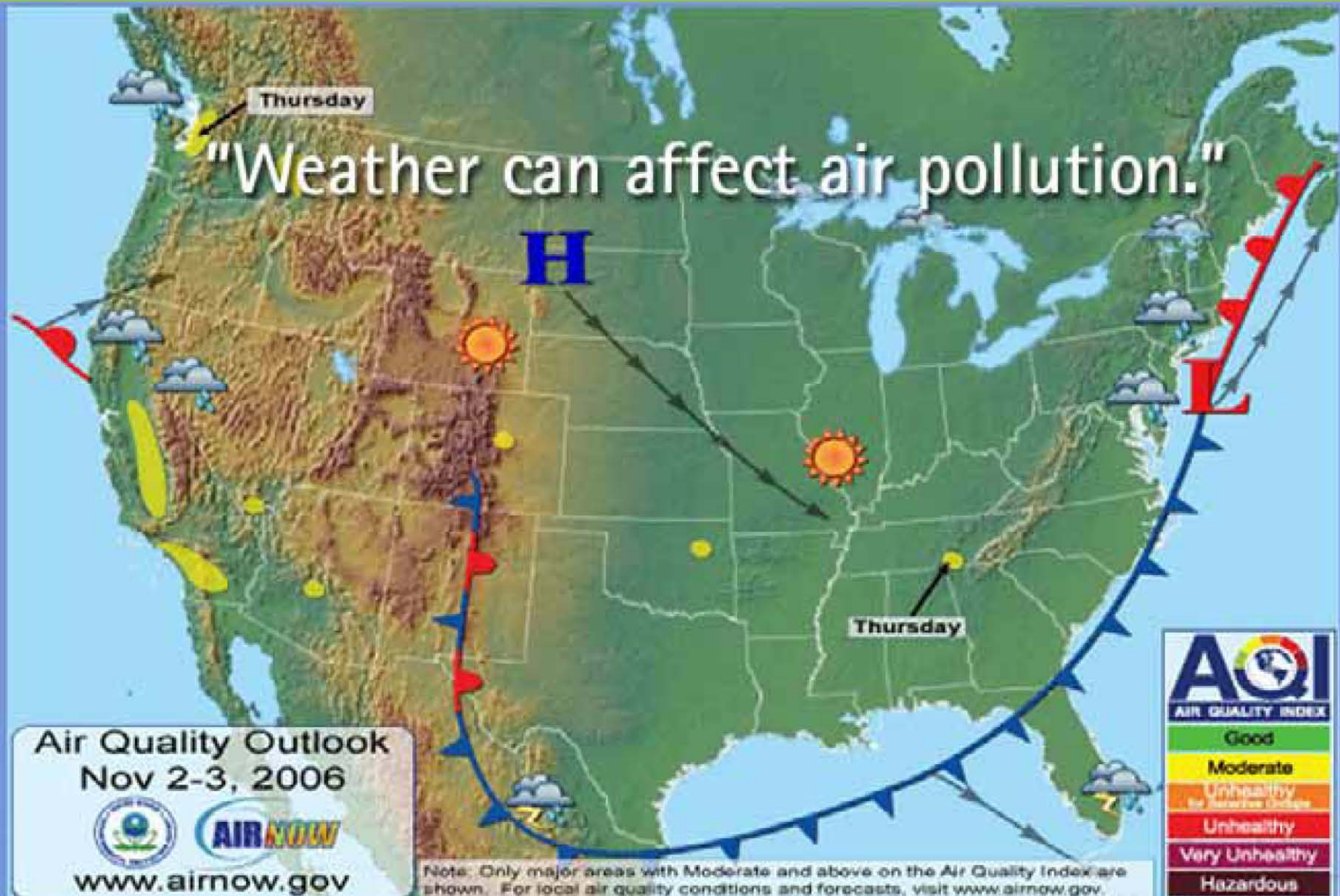


# Fact or Fiction?





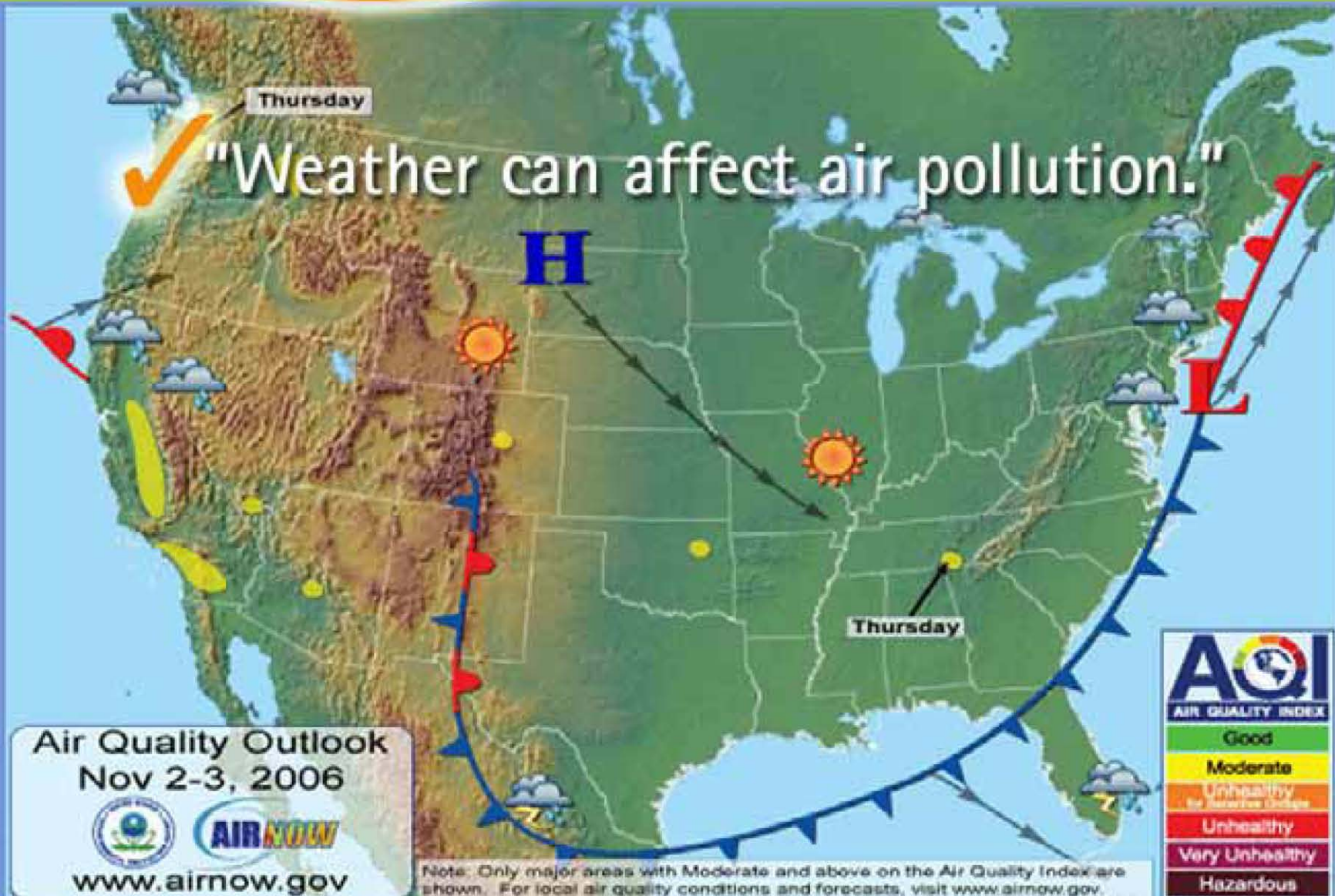
# Fact or Fiction?





# Fact or Fiction?

✓ "Weather can affect air pollution."





## Air pollution sources include:



# Fact or Fiction?

"Nature does not pollute its own air."





# Fact or Fiction?

~~"Nature does its own air."~~





# Ozone Pollution

# Particle Pollution

<http://www.airnow.gov> A cross-agency U.S. Government Web site. See a complete [list of AIRNow partner agencies](#) Search:  **GO**



## About AIRNow

[Air Quality Basics](#)  
[Air Quality Index](#)  
[Ozone](#)  
[Particle Pollution](#)

## The AQI for...

[Health Providers](#)  
[Kids](#)  
[Partner Agencies](#)  
[Teachers](#)  
[Weathercasters](#)

## Key Topics:

[Your Health](#)  
[Smoke from Fires](#)

## Resources

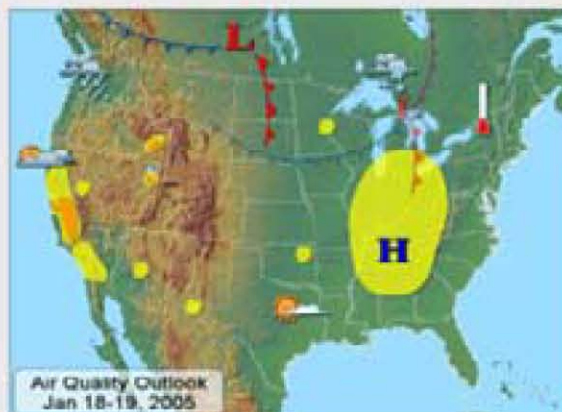
[Publications](#)  
[Publicaciones](#)  
[FAQ](#)  
[What You Can Do](#)  
[About the Data](#)

[Contact Us](#)

## National Overview

[Today's Forecast](#) | [Ozone Now](#) | [Particles Now](#) | [Outlook](#)

National Air Quality Outlook - click for larger map



January 19th, 2005

## National Outlook:

High pressure will cause stagnant conditions from the Inter-Mountain West to the California coast, leading to Moderate to Unhealthy for Sensitive Groups AQI levels across the region, with the highest levels occurring in city and valley locations.

[Today's Forecast](#)

[Particles Now](#)

[Ozone Now](#)

[Cities With Action Days](#)

[Archives](#)

[International Air Quality](#)

## Local Forecast & Conditions:

Local forecasts and current air quality conditions, animations, visibility [web cams](#) and state, tribal and local Web sites.

[Current Ozone and Particle Maps](#)

## Web cam



Current visibility at Acadia  
National Park, Maine

[EXIT AIRNOW ►](#)



**New Particle Pollution Maps.** PM2.5 maps are now available for [North Dakota](#) / [South Dakota](#) and [Portland, OR](#).

**Norfolk Southern Graniteville Derailment.** A collision of two freight trains in Graniteville, SC January 6, resulted in a release of chlorine gas to the atmosphere. This release has led to a large number of injuries and fatalities, according to news reports. -- [more](#) --

[SC Department of Health and Environmental Control](#)

The 2005 National Air Quality Conference "Quality of Air Means Quality of

## What You Can Do

## Winter Wood Burning

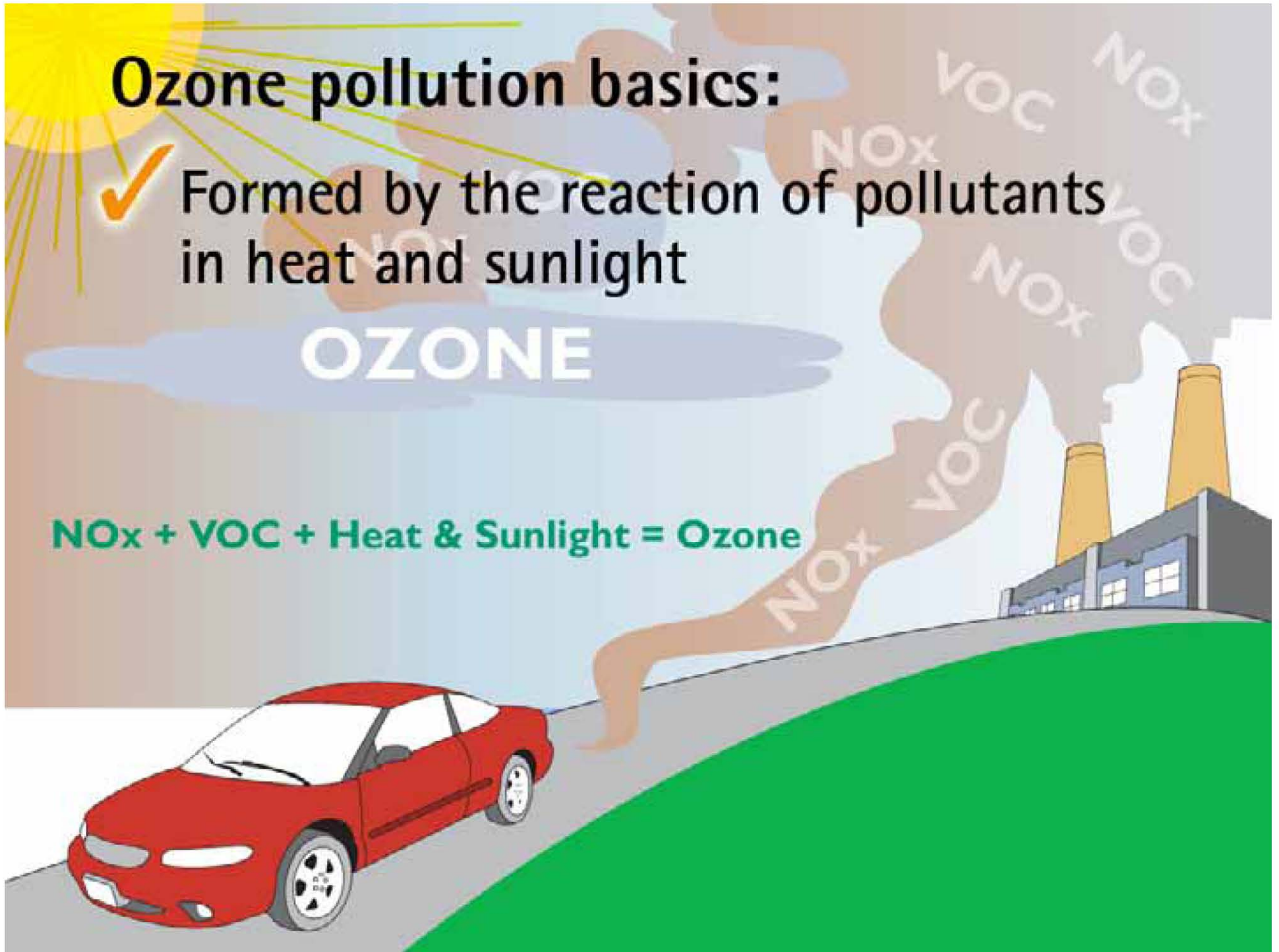


# Ozone pollution basics:

- ✓ Formed by the reaction of pollutants in heat and sunlight

**OZONE**

**$\text{NO}_x + \text{VOC} + \text{Heat \& Sunlight} = \text{Ozone}$**





# Fact or Fiction?

"Sometimes ozone in the air is a good thing."



# Fact or Fiction?

✓ "Sometimes ozone in the air is a good thing."



## Ozone pollution basics:

- ✓ Occurs in warmer months
- ✓ Found in urban and rural areas
- ✓ Can cause health effects
- ✓ A key ingredient of smog

## Ozone can cause:

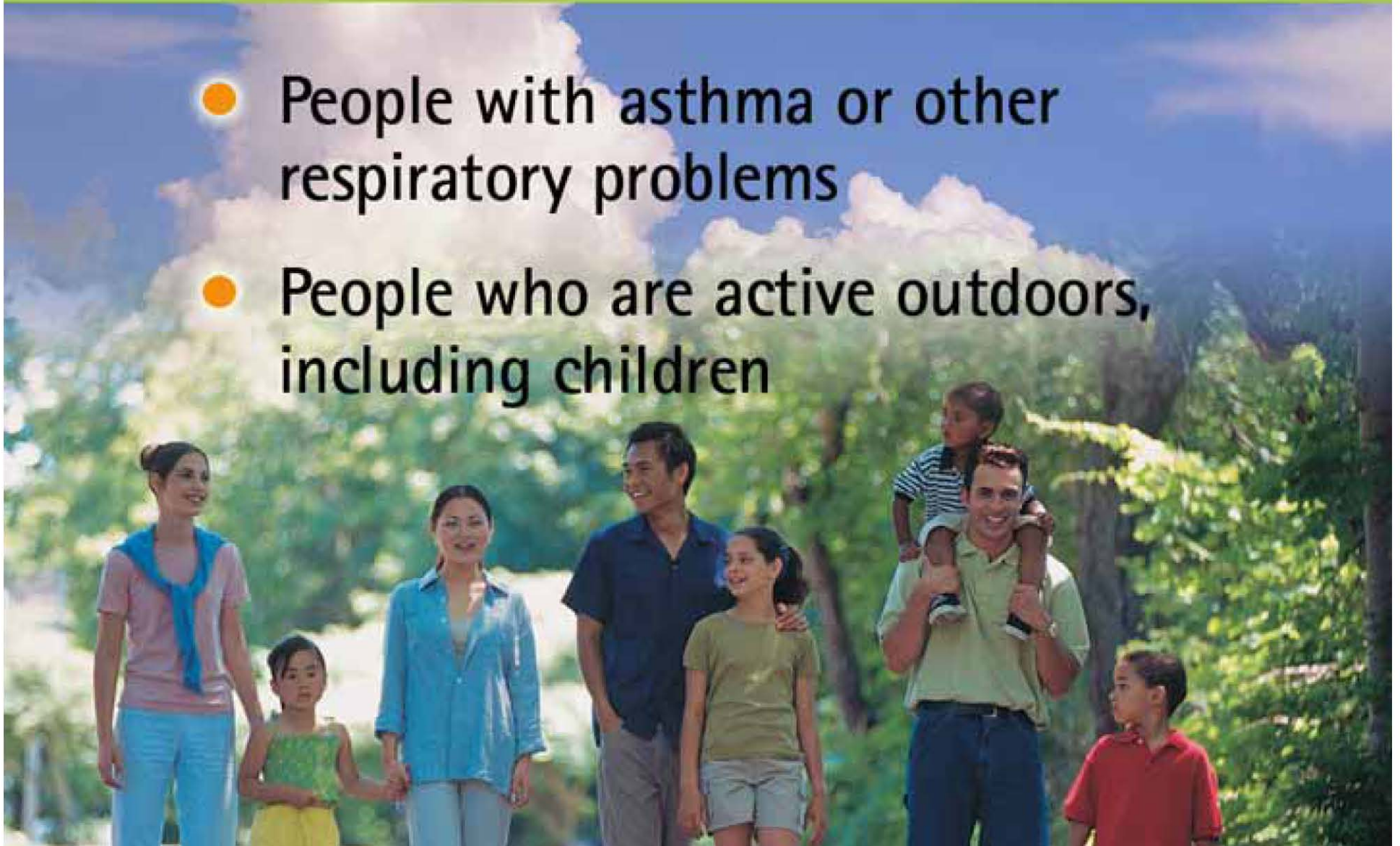
- Coughing
- Pain when taking a deep breath
- Breathing difficulties during outdoor activities
- Aggravated asthma
- Increased susceptibility
- Permanent lung damage





# Sensitive groups for ozone:

- People with asthma or other respiratory problems
- People who are active outdoors, including children







## Basic facts about particle pollution:

- ✓ Caused by human and natural sources
- ✓ May be bad near busy roads and factories
- ✓ May occur at any time of year
- ✓ May be especially bad in winter
- ✓ May be elevated outdoors and indoors







# Particle pollution:

- ✓ Consists of microscopic particles of dust, dirt, smoke, liquid droplets
- ✓ May penetrate deep into the lungs
- ✓ Can cause serious health effects

# Particle pollution can:

## ...Cause:

- Coughing
- Difficult or painful breathing
- Chronic bronchitis
- Premature death in people with heart or lung disease

## ...Aggravate:

- Asthma
- Heart disease





# Sensitive groups for particle pollution:

- People with heart or lung diseases
- Older adults
- Children







# Fact or Fiction?

"You can always tell when the air is polluted by how it looks."





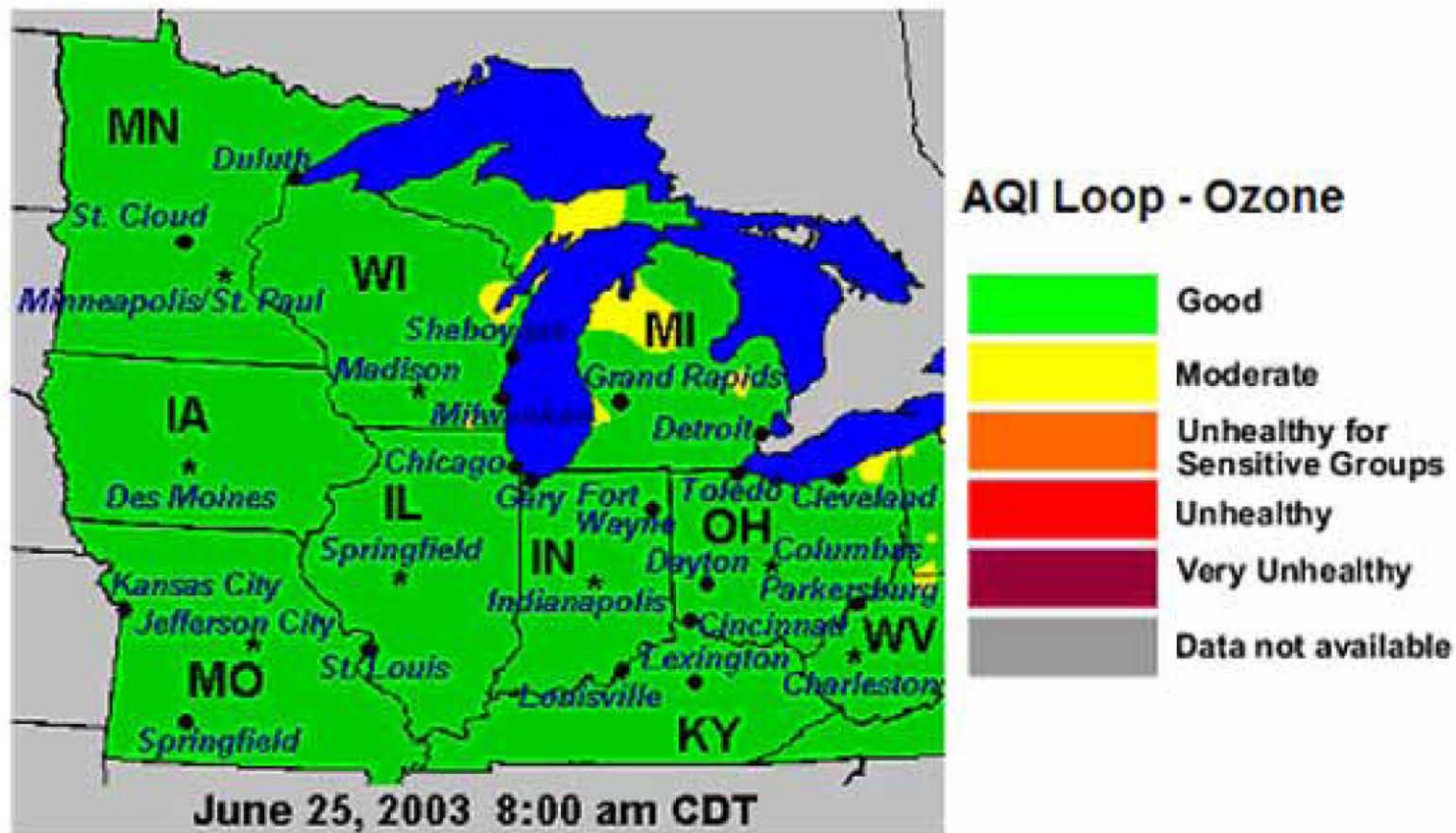
# Fact or Fiction?

~~"You can always tell when the air is polluted by how it looks."~~



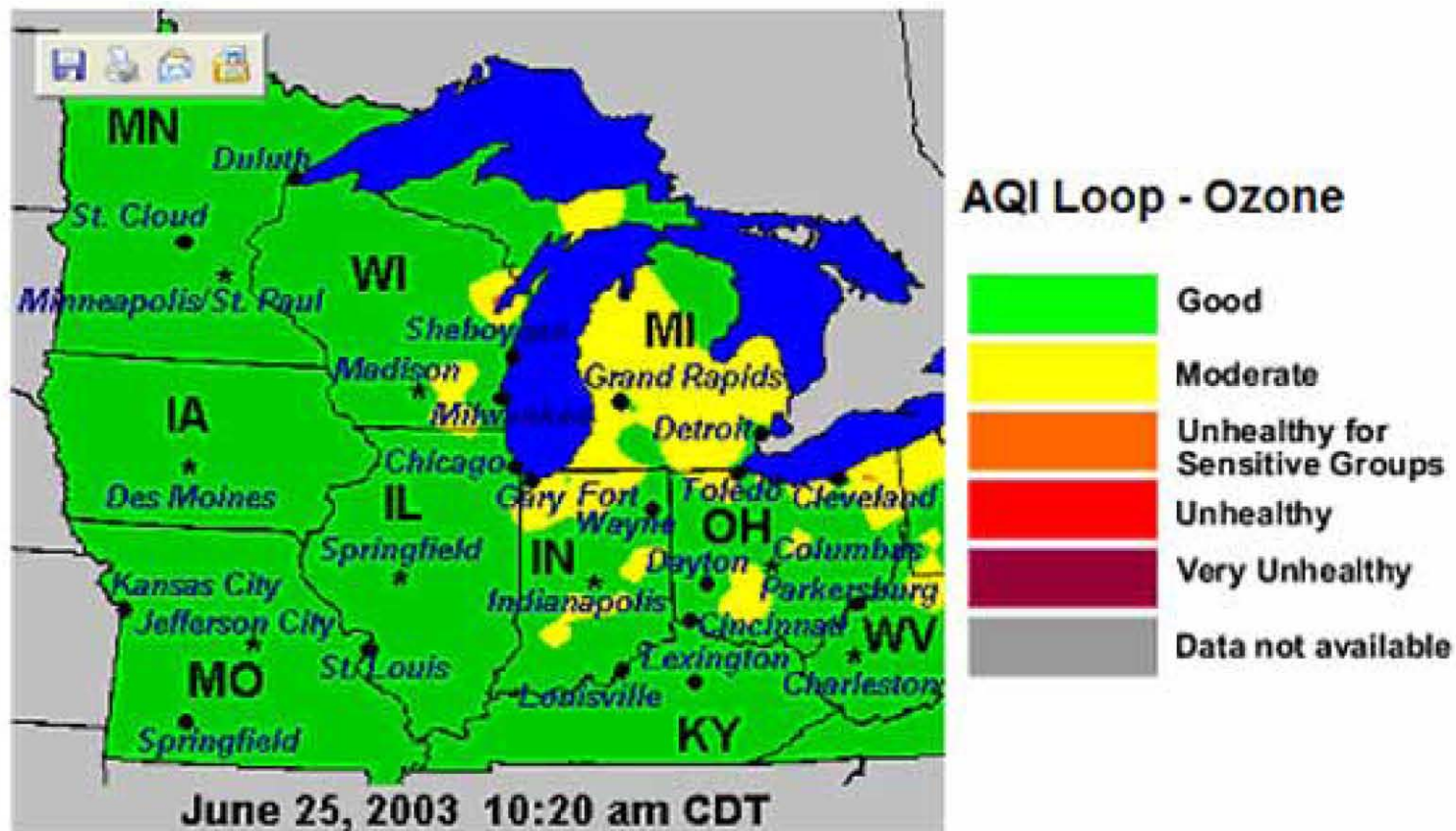


## Midwest Ozone Maps for June 25, 2003



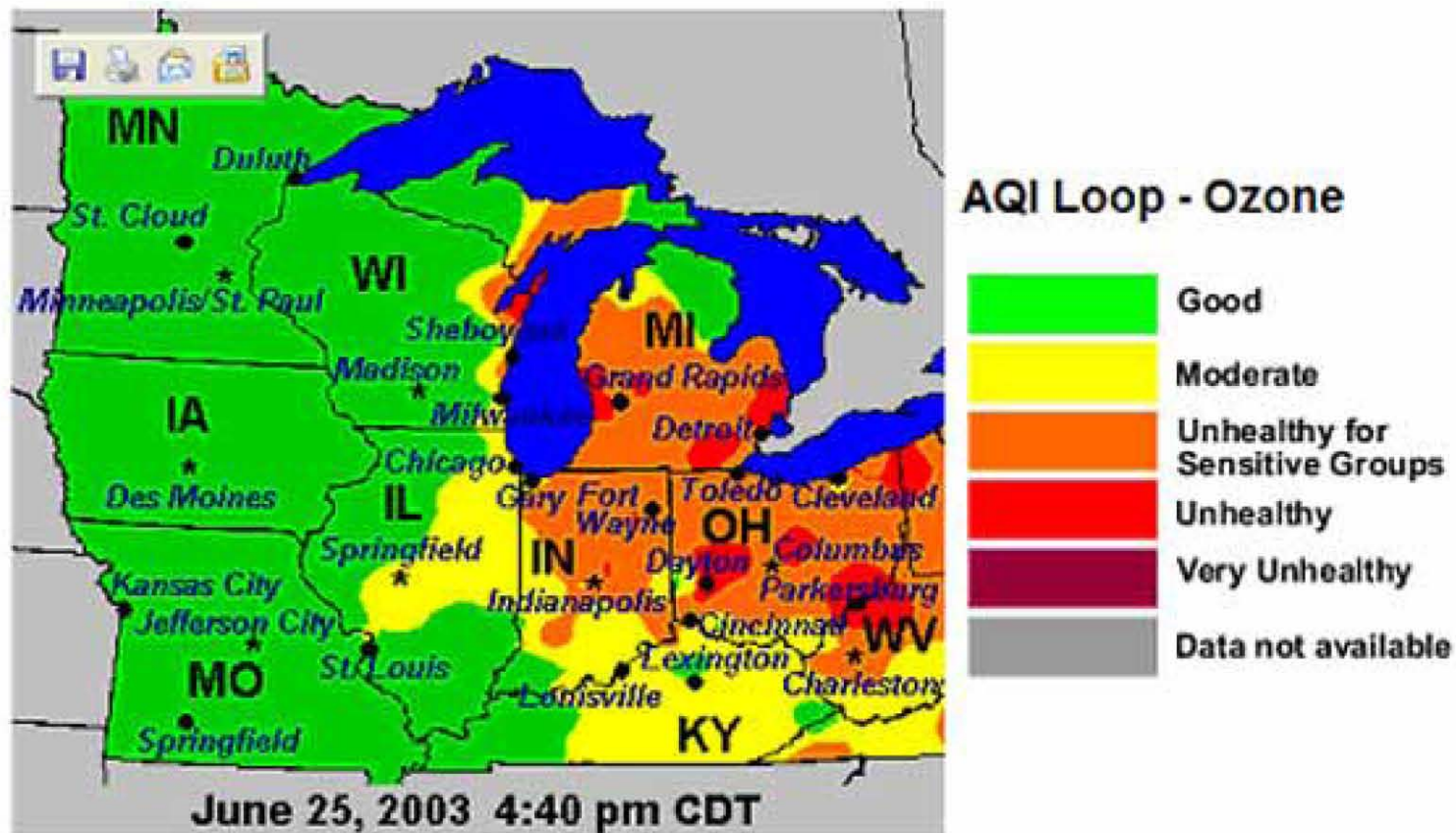
[www.airnow.gov](http://www.airnow.gov)

## Midwest Ozone Maps for June 25, 2003



[www.airnow.gov](http://www.airnow.gov)

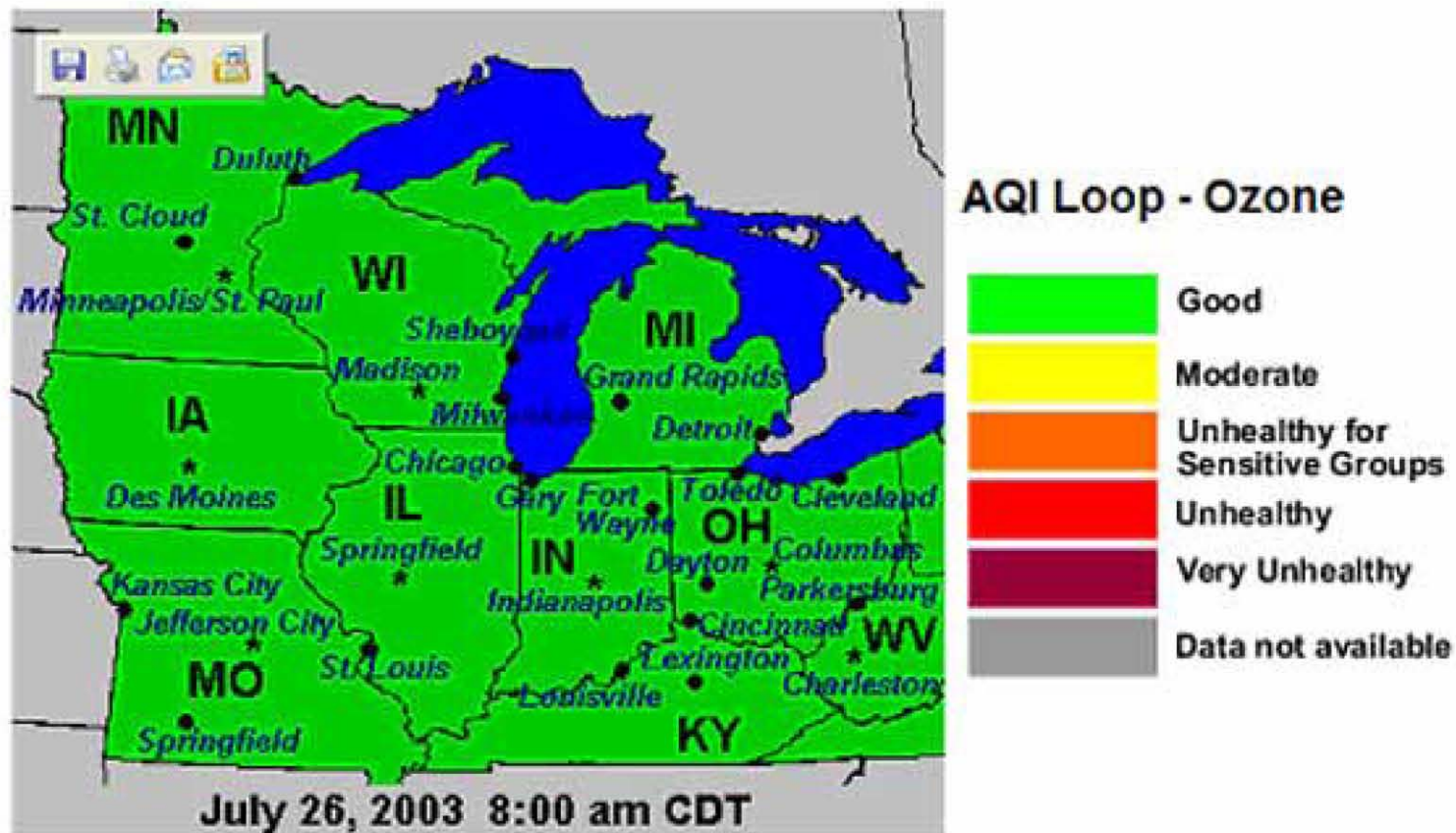
## Midwest Ozone Maps for June 25, 2003



[www.airnow.gov](http://www.airnow.gov)



## Midwest Ozone Maps for July 26, 2003



[www.airnow.gov](http://www.airnow.gov)

# Things You Can Do

1. Check the Air Quality Index.





# Things You Can Do

1. Check the Air Quality Index.
2. Take it easier when you are active outside and the air is polluted.





# Things You Can Do

1. Check the Air Quality Index.
2. Take it easier when you are active outside and the air is polluted.
3. Reduce your exposure to polluted air by changing when or where you exercise.





# Things You Can Do

1. Check the Air Quality Index.
2. Take it easier when you are active outside and the air is polluted.
3. Reduce your exposure to polluted air by changing when or where you exercise.
4. Pay attention to your body.





# Help reduce pollution:

- Drive less
- Turn off lights and appliances
- Insulate your home
- Reduce heating and cooling
- Run full loads
- Purchase energy-efficient products





**AIR QUALITY INDEX**

[www.airnow.gov](http://www.airnow.gov)

***Your forecast  
to breathe by***



# **Transparencies: Civic Groups**

## **Short version**







**AIR QUALITY INDEX**

[www.airnow.gov](http://www.airnow.gov)

***Your forecast  
to breathe by***



	<b>Good</b>
	<b>Moderate</b>
	<b>Unhealthy for Sensitive Groups</b>
	<b>Unhealthy</b>
	<b>Very Unhealthy</b>

## Air pollution sources include:



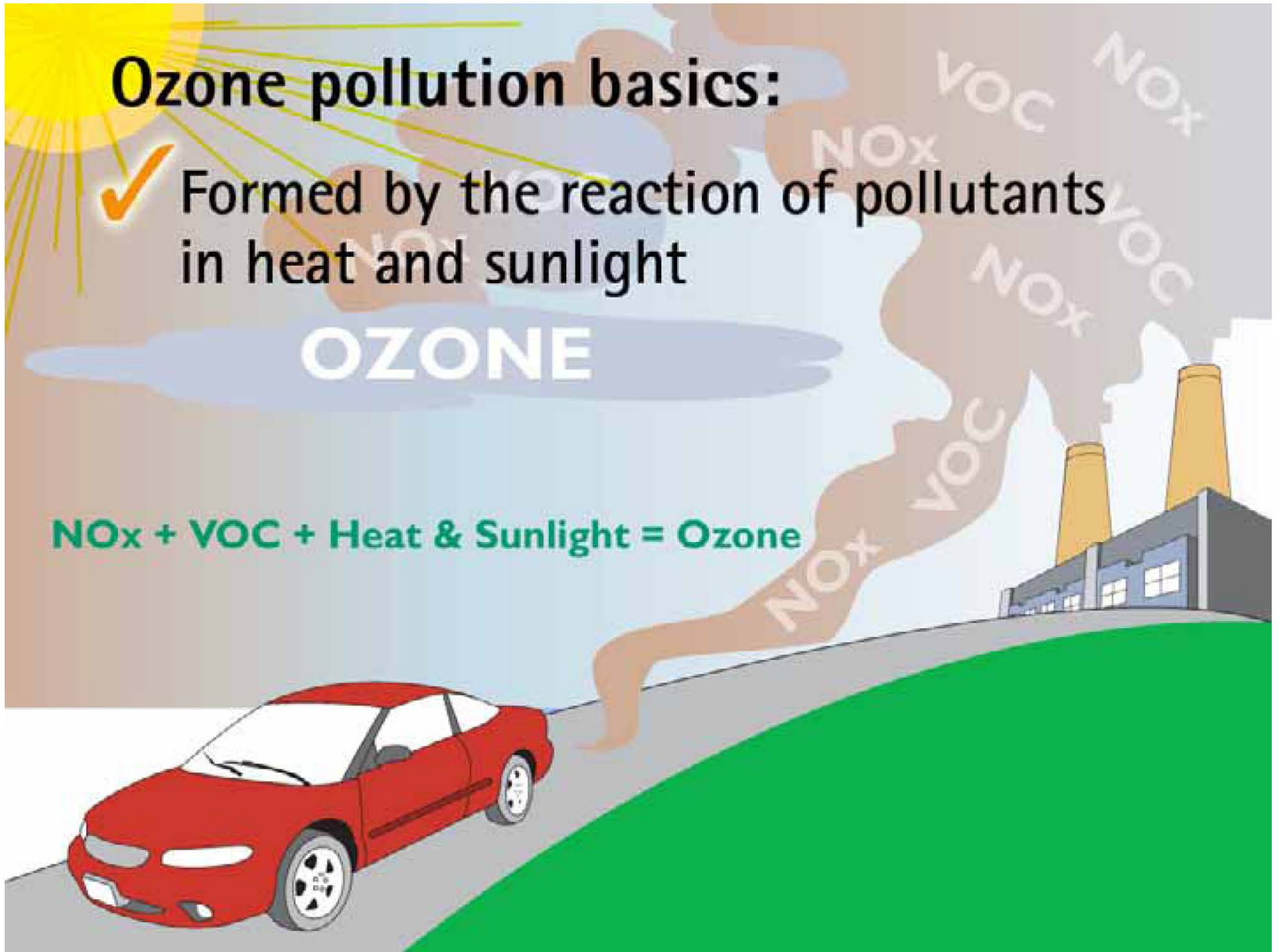


# Ozone pollution basics:

- ✓ Formed by the reaction of pollutants in heat and sunlight

**OZONE**

**$\text{NO}_x + \text{VOC} + \text{Heat \& Sunlight} = \text{Ozone}$**



A large, fluffy white cumulus cloud dominates the center of the frame, rising from a layer of lower, more horizontal clouds. The sky is a clear, vibrant blue. The lighting suggests a bright, sunny day.

**"Sometimes ozone in the air is a good thing."**



## Ozone pollution basics:

- ✓ Occurs in warmer months
- ✓ Found in urban and rural areas
- ✓ Can cause health effects
- ✓ A key ingredient of smog

## Ozone can cause:

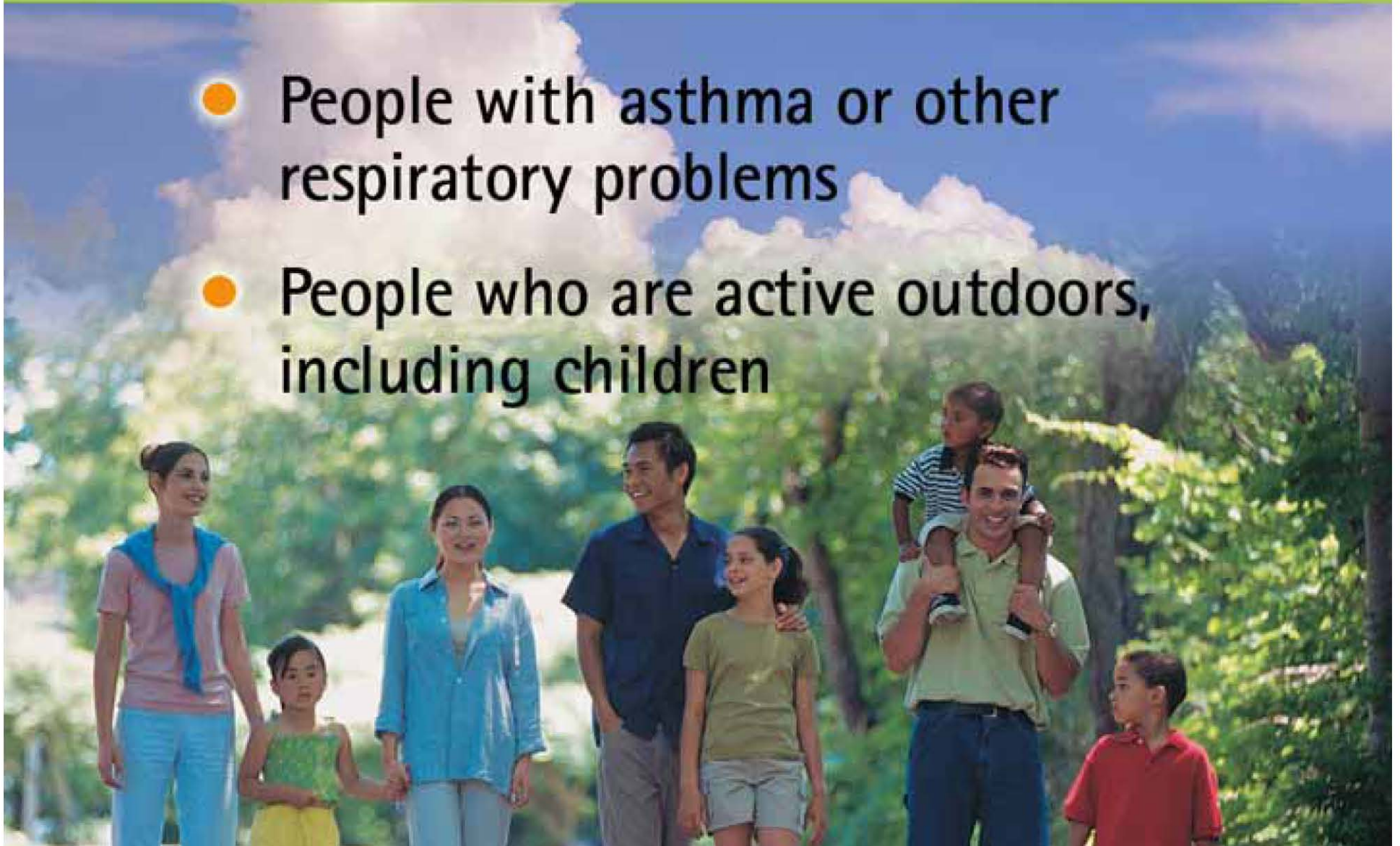
- Coughing
- Pain when taking a deep breath
- Breathing difficulties during outdoor activities
- Aggravated asthma
- Increased susceptibility
- Permanent lung damage





# Sensitive groups for ozone:

- People with asthma or other respiratory problems
- People who are active outdoors, including children



## Basic facts about particle pollution:

- ✓ Caused by human and natural sources
- ✓ May be bad near busy roads and factories
- ✓ May occur at any time of year
- ✓ May be especially bad in winter
- ✓ May be elevated outdoors and indoors



# Particle pollution:

- ✓ Consists of microscopic particles of dust, dirt, smoke, liquid droplets
- ✓ May penetrate deep into the lungs
- ✓ Can cause serious health effects



# Particle pollution can:

## ...Cause:

- Coughing
- Difficult or painful breathing
- Chronic bronchitis
- Premature death in people with heart or lung disease

## ...Aggravate:

- Asthma
- Heart disease



# Sensitive groups for particle pollution:

- People with heart or lung diseases
- Older adults
- Children





# Things You Can Do

1. Check the Air Quality Index.
2. Take it easier when you are active outside and the air is polluted.
3. Reduce your exposure to polluted air by changing when or where you exercise.
4. Pay attention to your body.





# Help reduce pollution:

- Drive less
- Turn off lights and appliances
- Insulate your home
- Reduce heating and cooling
- Run full loads
- Purchase energy-efficient products





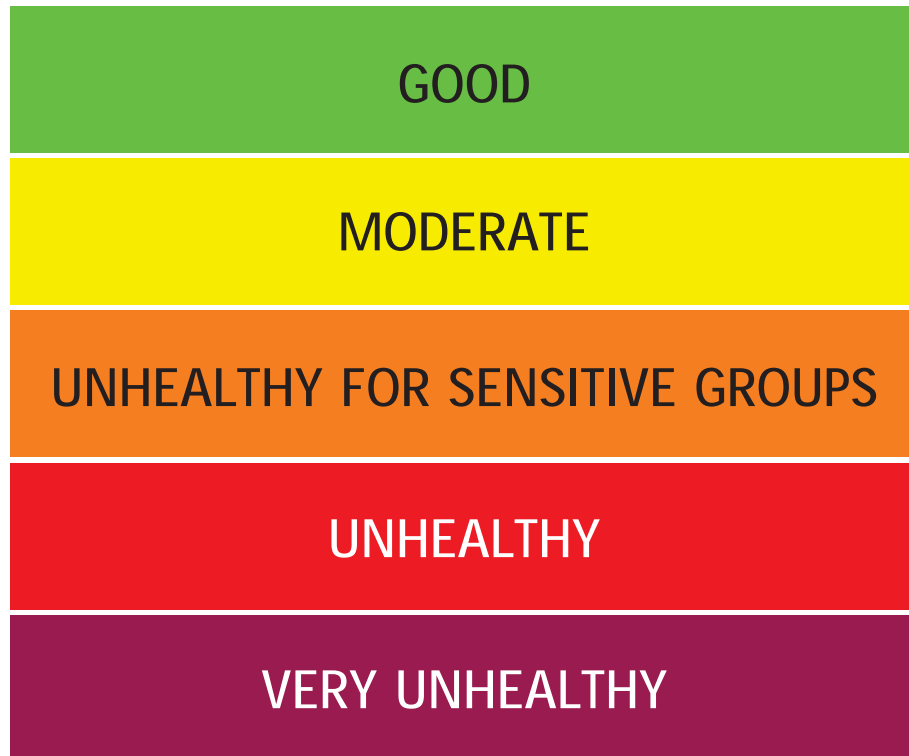
**AIR QUALITY INDEX**  
[www.airnow.gov](http://www.airnow.gov)

***Your forecast  
to breathe by***





# Additional Resources for Weathercasters



# Air Pollution and Health:

## Key Facts for Weathercasters

Like the weather, local air quality can affect people's daily lives. Millions of people live in areas where air pollution can cause serious health problems. Ground-level ozone and particle pollution are the two key air pollutants that pose health concerns in the United States.

**Health effects of ozone.** Ground-level ozone, a component of smog, can aggravate asthma and bronchitis and cause coughing, throat irritation, chest tightness, wheezing, shortness of breath, painful or difficult breathing, and premature aging of the lungs.

**Health effects of particle pollution.** Particle pollution, also a component of smog, can irritate the eyes, nose, and throat; cause chronic bronchitis, coughing, chest tightness, shortness of breath, and painful or difficult breathing; aggravate asthma; and even result in premature death in people with heart or lung disease. Particle pollution may be worse near busy roads or factories, and unhealthy levels may occur outdoors or indoors.

**Some people are particularly at risk for health problems from air pollution.** People with lung diseases, and children and adults who are active outdoors, are at greater risk from ground-level ozone. People with heart or lung disease, older adults, and children are at greater risk from particle pollution.

**How people can protect their health from the effects of air pollution.** To help protect their health from ozone and particle pollution, people can check the Air Quality Index daily, and take it easier when the air is polluted and they are active outside. They can also choose to exercise outdoors when ozone or particle pollution levels are lower, and exercise away from busy roadways to avoid particle pollution. If someone is having difficulty breathing or chest pain, he or she should stop strenuous activity and do something less active instead. People with asthma or lung disease should check with their doctors if they have any symptoms. People with heart disease should check with their doctor before engaging in vigorous outdoor exertion when particle levels are high.

**Weather, air pollution, and health.** Particle pollution may occur at any time of year, but may be worse in the winter. Ozone is of most concern in warmer months, since sunlight and warm temperatures increase ozone formation. Wind can move air pollution away from its source, making the air cleaner in that area, and blow the pollution hundreds of miles away. High pressure systems and temperature inversions can keep air pollution in one location.

**Sources of ground-level ozone.** Ozone is formed when certain pollutants (nitrogen oxides [NO<sub>x</sub>] and volatile organic compounds [VOC]) react in the presence of heat and sunlight. Sources of NO<sub>x</sub> and VOC include vehicle exhaust, industrial emissions, gasoline vapors, and chemical solvents.

**Sources of particle pollution.** Particle pollution consists of microscopic particles of dust, dirt, smoke, and liquid droplets. Particle pollution may be caused by human activities (such as emissions from vehicles, factories, or power plants) or natural sources (such as forest fires or volcanic eruptions).

**Studies on the health effects of air pollution.** Results of many scientific studies over several decades provide compelling and consistent evidence about how air pollution can affect people's health. For example:

- In a study on children's health, the California Air Resources Board tracked air pollution exposure and the health of approximately 5,500 children from twelve different communities in southern California for 10 years (1993 to 2003). The findings suggest that air pollution harms children's

lungs for life, and that air pollution may actually cause, not only aggravate, asthma (Peters, 2004).

- A study of 500,000 adults in over 100 American cities found that prolonged exposure to fine particle pollution significantly increases the risk of dying from lung cancer and cardiopulmonary causes (Pope et al., 2002).
- Policies to reduce car traffic during the Olympics also reduced peak ozone concentrations by 28 percent and hospitalizations for asthma by almost 20 percent (Friedman et al., 2001).
- A study of 5,000 people in the Netherlands from 1986 to 1994 found that people living near a main road and exposed to traffic-related particle pollution were almost twice as likely to die from heart or lung disease compared to people living further from traffic (Hoek et al., 2002).
- Increases in particle pollution have been associated with a rise in the incidence of asthma attacks among adults with asthma (Desquerox et al., 2002).
- A study in Erie County, New York (excluding the city of Buffalo) found that children living in neighborhoods with heavy truck or trailer traffic within 200 meters of their homes had increased risks of asthma hospitalization (Lin et al., 2002).
- During the year that a steel mill in Utah Valley was temporarily closed, particle pollution dropped by half, and children's hospital admissions for respiratory problems were two to three times lower than usual (Pope, 1989).

---

*Reference information for the above studies and additional health studies is included in Supplementary Air Quality Resources in this Toolkit.*

# Tips for Weathercasters:

## How to Introduce AQI Forecasts to Your Viewers

- Include AQI information in your forecast every day. You can refer to air quality or you can mention the pollutants—ozone and particles—to draw a distinction between the two.
- Use key messages along with a supporting health message (what actions people should take) in your on-air script.

### *Sample Script (Ozone forecast is code orange):*

- “Tomorrow’s forecast is code orange—that means air quality is unhealthy for sensitive groups. The primary pollutant of concern is ozone.
- If you are in a sensitive group, including people with lung disease (such as asthma), or active adults and children, cut back your strenuous outside activities or reschedule them when air quality is better. You might want to go for a walk instead of a jog.”

### *Sample Script (Particle pollution forecast is code orange):*

- “The air quality forecast for tomorrow is unhealthy (or code orange) for particle pollution, which means air quality is unhealthy for people with heart or lung disease (such as asthma), older adults, and children.
  - If you are in a sensitive group, including people with heart or lung disease (such as asthma), older adults, and children, cut back your strenuous activities or reschedule them when air quality is better. Coaches, it’s a good idea to rotate your players, especially if any have asthma.”
- Offer a link to the AIRNow web site on your station’s web site and mention it in your on-air script for people who would like more information on air quality issues.

### *For Example:*

- For more real-time information on air quality, go to our web site at [Insert site] or EPA’s web site at: [www.airnow.gov](http://www.airnow.gov)
- Use graphics to help relay your on-air message. Graphics that you can adapt or use “as is” can be downloaded from EPA’s web site at: [www.airnow.gov](http://www.airnow.gov) (then search on “graphics”)

# Air Quality Index: Fact Sheet for Weathercasters

Developed by the U.S. Environmental Protection Agency (EPA), the Air Quality Index, or AQI, provides a standard, uniform index for reporting daily air quality. The AQI helps make daily air quality information as easy to understand as weather forecasts. It is now used in local air quality reports and forecasts nationwide to tell the public how clean or polluted the air is, and how they can protect their health at different levels of pollution.

## How the AQI Works

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. AQI values below 100 are generally thought of as satisfactory. 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, some 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.

## AQI Colors

EPA has assigned a specific color to each AQI category to make it easier for people to quickly understand whether air pollution is reaching unhealthy levels in their communities. For example, the color orange communicates that conditions are “unhealthy for sensitive groups,” while red means that conditions may be “unhealthy for everyone,” and so on. Over time, as local air quality reports become more available, the public is becoming increasingly familiar with the meaning of the AQI colors.

## How a Community’s AQI is 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 in that area.

## When and How the AQI is 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 when warranted 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 are the same everywhere in the United States. AQI reports for areas across the U.S. are always available on the Internet at EPA’s AIRNow web site: [www.airnow.gov](http://www.airnow.gov). The AQI is also frequently reported in local newspapers, on local television and radio stations, via e-alert systems, and on many state and local telephone hotlines.

## 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.

## Introducing AQI Forecasts to Your Viewers

Increasingly, weathercasters are providing local air quality information and forecasts as part of their daily TV and radio weather reports. Because of the connection between air quality and weather, weathercasts provide a natural venue for communicating air quality information to the public. The AQI provides an important tool to help you do this efficiently and effectively. Including air quality information in a weather report takes just a few seconds and provides an important public health service.

You can find daily information on local air quality and forecasts to use in your weather reports on EPA's AIRNow web site at [www.airnow.gov](http://www.airnow.gov)

Standard advisory statements for each AQI level are also available at: [www.airnow.gov](http://www.airnow.gov). Search for *Air Quality Guide for Particle Pollution* - click on the (usually first) entry entitled "AIRNow - TV Weather - *Air Quality Guide for Particle Pollution* - Air Quality Index (AQI) At-A-Glance Messages". This version of the Guide includes statements for particle pollution, ozone, and combined particle pollution and ozone.

Note that these advisory statements have been carefully crafted based on data from health studies and should not be altered. Also, note that the statements for ozone and particle pollution advise people to take it easier outside when the air is polluted, but do not advise them to remain indoors (with one exception: the advisory statement to sensitive groups when particle pollution is at hazardous levels, which are rarely reached in the U.S.).

Including daily AQI information in your forecast will allow the public to become familiar with the AQI and know that your forecast is a reliable source for local air quality information.

# AIRNow Air Quality Mapping and Forecasting

## Introduction

EPA's AIRNow program collects air quality data and smog observations and forecasts for over 300 metropolitan areas across the country. Gridded data maps are available free to weather service providers. These data provide four types of information:

- ***Air quality forecasts.*** Similar to maximum temperature forecasts, these air quality forecasts represent the maximum smog levels expected for the current day, next day, and beyond. The forecasts are issued by meteorologists in each state, collected by the AIRNow program, and distributed free of charge to weather providers.
- ***Current air quality conditions.*** Like current temperature, the current air quality values provide the highest Air Quality Index (AQI) reading observed in each city.
- ***Previous day's AQI maximum.*** This data value provides the peak AQI reached at any monitor in each city.
- ***Educational resources for broadcasters.*** The AIRNow web site includes air quality information specifically for radio/television broadcasters at: [www.airnow.gov](http://www.airnow.gov) (click on "Weathercasters" on the left side of the web page; also from the main AIRNow web page, search on "media").

## Forecast Frequency and Data Files

Air quality agencies throughout the United States typically issue their forecasts once or twice a day. Agencies usually submit the forecasts in the late morning to early afternoon (local time), with all forecasts completed by 1700 ET (2100 UTC) each day. Current observations are updated hourly. Data are stored in an ASCII file that contains the latest forecasts and observations for all cities.

The AIRNow Data Management Center's FTP Internet site includes two sets of data. One data set — "outgoing\forecasts" — typically contains forecasts for the current and next day; for some cities, the file contains forecasts for two to five days. Current observations for each city and the previous day's maximum AQI readings are also provided. The second data set — "outgoing\grids" — contains one hour's worth of gridded observations (or previous day's peak). Both of these data sets can be accessed through the Data Management Center's FTP Internet site at: <ftp.airnowdata.org>. Additional information on file format specifications and forecast issuance is provided at: [www.airnow.gov](http://www.airnow.gov) (click on "Weathercasters" on the left side of the web page and choose "AIRNow Fact Sheet").

## Guidelines for Using AIRNow Data, Forecasts, and Advisories

- Air quality data, forecast values, and advisory statements should be disseminated as received and not altered in any way.
- All end-users who receive air quality, forecast, and advisory information should be provided with the most current data available when possible. Current updates are particularly important when advisories are issued by state/local air quality agencies. The AIRNow program updates all data hourly.
- State and local agencies are the authority for issuing air quality forecasts and advisories.
- Credit should be given to the appropriate source—either EPA AIRNow or the state/local air quality agency if known.

- AIRNow observational data are not fully verified or validated and should be considered preliminary. As such, they should not be used to formulate or support regulation, guidance, or any other government or public decision.
- Observed air quality and forecast values should be disseminated in accordance with the Air Quality Index and corresponding RGB colors as follows:

AQI Level	Color	R	G	B
Good	Green	0	228	0
Moderate	Yellow	255	255	0
Unhealthy for Sensitive Groups	Orange	255	126	0
Unhealthy	Red	255	0	0
Very Unhealthy	Purple	153	0	76
Hazardous	Maroon	76	0	38

Questions regarding AIRNow data, forecasts, and advisories should be directed to:  
[AIRNowDMC@sonomatech.com](mailto:AIRNowDMC@sonomatech.com) and [white.johne@epa.gov](mailto:white.johne@epa.gov)

# Supplementary Air Quality Resources

## The Air Quality Index

**EPA's AIRNow Web site.** The U.S. EPA's AIRNow web site provides the public with easy access to air quality information. The web site offers real-time air quality conditions and daily air quality forecasts for more than 300 cities across the U.S. It also provides links to more detailed state and local air quality web sites, and supplies real-time images of air quality and visibility via webcams in a number of locations. Available at: [www.airnow.gov](http://www.airnow.gov)

The AIRNow web site also provides a chart to easily link the AQI colors with air quality and health risks. This chart and related information can be found by visiting the AIRNow web site homepage ([www.airnow.gov](http://www.airnow.gov)) then clicking on "Air Quality Index" on the menu bar on the left; the chart is on the bottom of this page.

EPA's AIRNow web site also includes a children's section - see: [www.airnow.gov](http://www.airnow.gov) (click on "Kids" on the menu bar on the left). This web site explains the Air Quality Index (AQI) to children. It uses games, targeted for K-1 and ages 7-10, to teach children about the AQI and how they can moderate their activity to play safely outside when air pollution is elevated.

**EPA AQI Publications.** Available in pdf and html formats (print versions can be requested free of charge) at: [www.airnow.gov](http://www.airnow.gov) - click on "Publications" on the menu bar on the left for the following publications, among others:

- ***Air Quality Index - A Guide to Air Quality and Your Health.*** Explains EPA's Air Quality Index (AQI) and the health effects of major air pollutants.
- ***Air Quality Guide for Ozone.*** Provides information about ways to protect health when ozone levels reach the unhealthy range, and ways to help reduce ozone air pollution.
- ***Air Quality Guide for Particle Pollution.*** Provides information about ways to protect health when particle pollution levels reach the unhealthy range, and ways to help reduce particle air pollution.

## Air Quality Mapping and Forecasting

**EPA Publications.** Available at [www.airnow.gov](http://www.airnow.gov) - click on "Publications" on the menu bar on the left for the following publications:

- ***Guidelines for Developing an Air Quality (Ozone and PM2.5) Forecasting Program.*** Provides technical guidance to help air quality agencies develop, operate, and evaluate ozone and PM2.5 forecasting programs. Includes: 1) background information about ozone and PM2.5 and the weather's effect on these pollutants; 2) a list of how air quality forecasts are currently used; 3) a summary and evaluation of methods currently used to forecast ozone and PM2.5; 4) steps to develop and operate an air quality forecasting program; and 5) information on the level of effort needed to set up and operate a forecasting program.
- ***Ozone Monitoring, Mapping, and Public Outreach: Delivering Real-Time Ozone Information to Your Community.*** Provides step-by-step instructions about creating an ozone monitoring, mapping, and public outreach program at the local community level.



- **Guideline for Reporting of Daily Air Quality - Air Quality Index (AQI).** Provides guidance to aid local agencies for reporting air quality using the AQI, as required in Part 58.50 of 40 CFR and according to Part 58 of 40 CFR, Appendix G.

**TV Weather Links and Reference Materials for Air Quality.** Available at: [www.airnow.gov](http://www.airnow.gov) - click "Weathercasters" on the menu bar on the left for the following materials, among others:

- **Talking Points for Meteorologists.** This document summarizes the health messages and recommended actions for ozone and particle pollution at each AQI level.
- **Myths and Facts for Meteorologists.** This page contains basic information about ozone and particle pollution and their health impacts.

## Air Pollution and Health

**Scientific Publications and Related Reports.** Key reports on air pollution and health include:

- The American Lung Association. All of the ALA reports listed below are available at: [www.lungusa.org/site/pp.asp?c=dvLUK900E&b=36864](http://www.lungusa.org/site/pp.asp?c=dvLUK900E&b=36864)  
***The American Lung Association State of the Air: 2004***  
***Selected Key Studies on Ozone and Health (1997-2001)***  
***Selected Key Studies on Particulate Matter and Health (1997-2001)***  
***Annotated Bibliography of Recent Studies on the Health Effects of Air Pollution (2001-2002)***
- Balbus, J. and Y. Chee. 2004. ***Dangerous Days of Summer.*** Environmental Defense Fund. Ranks 50 major population centers in the U.S. where air pollution impacts the greatest number of children. Available at: [www.environmentaldefense.org/dangerousdays.cfm](http://www.environmentaldefense.org/dangerousdays.cfm).
- Desquereux et al., 2002. ***Short-Term Effects of Low-Level Air Pollution on Respiratory Health of Adults Suffering from Moderate to Severe Asthma.*** Environmental Research Vol. 98: 29-37. This study found that increases in particle pollution have been associated with a rise in the incidence of asthma attacks among adults with asthma.
- Friedman, M.S., K.E. Powell, L. Hutwagner, L.M. Graham, W.G. Teague. 2001. ***Impact of Changes in Transportation and Commuting Behaviors during the 1996 Summer Olympic Games in Atlanta on Air Quality and Childhood Asthma.*** J. Am. Med. Assoc. 285(7):897-905 (February). Policies to reduce car traffic during the Olympics also reduced peak ozone concentrations by 28 percent and hospitalizations for asthma by almost 20 percent.
- Gauderman, W.J. et al. 2004. ***The Effects of Air Pollution on Lung Development from 10 to 18 Years of Age.*** New England Journal of Medicine 351:1057-1067.
- Hoek, G., B. Brunekreef, S. Goldbohm, P. Fischer, P.A. van den Brandt. 2002. ***Association Between Mortality and Indicators of Traffic-Related Air Pollution in the Netherlands: A Cohort Study.*** The Lancet 19:1203-1209. A study of 5,000 people in the Netherlands from 1986 to 1994 found that people living near a main road and exposed to traffic-related particle pollution were almost twice as likely to die from heart or lung disease compared to people living further from traffic.
- Hricko, A., K. Preston, H. Witt, J. Peters. 1999. ***Air Pollution and Children's Health.*** Chapter excerpt from the 1999 Health Atlas of Southern California. Available at: [http://hydra.usc.edu/scehsc/coep/coep\\_atlaschap.asp](http://hydra.usc.edu/scehsc/coep/coep_atlaschap.asp)

- Kleinman, M. 2000. *The Health Effects of Air Pollution on Children*. Department of Community and Environmental Medicine University of California, Irvine. South Coast Air Quality Management District. Available at: [www.aqmd.gov/forstudents/health\\_effects\\_on\\_children.pdf](http://www.aqmd.gov/forstudents/health_effects_on_children.pdf)
- Lin, S., J.P. Munsie, S.-A. Hwang, E. Fitzgerald, M.R. Cayo. 2002. *Childhood Asthma Hospitalization and Residential Exposure to State Route Traffic*. Environmental Research Vol. 88: 73-81. A study in Erie County, New York (excluding the city of Buffalo) found that children living in neighborhoods with heavy truck or trailer traffic within 200 meters of their homes had increased risks of asthma hospitalization.
- Peters, J.M. 2004. *Epidemiologic Investigation to Identify Chronic Effects of Ambient Air Pollutants in Southern California*. University of Southern California, Los Angeles; California Air Resources Board. This prospective study of about 5,500 children living in Southern California found serious adverse impacts to children's lung function from exposure to air pollution. Study overview available at: [www.arb.ca.gov/research/chs/over.htm](http://www.arb.ca.gov/research/chs/over.htm) . Abstract available at: [www.arb.ca.gov/research/abstracts/94-331.htm](http://www.arb.ca.gov/research/abstracts/94-331.htm)
- Pope, C.A., R.T. Burnett, M.J. Thun, E.E. Calle, D. Krewski, K. Ito, G.D. Thurston. 2002. *Lung Cancer, Cardiopulmonary Mortality, and Long-term Exposure to Fine Particulate Air Pollution*. J. Am. Med. Assoc. 287(9). A study of 500,000 adults in over 100 American cities found that prolonged exposure to fine particle pollution significantly increases the risk of dying from lung cancer and cardiopulmonary causes.
- Pope, C.A. 1989. *Respiratory Disease Associated with Community Air Pollution and a Steel Mill, Utah Valley*. Am. J. Public Health 79(5):623-8. During the year that a steel mill in Utah Valley was temporarily closed, particulate pollution dropped by half, and children's hospital admissions for respiratory problems were two to three times lower than usual.

#### **"Plain English" Publications**

The following U.S. EPA publications are available in pdf and html formats at: [www.airnow.gov](http://www.airnow.gov) - click on "Publications" on the menu bar on the left (print versions can be requested free of charge):

- **Particle Pollution and Your Health**. Describes who is at risk from exposure to particle pollution, what health effects may be caused by particles, and simple measures that can be taken to reduce health risk.
- **Ozone and Your Health**. Describes who is at risk from exposure to ozone, what health effects are caused by ozone, and simple measures to reduce health risk.
- **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 Kids Safe from Sun and Smog**. Discusses summer health hazards that pertain particularly to children and includes information about EPA's Air Quality Index and UV Index tools.
- **Ozone: Good Up High, Bad Nearby**. Provides basic information about ground-level and high-altitude ozone.

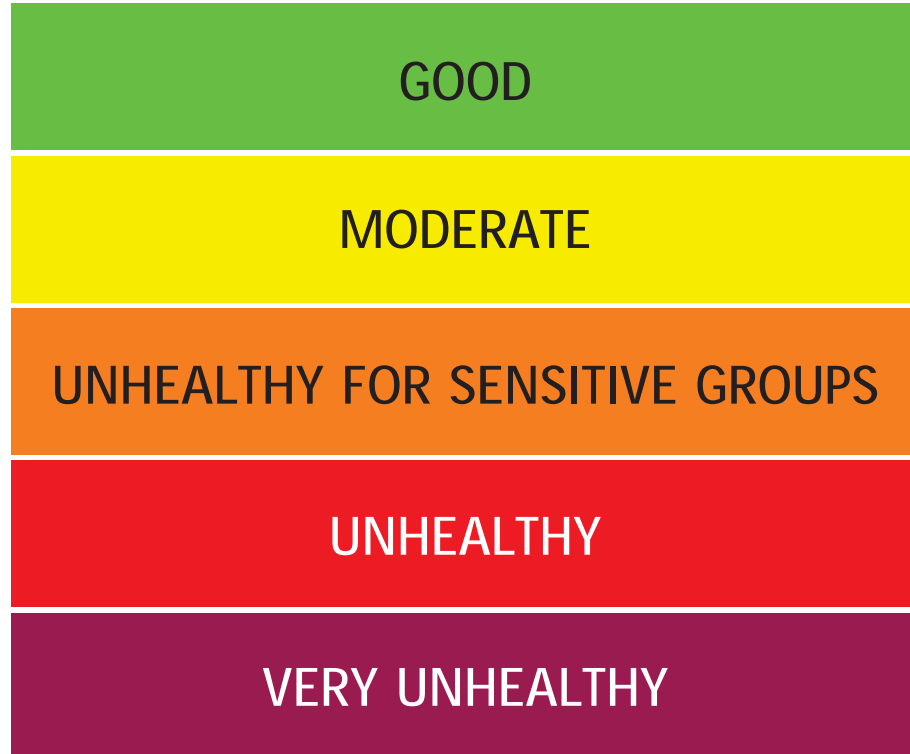
The following publication on smoke and air pollution was produced by the state of California:

- ***Wildfire Smoke: A Guide for Public Health Officials.*** This publication describes the health effects of smoke and provides detailed guidance on how to protect public health from wildfire smoke. Contact: [www.arb.ca.gov](http://www.arb.ca.gov)

### ***Links***

- ***Southern California Environmental Health Sciences Center.*** Contains links to press releases, notices, and summaries of studies related to air pollution and health, as well as other environmental health research areas. Available at: <http://hydra.usc.edu/scehsc/press.asp>
- ***Air...ing the Truth About Indoor and Outdoor Air Pollution.*** American Lung Association web page providing basic facts about the numbers of people affected by air pollution. Available at: [www.lungusa.org/site/pp.asp?c=dvLUK900E&b=107829](http://www.lungusa.org/site/pp.asp?c=dvLUK900E&b=107829)

# Teacher Resources



# Introduction

Because children's lungs and bodies are still developing, children are one of the sensitive groups at risk for health effects of air pollution. Air quality education empowers students and their families to know why and how they should protect their health when the air is polluted. The materials in this "Teachers" section of the toolkit, compiled by the U.S. Environmental Protection Agency, contain activities and resources you can use to teach students about the connections between weather, air pollution, and health concerns, as well as the actions they can take to protect their health and reduce pollution. The activities meet national education standards for science and health (see below).

This "Teachers" section of the toolkit includes:

- Easy-to-implement activities appropriate for:
  - Grades 3 through 5
  - Grades 6 through 8
- Background information and resources:
  - Air Pollution and Health
  - What Is the Air Quality Index?
  - Additional Air Quality Resources for Teachers

## Education Standards

The lesson activities in this toolkit meet the following National Science Educators Standards ([www.nap.edu/html/nses/html](http://www.nap.edu/html/nses/html)) and National Health Education Standards ([www.aahperd.org/aahe/pdf\\_files/standards.pdf](http://www.aahperd.org/aahe/pdf_files/standards.pdf)) (developed by the Joint Committee on National Health Education), as verified by an education expert:

Activity	Education Standards
Breathing, Exercise, and Air Pollution	<i>Unifying Concepts and Processes</i> Evidence, Models, and Explanation Constancy, Change and Measurement <i>Science as Inquiry</i> Abilities Necessary to do Scientific Inquiry <i>Life Science</i> Organisms and Their Environments <i>Science in Personal and Social Perspectives</i> Personal Health Types of Resources



## Education Standards (cont.)

Activity	Education Standards
Particle Pollution: How Dirty is the Air We Breathe?	<i>Unifying Concepts and Processes</i> Evidence, Models, and Explanation <i>Science as Inquiry</i> Abilities Necessary to do Scientific Inquiry <i>Life Science</i> Organisms and Their Environments <i>Science in Personal and Social Perspectives</i> Types of Resources Changes in Environments
Air Pollution: What's the Solution? The Ozone Between Us	<i>Science as Inquiry</i> Abilities Necessary to do Scientific Inquiry <i>Life Science</i> Organisms and Their Environments <i>Science in Personal and Social Perspectives</i> Types of Resources Changes in Environments
Tracking Air Quality	<i>Unifying Concepts and Processes</i> Evidence, Models and Explanations <i>Science as Inquiry</i> Abilities Necessary to do Scientific Inquiry Understandings About Scientific Inquiry <i>Science in Personal and Social Perspectives</i> Personal Health Populations, Resources and Environments Risks and Benefits
Smog Alert	<i>Unifying Concepts and Processes</i> Evidence, Models and Explanations <i>Science as Inquiry</i> Abilities Necessary to do Scientific Inquiry Understandings About Scientific Inquiry <i>Science in Personal and Social Perspectives</i> Personal Health Populations, Resources and Environments Risks and Benefits

## Education Standards (cont.)

Activity	Education Standards
What's "Riding the Wind" in Your Community?	<i>Unifying Concepts and Processes</i> Evidence, Models and Explanations <i>Science as Inquiry</i> Abilities Necessary to do Scientific Inquiry Understandings About Scientific Inquiry <i>Science in Personal and Social Perspectives</i> Personal Health Populations, Resources and Environments Risks and Benefits
Smog City	<i>Unifying Concepts and Processes</i> Evidence, Models and Explanations <i>Science as Inquiry</i> Abilities Necessary to do Scientific Inquiry Understandings About Scientific Inquiry

# **Air Quality Activities: Grades 3-5**

# Breathing, Exercise, and Air Pollution

## Summary

Air is essential to life. Humans and other animals use the oxygen they breathe along with the food they eat to produce energy. Increased physical activity raises the body's energy demand, which increases consumption of oxygen and nutrients. When we are active, we notice an increase in breath rate. This is our respiratory system's response to increased energy demand.

More air flowing in and out of our lungs can increase our exposure to air pollution. As a result, active children, adults, and athletes are more vulnerable to the unhealthy impacts of air pollution. During episodes of unhealthy levels of air pollution, public health officials may advise that people reduce their outdoor activities (e.g., soccer, running).

## Grade Level

Grades 3-5

## Estimated Time

30 minutes

## Materials

Stopwatch, watch, clock, or timer for each team (if using the classroom clock, the teacher or a student can be the timer for the whole class if there are not enough watches for each group)

Student Worksheet (included)

## Relevant National Science and Health Education Standards

*Unifying Concepts and Processes*

Evidence, Models, and Explanation

Constancy, Change and Measurement

*Science as Inquiry*

Abilities Necessary to do Scientific Inquiry

*Life Science*

Organisms and Their Environments

*Science in Personal and Social Perspectives*

Personal Health

Types of Resources

## Objective

Students will:

- Observe and record how breathing changes with physical activity

## Directions

1. Have students form research teams of 2-3 persons. In the 2-person groups, one student will time and record data while the other student will be the research subject. In the 3-person groups, one student will time, one will record data, and the last will be the research subject. If time permits, each team member can take a turn as the research subject.
2. Hand out the Student Worksheet to each team. Hand out the stopwatches, if using them, or make sure the person acting as the timekeeper is ready. Each team will write their prediction on the Worksheet, answering the question, "Does a person breathe more or less during exercise?"
3. *Breathing at Rest.* The subject is sitting down. The timer/recorder will give the subject the following instructions. "When I say start, begin counting your breaths. Breathe normally." The timer tells the subject to start. After 1 minute, the timer asks the subject how many breaths he or she has taken. The timer records the number on the Worksheet under the subject's name.
4. *Breathing during Exercise.* The timer/recorder tells the subject, "When I say start, begin jumping up and down. After 15 seconds, I will say stop. Stop jumping and immediately start counting your breaths." The timer tells the subject to start. After 15 seconds, the timer tells the subject to stop jumping. After an additional 15 seconds, the timer asks the subject for a breath count. The recorder writes the number of breaths on the worksheet and multiplies it by 4. The timer asks the subject, "Did you breathe more or less when you exercised?" The recorder writes down the answer.
5. Repeat Steps 3 and 4 until each team member has been the subject, if time allows for switching roles.
6. *Comparing results.* Have each team make a chart or graph showing the results of their research. Have one member of the team present their prediction and results to the class. Discuss the variety of results. What other variables could cause widely varying results (e.g., physical condition, respiratory illness such as asthma)? How could the results for the whole class could be shown?

## Extension

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, if not too disruptive.

## Acknowledgments

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



# Student Worksheet – Breathing and Exercise

Prediction: “Does a person breathe more or less during exercise such as jumping up and down?”

How much more or less? \_\_\_\_\_ (For example: Half as much? Twice as much?)

A. Subject A: \_\_\_\_\_ (name)

Breaths in one minute at rest \_\_\_\_\_

Breaths after 15 seconds of exercise \_\_\_\_\_ x 4 = \_\_\_\_\_

Is the breathing more or less after jumping? \_\_\_\_\_

B. Subject B: \_\_\_\_\_ (name)

Breaths during one minute at rest \_\_\_\_\_

Breaths after 15 seconds of exercise \_\_\_\_\_ x 4 = \_\_\_\_\_

Is the breathing more or less after jumping? \_\_\_\_\_

C. Subject C: \_\_\_\_\_ (name)

Breaths in one minute at rest \_\_\_\_\_

Breaths after 15 seconds of exercise \_\_\_\_\_ x 4 = \_\_\_\_\_

Is the breathing more or less after jumping? \_\_\_\_\_

D. Present your results as a chart or graph.

E. Why might it be important to be less active when air quality levels are unhealthy?

What steps could be taken to limit activity and excessive strain on our lungs? (Discuss with class. *Possible answer:* Walk instead of run)

# Particle Pollution: How Dirty Is the Air We Breathe?

## Summary

The atmosphere is almost completely made up of invisible gaseous substances. Most major air pollutants are also invisible, although large amounts of them concentrated in areas such as cities can be seen as smog. One often visible air pollutant is particle pollution, especially when the surfaces of buildings and other structures have been exposed to it for long periods of time, or when it is present in large amounts. Particle pollution is made up of tiny particles of solid matter and droplets of liquid, and can be produced by human activities or natural sources. Coal and oil burned by power plants and industries, and diesel fuel burned by many vehicles are the chief sources of particle pollution associated with human activities. Not all important sources are large scale, however. The use of wood in fireplaces and wood burning stoves also produces significant amounts of particle pollution in some local areas, although the total amounts are much smaller than those from vehicles, power plants, and industries. Natural sources of particle pollution include smoke from fires and volcanic ash, which can be blown about by the wind.

## Grade Level

Grades 3-5

## Estimated Time

30 minutes

## Materials

Plastic squares (5 centimeters by 5 centimeters)

Petroleum jelly

Masking tape

Blocks of wood

White paper for each child or each group of children

## Relevant National Science and Health Education Standards

*Unifying Concepts and Processes*

Evidence, Models, and Explanation

*Science as Inquiry*

Abilities Necessary to do Scientific Inquiry

*Life Science*

Organisms and Their Environments

*Science in Personal and Social Perspectives*

Types of Resources

Changes in Environments

## Objectives

Students will:

- Make a simple particle pollution tester
- Collect and observe particle pollution from the air

## Directions

1. Tell the students, "As we look outside, we often see a clear blue sky. Where is the pollution? We are going to make a simple tester for air pollution so we can see the pollution."
2. Divide the class into groups. Have each group coat their plastic square with a thin, even coat of petroleum jelly. With masking tape, fasten the square, jelly side up, to the wooden blocks.
3. Place the blocks outdoors on posts, fences, walls, and/or window sills. Leave them for 24 hours.
4. Collect the blocks. In the classroom, remove the plastic squares from the blocks. Lay them on white paper.
5. Let the students examine the pollution that collected on the petroleum jelly.
6. Have the groups record the findings of their testers.
7. Have groups share their findings with the other groups. Ask: Did you collect any dirt particles? How does your square compare to those of the other groups? In what places does the air seem to be the dirtiest?
8. Say: We have seen particle pollution where we first saw none. Clean air is important for us to be healthy. What can we do to keep the air clean? (*Possible answers:* People could drive less. We can turn off lights and equipment when we're not using them. Factories could reduce their pollution. We could use less polluting vehicles and equipment.)

## Extensions

- Have students write a paper and explain the differences they observed among the plastic squares.
- Have students take their tester home to test for particle pollution for 24 hours. Students then report to the class on their findings.
- Ask students to leave the tester outside for a week, a month (sheltered from precipitation). Students keep a journal of its progress each day and report to the class.
- Have students compile data on their findings and write the mayor about their samples.

## Reference

Holt Science 6th. Holt, Rinehart, and Winston Publishers, New York. p. 257.

## Acknowledgment

Texas Natural Resource Conservation Commission (TNRCC)  
URL: [www.tnrcc.state.tx.us/air/monops/lessons/partlesson4.html](http://www.tnrcc.state.tx.us/air/monops/lessons/partlesson4.html)

# Air Pollution: What's the Solution?

## The Ozone Between Us

### Summary

At ground level, in the Earth's atmosphere, ozone is an air pollutant that can damage human health, animals, and vegetation and is a key ingredient of smog. Many urban areas tend to have a lot of ground-level ozone, often because of local traffic and industry. Other more rural or suburban areas without major industry or large populations can have a lot of ground-level ozone if the ozone was transported by the wind from other communities. Motor vehicles, factories, and power plants are major sources of ozone pollution. This activity allows students to explore ozone levels in different areas of the country and develop an understanding of why more ozone pollution may be present in certain areas.

### Grade Level

Grades 3-5

### Estimated Time

20 minutes

### Materials

Internet access

Student Worksheet (included)

### Relevant National Science and Health Education Standards

*Science as Inquiry*

Abilities Necessary to do Scientific Inquiry

*Life Science*

Organisms and Their Environments

*Science in Personal and Social Perspectives*

Types of Resources

Changes in Environments

### Objectives

Students will:

- Discover that ground-level ozone occurs in many areas of the country
- Discover that ground-level ozone problems are often associated with population centers

## Directions

1. Have the class access the following Internet web site:  
[www.k12science.org/curriculum/airproj/lessonscore1.html](http://www.k12science.org/curriculum/airproj/lessonscore1.html)
2. On this web site, have students open the pages for two items:  
*Ozone Map*  
*Air Quality Guide for Ozone*  
  
(Note: A modified version of the Student Worksheet is included in this Toolkit)
3. With the class, answer the questions on the Student Worksheet. The students will be able to answer the questions using the *Ozone Map* and the *Air Quality Guide for Ozone*.

## Extensions

Several resources are available to obtain more information about ground-level ozone for your students. Visit the “Links” section of the above web site, and EPA’s AIRNow web site at [www.airnow.gov](http://www.airnow.gov)

A videotape entitled *Ozone DoubleTrouble* is available from the U.S. EPA that may be helpful for introducing the topic of ground-level ozone. The video discusses two ozone problems — the formation of too much ground-level ozone (discussed in this activity), and the deterioration of the protective upper-level ozone layer (not covered in this activity). (Contact: EPA Office of Air Quality Planning and Standards (OAQPS), Education and Outreach Group at: [www.epa.gov/air/oaqps/eog/contact.html](http://www.epa.gov/air/oaqps/eog/contact.html) )

## Acknowledgment

The Air Pollution: What’s the Solution? project was developed by the U.S. EPA, the Northeast States for Coordinated Air Use Management, and the Center for Innovation in Engineering & Science Education. URL: [www.k12science.org/curriculum/airproj](http://www.k12science.org/curriculum/airproj)



# Student Worksheet

## Air Pollution: What's the Solution? The Ozone Between Us

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

### Ozone Map

Review the *Air Quality Guide for Ozone*, including what the different colors mean. Then study the *Ozone Map* and answer the following questions:

1. Find Los Angeles, CA on the map. What color is it? Circle:  
Green              Yellow              Orange              Red              Purple
2. Find a city on the map that is red. Write the city and state below.
3. Find two orange cities on the map. Write the city names and states below.
4. Are there any green cities on the map? If so, list three.
5. Where are most of the red and orange areas on the map, near or far away from cities?
6. Write a sentence that compares the kinds of places where green areas are found and the kind of areas where red and orange areas are found.
7. Can you think of any reasons why more ozone pollution would be found in the red areas?
8. What are the cautions, or health concerns, for orange areas? If you lived in an area with orange ozone levels, do you think you would be affected? How?

# **Air Quality Activities: Grades 6-8**

# Tracking Air Quality

## Summary

In this activity, students locate and study color-coded maps from the Internet showing air quality data for their area. By graphing the data from these maps and discussing the results, they learn how clean or polluted the air they breathe is, the extent of the ozone season in their area, and the relationship between weather and air pollution. While learning about air pollution, they build their research, graphing, and critical thinking skills.

Through this activity, they also become familiar with the Air Quality Index—a standard index for reporting daily air quality to the public. Students learn how the different colors of the AQI scale correspond to different levels of health concern. They also learn who may be affected at different levels of ozone pollution and what steps can be taken to protect health from air pollution.

## Grade Level

Grades 6-8

## Relevant National Science Education Standards

*Unifying Concepts and Processes*

Evidence, Models and Explanations

*Science as Inquiry*

Abilities Necessary to do Scientific Inquiry

Understandings About Scientific Inquiry

*Science in Personal and Social Perspectives*

Personal Health

Populations, Resources and Environments

Risks and Benefits

## Estimated Time

30 minutes - 1 hour per session (6 sessions, optional)

## Materials

Internet access

Student Worksheets (included with this toolkit)

Colored pencils in black, green, yellow, orange, red, and purple

## Objectives

Students will:

- Observe air quality changes and the impact of weather on air quality
- Demonstrate data gathering and analysis skills and graphing skills
- Apply techniques of comparison and critical thinking

## Directions

This activity has a number of variations, all of which involve accessing, observing, and gathering data from AQI color-coded air quality maps on the Internet. Students can be assigned an activity on their own, if they have individual access to the Internet. Or, they can work in teams; each team will need Internet access. If teams are used, the work can be divided in a number of ways. For example, each team can graph data for a different year (in which case three teams can be used) and then the teams can compare their data. Or, each team can focus on air quality data for a particular month in each of the three years. The team then can summarize the data for that month and note any trends.

## Accessing and Navigating Air Quality Maps

1. Explain that students will research and graph daily changes in ozone levels for their geographic area.
2. Provide students with copies of the graph of "Air Quality Versus Time" (Student Worksheet #1). (This graph, provided with this toolkit, has an "x" axis labeled "date" with a scale of 31 days and a "y" axis labeled "Air Quality Index" with a scale of 0 to 300. Note: The AQI scale actually runs to 500, but pollution levels in the U.S. virtually never rise above 300, a hazardous level that would trigger health warnings of emergency conditions).
3. Have each team access the following Internet data:  
*Air quality maps at:* [www.airnow.gov](http://www.airnow.gov) - click on "Archives" on the list to the right of the map shown, then:
  - a) Click on your geographic area on the map.
  - b) On the next screen, select the month and year to be researched, the region, and select "Ozone," then click on "See Map Archives".
  - c) Click on the first map, which provides data for the first day of that month. The next screen shows three maps. The activities will focus on the first two maps: "Ozone - AQI Loop," which shows a "movie" of the progression of ozone pollution throughout the day, and "Ozone - Peak AQI," which shows the highest ozone reading for the day.
4. Ask students to observe the color-coded AQI scale to the right of the maps. Each color corresponds to a segment of the AQI scale. Ask students to use the colored markers to mark these segments on the "y" axis of their Worksheet graph as follows: green = 0 to 50; yellow = 51 to 100; orange = 101 to 150; red = 151 to 200; purple = 201 to 300. Have students label these segments as indicated in the key: good, moderate, unhealthy for sensitive groups, unhealthy, very unhealthy (alert).
5. Ask students to click on any of the colors displayed on the AQI scale to the right of the maps. This will take them to the *Air Quality Guide for Ozone*. Ask them to look at this guide and notice that the right-hand column has specific messages about how people can protect their health at each different level of ozone pollution.
6. Now students are ready to research and record data on their graphs. To do this, students will need to go back and forth between the three pages mentioned above: (1) the first page which allows you to choose the different sets of maps by selecting the desired region, month, year, and pollutant; (2) the second page which shows all maps for a single month (note that students can navigate from one month to the next by clicking on the triangles to the left [for pre-

vious month] and right [for the next month] of the month and year listed on top of the maps; and (3) the third page which shows three maps for an individual day within the month (the activities below use only the first two of these maps: AQI Loop and Peak AQI).

## Activity 1: Graph Ozone Levels for the Warm Months of the Year

**Estimated Time:** 1 hour (or more depending on the number of students and the number of questions you ask them to answer)

*Summary:* At ground level, ozone forms when the pollutants nitrogen oxides (NO<sub>x</sub>) and volatile organic compounds (VOC) react in the presence of heat and sunlight. Therefore, ozone tends to form in warm weather. Each area's ozone season will be as long or as short as the number of warmer months. For this activity, students observe how ozone levels change over several consecutive months and record their observations on the graph "Air Quality Versus Time" (Student Worksheet #1 provided with this toolkit). If possible, ask students to gather data for all warmer months (i.e., months when temperatures tend to be consistently in the 70s or higher), as well as the cooler month just before and after the warm months. Students should have a separate graph for each month. They can gather each month's data fairly quickly by observing the page that displays all maps for that month. Though the maps are small, the colors can be observed reasonably well. If there is any question about what the colors are on the map, students can click on the map to observe it in a large size. For each day of each month, ask students to record on their "Air Quality Versus Time" graph for that month the highest AQI color they see. For example, if they see the colors green, yellow, and orange on a map, they should record that day as "orange" by marking the highest AQI level on the "orange" segment of the "y" axis (i.e., all orange days are marked as "150" which is the highest AQI level for orange; all green days are marked as "50" which is the highest AQI level for green, etc.).

Now ask students to fill out the table "Total Number of Days Each Month with Elevated Ozone Levels" (Student Worksheet #2 provided with this toolkit) to record the total number of days in each month with ozone levels that were green, yellow, orange, and red.

After preparing the graphs and table students can be asked any or all of the following questions:

1. What was the first day for that year when ozone levels were elevated (i.e., yellow or higher)?
2. What was the last day for that year when ozone levels were elevated?
3. Which month had the most green days?
4. Which month had the most yellow days?
5. Which month had the most orange days?
6. Which month had the most red days?
7. Which month had the most purple days?
8. What was the longest ozone "episode"? In other words, what was the most number of days in a row that ozone was elevated in any of these months?
9. Which month of the year was the worst month for ozone (i.e., had the most days when ozone was higher than green)? Which was the next worse ozone month?
10. Rank the months according to how bad they were for ozone, starting with the worst month at the top and the best month at the bottom. Now think about how hot these months are. What do you notice about ozone levels in hotter months?



11. How many days total over all these months were ozone levels elevated (i.e., higher than green)?
12. What percentage of days over these months were ozone levels elevated?
13. Who are the people that must be careful when ozone is at an orange level (“Unhealthy for Sensitive Groups”) or above? (Refer to the health messages on the *Air Quality Guide for Ozone* at: [www.airnow.gov](http://www.airnow.gov) - search the web site for “Air Quality Guide for Ozone”. Note: The answer is: Active children and adults and people with respiratory disease such as asthma.)

## Activity 2: Compare Ozone Levels Over Three Years

Estimated Time: 30 minutes (to answer the questions below after students have prepared the graphs and tables as described under Activity 1)

Ask students to create the graphs and table described under Activity 1 for three archived years of ozone data. For each of the questions given under Activity 1, have students compare the answers for the three years to answer these additional questions:

1. Which year had the longest ozone season (i.e., the time period from the first day ozone was observed to the last day)?
2. When you ranked the months from worst to best based on number of days of elevated ozone, were the results the same for each year or different? Does there seem to be any pattern to when ozone levels are elevated in this area? How would you describe that pattern?
3. Children can be sensitive to ozone when it reaches orange levels (see Activity 1). During what time period of the year might it be a good idea to check the AQI forecast regularly?

## Activity 3: Graph and Compare Ozone Levels in One Region of the U.S. versus Another

Estimated Time: 20 minutes (after students have prepared the graphs and tables as described under Activity 1 for both regions)

*Summary:* Different areas of the U.S. have significantly different ozone seasons depending on a number of factors, including climate, pollution sources, and regional transport of pollution away from one area and into another. For this activity, students will create the graphs and table as described under Activity 1 for the same year for two very different areas of the United States. They will answer the questions listed under Activity 1 for each area, and then compare the two areas by answering these additional questions. This will be most interesting if you pick an area that contrasts with your region. For example, if you live in an area where ozone is less often a problem (for example, the Northwest or Hawaii), have students compare that to areas with more frequently elevated ozone levels (such as California, the South and Southwest, and the Mid-Atlantic and Northeast states)—or vice versa. Once the graphs and tables have been prepared, ask students to use the data to answer the following questions:

1. Which region has the longest ozone season? By how much do the two seasons differ? Do you think this is related to temperature in these areas?
2. Compare the total number of days in each region that ozone was elevated. How much worse was ozone pollution in one region versus the other?
3. Compare the length of the longest ozone episode in the two regions. Was the longest ozone episode in the region during the longest ozone season?

## Activity 4: Graph and Compare Ozone Levels Over the Course of the Day

Estimated Time: 45 minutes

*Summary:* Ozone levels tend to be lowest in the morning, rise during the afternoon, and then decline during the evening. This is because (1) temperature and sunlight catalyze the formation of ozone, and (2) the pollutants from human activities (such as transportation) that react to form ozone tend to increase during the day and be lowest at night.

For this activity, students will hypothesize what they expect to observe about ozone levels over the course of a day based on an understanding of how ozone is formed. They will then observe actual ozone levels over the course of three days to test whether their hypothesis is correct. They will record their observations on the table called “Daily Air Quality for \_\_\_\_” (Student Worksheet #3 provided with this toolkit). The rows of the table are marked off in 1-hour increments. The columns correspond to the ozone level (as indicated by the AQI color) for each day.

Start the activity by explaining that ozone at ground level is not emitted directly. Rather, it is formed when two types of pollutants (nitrogen oxides and volatile organic compounds) react in the presence of heat and sunlight. Explain that sources of nitrogen oxide and volatile organic compound pollution include cars, power plants, and chemical plants. Ask students: If ozone needs heat and sunlight to form, when during the day do you think ozone levels will be highest? Then ask them to record data, as described below, to test their hypothesis.

For this exercise, students should use ozone maps from an area of the U.S. that tends to have elevated ozone levels in warm months (California and the South are good choices). Ask students to go to the page showing maps of one of these areas for July or August. From this month, ask them to click on a map that shows ozone at an orange or preferably red level. When they click on that map, they will go to the page that shows three larger maps of this area for that day. For this exercise, ask them to focus on the top map: Ozone — AQI Loop. This map loops through the ozone levels for that day in 20-minute increments. The date and time are shown at the bottom of the map. The animation is rapid, but tell students they can freeze the animation by clicking on the “escape” button on their keyboard. By doing so, they can record the highest AQI level (color) for each hour (i.e., 8 a.m., 9 a.m., etc.) starting with the earliest time ozone levels are provided and ending with the latest time. After they have recorded the ozone level, they will need to click the “back” key and then the “forward” key at the top of the browser to start the animation again. After the students have filled out all the ozone levels for one day, they should pick another day that has red or orange levels and do the same thing. Then, they should repeat for a third day. At this point, they should have enough data to answer the following questions:

1. Of the three days, what was the earliest time that ozone was elevated (i.e., above green)?
2. Of the three days, what was the latest time that ozone was elevated?
3. For each day, what time of day was ozone level the highest?
4. For each day, what time of day was ozone at the green level (i.e., not elevated)?
5. Based on these data, was your hypothesis about ozone correct?
6. When ozone levels are elevated, especially to an orange or red level, it’s a good idea to take it easier when you’re outside (so you don’t breathe as much or as deeply). If the air quality forecast predicts ozone pollution for a summer day, what time of day should you think about taking it easier?

## Activity 5: Graph Real-Time Ozone Data for a Month During Ozone Season

Estimated Time: 20 minutes the first day, 5 minutes per day after that, and 20 minutes for discussion on the final day.

If school is in session in your area during the ozone season, students can track the actual ozone forecast and levels each school day for a month. They can compare the forecast data to the actual data to see how accurate the forecasts are. They can also track the peak temperature each day to see whether there is a correlation between ozone levels and temperature.

Each day, at the same time of day if possible, have students record the following data on the “Daily Ozone Forecast, Peak Ozone Level, and Daily Peak Temperature” table (Student Worksheet #4 included with this toolkit):

- **Ozone forecast.** Ask students to visit the AIRNow web site at: [www.airnow.gov](http://www.airnow.gov). Ask them to record the day's forecast by clicking on “Local Forecasts and Conditions” which is on the right side of the web page, then click on the region of interest. This will bring them to a page that provides “Current AQI” and “Forecast” for the city. Students should record both forecasts (as available) for ozone on the table.
- **Yesterday's peak ozone level.** Then ask students to record the peak ozone level for that city for the prior day. Students can access yesterday's peak level data for the area by going to [www.airnow.gov](http://www.airnow.gov) and clicking on “Archives” (to the right of the national map) then selecting the area of interest, then clicking on “See Map Archives” (which should already list the current month; if not, enter the correct month, year, and region, and select “Ozone”). Then click on the map for the previous day. They can then observe the second map on the page “Ozone — Peak AQI” and record the highest color AQI level for their city on that day.
- **Yesterday's peak temperature.** Ask students to record the peak temperature by going to [www.wunderground.com](http://www.wunderground.com) then entering the city name and state in the box at the top of the page, and clicking on the icon just to the right of the box. This will take them to a page of data for that city. Ask them to scroll down the page to an area call “History & Almanac.” In this box they will find yesterday's maximum temperature, which they should record on their tables.

Once students have gathered a month's worth of data, they can answer the following questions:

1. For each day of the month, compare the forecast ozone level with the actual ozone AQI level. For how many days did the forecast accurately predict the day's ozone level? For how many days did the forecast predict that ozone levels would be higher than they were? For how many days did the forecast predict ozone levels would be lower than they were?
2. Calculate the average temperature for all days when the ozone level was green. Then calculate the average temperature for all days when the ozone level was yellow, for all days when the ozone level was orange, and for all days when the ozone level was red. What do you notice about temperature and ozone levels?
3. What ideas do you have for reducing ozone pollution during the day? (Possible answers include: drive less by walking, biking, carpooling, or using public transportation; turn off lights and equipment when you aren't using them.)

## Activity 6: Compare Ozone and Particle Pollution

Estimated Time: 30 to 60 minutes depending on how many months of data are gathered.

*Summary:* Particle pollution and ozone behave in very different ways. Ozone forms in warm weather and is generally highest in the afternoon and early evening. Particle pollution can be high at any time of year and any time of day. It can be particularly bad in winter during inversions, when warm air traps pollution in a location for a period of time. For this activity, students will gather data for levels of particle pollution throughout the year and compare these data with what they have observed for ozone in the earlier activities.

From the [www.airnow.gov](http://www.airnow.gov) web site, ask students to click on "Archives," then select the region "Northeast," click on "Go," and select the region "New England" and the pollutant "ParticlesPM2.5". Then click on "See Map Archives". Tell them that they will access data for an entire year. Have students begin with the month of January (select the year 2004 or later as particle pollution data are not available on AIRNow before October 2003.) Have students access the screen that shows the data for the entire month of January, and then have them click on January 1. Ask them what difference they observe between the particle pollution map and the ozone map. (*Answer:* Particle pollution readings are given as dots/circles whereas ozone maps have continuous bands of color). Explain that this is because particle pollution is more localized than ozone, so you can't predict as accurately that the particle levels between two areas where they are measured will be the same as at the measured locations.

Ask students to look at the second map on the page for each day in the month and record on the table "Frequency of Particle Pollution" (Student Worksheet #5 included with this toolkit) the number of locations (i.e., circles) that reported yellow AQI particle levels, orange particle levels, red, and purple particle levels. Have students do this for all twelve months of the year, if possible (or have them record for four months in different seasons: e.g., January, April, July, and October). (Ideally students can be divided into several teams and each record data for one or two months to cover the whole year.) Then have students answer these questions:

1. Were there any months when particle pollution was never elevated above the green level?
2. Are there any times of year when particle pollution appears to be worse? How does this compare with ozone?

Explain that particle pollution affects health in a different way than ozone, so the advice given to protect your health when particle pollution is elevated is different than the advice given for ozone. Have students access the *Air Quality Guide for Particle Pollution* either by clicking on the AQI colors to the right of the particle pollution maps, or by going to [www.airnow.gov](http://www.airnow.gov) and searching for *Air Quality Guide for Particle Pollution*. Ask:

1. Who is sensitive to particle pollution?
2. How does this differ from who is sensitive to ozone pollution?
3. If you have asthma, at what AQI level should you consider taking it easy when you are active outside? (*Answer:* Orange, unless you are unusually sensitive, in which case, yellow.)

## Additional Followup Activities

If it is winter and you live in an area that tends to have inversions in winter, students can track real-time air pollution data for particle pollution, as well as temperature and wind speed, as described for ozone under Activity 5. Also, have students track local weather reports for information on when temperature inversions are occurring and report back to the class.

- Ask students: What did you observe with respect to particle pollution levels during the inversion? Is there a relationship between cold temperatures and inversions? Is there a relationship between wind speed and inversions?
- Have students write a report on what a temperature inversion is.

## Suggested Reading

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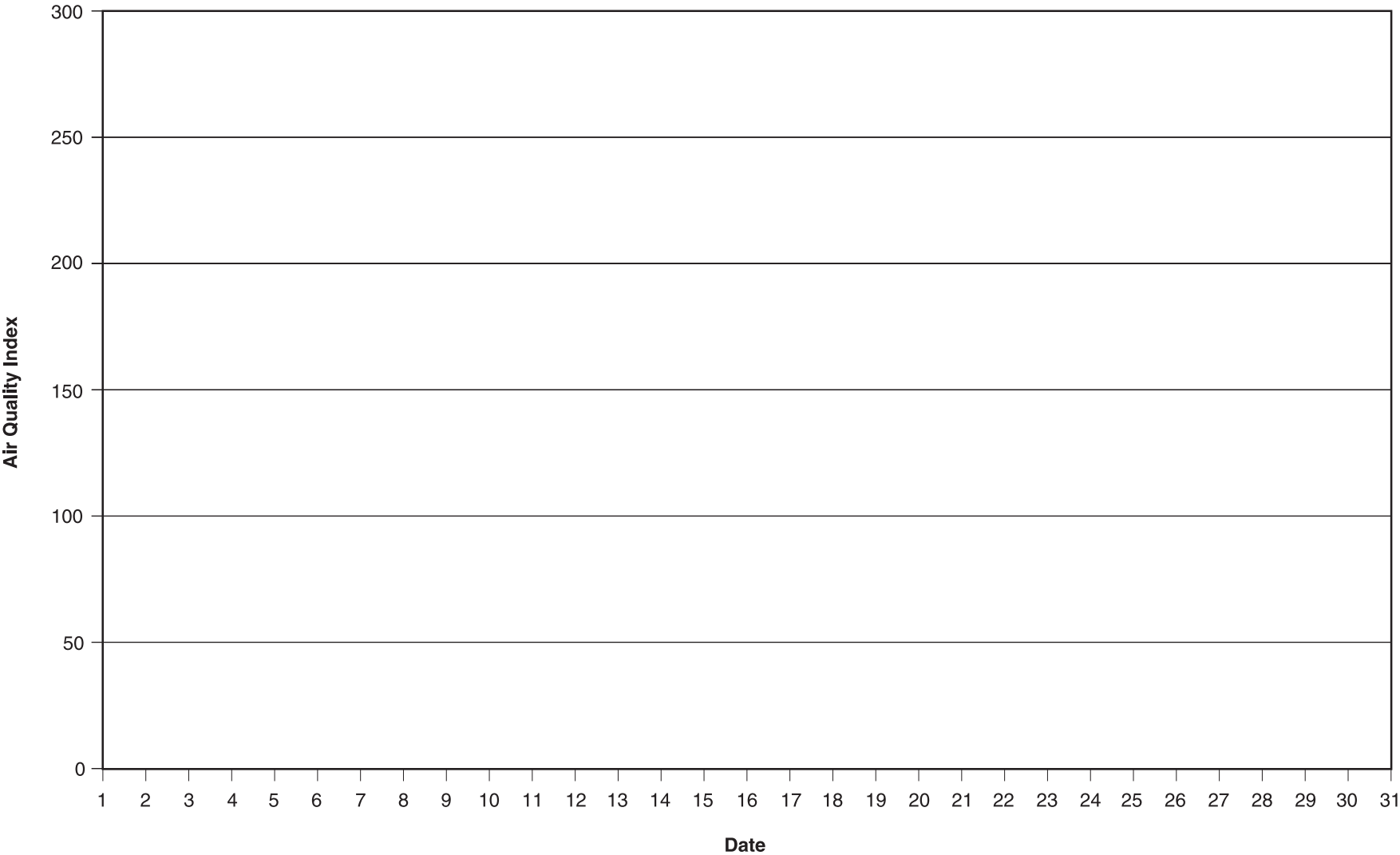
Project A.I.R.E. *Tracking Air Quality*. URL: [www.epa.gov/region01/students/pdfs/warm\\_e.pdf](http://www.epa.gov/region01/students/pdfs/warm_e.pdf)

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# Student Worksheet #1: Activities 1, 2, and 3

Air Quality vs. Time



Month: \_\_\_\_\_

## Student Worksheet #2: Activities 1, 2, and 3

### Total Number of Days Each Month with Elevated Ozone Levels

[illegible]

# Student Worksheet #3: Activity 4

Daily Air Quality for \_\_\_\_\_

	Highest AQI Color Observed on ____ (Date)	Highest AQI Color Observed on ____ (Date)	Highest AQI Color Observed on ____ (Date)
12 a.m.			
1 a.m.			
2 a.m.			
3 a.m.			
4 a.m.			
5 a.m.			
6 a.m.			
7 a.m.			
8 a.m.			
9 a.m.			
10 a.m.			
11 a.m.			
12 p.m.			
1 p.m.			
2 p.m.			
3 p.m.			
4 p.m.			
5 p.m.			
6 p.m.			
7 p.m.			
8 p.m.			
9 p.m.			
10 p.m.			
11 p.m.			

# Student Worksheet #4: Activity 5

## Daily Ozone Forecast, Peak Ozone Level, and Daily Peak Temperature

	Ozone Forecast Today: Tomorrow:	Actual Peak Ozone Level	Actual Peak Temperature
Day: 1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
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25			
26			
27			
28			
29			
30			
31			

# Student Worksheet #5: Activity 6

## Frequency of Particle Pollution

Month: \_\_\_\_\_

	Number of Monitors Showing Yellow AQI	Number of Monitors Showing Orange AQI	Number of Monitors Showing Red AQI	Number of Monitors Showing Purple AQI
Day: 1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
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31				



# Smog Alert

## Summary

The expression “smog” was first used in “Turn-of-the-Century” London to describe a combination of “smoke” and “fog.” Smog occurred when water vapor in the air condensed on small particles of soot in the air, forming small smog droplets. Thousands of Londoners died of pneumonia-like diseases due to the poisonous air. Today, smog is usually produced photochemically, when chemical pollutants in the air, called “precursors” (notably nitrogen oxides and volatile organic compounds) are baked by the sun and react chemically to form other substances, such as ozone. The chemicals that form ground-level ozone (that is, ozone within the Earth’s atmosphere) are produced by a combination of pollutants from many sources such as automobile exhaust, smokestacks, and fumes from chemical solvents like paint thinner or pesticides. Weather conditions such as the lack of wind or a “thermal inversion” can cause smog to be trapped over a particular area. (A thermal inversion occurs when a layer of warm air in the Earth’s atmosphere traps cold air and pollution, including ground-level ozone, below it).

Smog can cause health problems such as difficulty breathing, aggravated asthma, reduced resistance to lung infections, colds, and eye irritation. The ozone in smog also can damage plants and trees. The haze from smog can reduce visibility, which is particularly noticeable from mountains and other beautiful vistas such as National Parks.

Severe smog and ground-level ozone problems often occur in many major cities, including much of California from San Francisco to San Diego, the mid-Atlantic seaboard from Washington, DC to southern Maine, and major cities of the Midwest.

## Grade Level

Grades 6-8

(Note: This activity can also be done with careful supervision for Grades 3-5)

## Estimated Time

20 minutes

## Materials

Clean, dry, wide-mouth glass jar (e.g., mayonnaise jar)

Heavy aluminum foil

Two or three ice cubes

Ruler

Scissors

Stop watch or watch with second hand

Matches

# Relevant National Science and Health Education Standards

## *Unifying Concepts and Processes*

Evidence, Models and Explanations

## *Science as Inquiry*

Abilities Necessary to do Scientific Inquiry

Understandings About Scientific Inquiry

## *Science in Personal and Social Perspectives*

Personal Health

Populations, Resources and Environments

Risks and Benefits

## Objectives

Students will:

- Create artificial “smog” in a jar
- Recognize that invisible air pollutants and weather conditions are involved in creating smog
- Understand that not all air pollution is visible
- Appreciate that human activities can cause air pollution
- Strengthen their observational skills and their ability to draw conclusions

## Directions

**Be careful!** Teacher may want to (or be required to) use matches instead of having the students do so. If students use the matches, they should do so only under teacher supervision.

1. Explain that the class will perform an experiment in which they will create artificial “smog” in a jar. Make sure that students understand that the jar is only a model, and models by nature are limited. For example, the purpose of this model is to illustrate the appearance and behavior of smog, not the composition or effects. It is important to understand that smog is not just a “smoky fog,” but a specific phenomenon.
2. Select students to perform the experiment. Have them cut a strip of paper about 6 inches by 2 inches. Fold the strip in half and twist it into a rope.
3. Have them make a snug lid for the jar out of a piece of aluminum foil. Shape a small depression in the foil lid to keep the ice cubes from sliding off. Carefully remove the foil and set it aside.
4. Have the students put some water in the jar and swish it around to wet all the inside of the jar. Pour out the extra water.
5. The teacher (or possibly the students under teacher supervision) should light the paper “rope” with a match and drop it and the match into the damp jar. Put the foil lid back on the jar and seal it tightly. Put ice cubes on the lid to make it cold. (The ice cubes will make the water vapor in the jar condense.) Students must do this step very quickly, perhaps with some assistance.
6. Ask students to describe what they see in the jar. How is this like real smog? What conditions in the jar produced “smog”? (*Correct answer:* Moisture and soot particles from the burning matches, plus carbon dioxide and other solvent vapors.)

7. Ask the students if they have ever seen smog (not fog).

## Extensions

Have students put a glass thermometer (not plastic) into the jar before they do the experiment. Have them record the temperature before proceeding to step 4. Have them record the temperature again during step 5. Ask them to describe what the temperature did and why. Let them try it again without adding water.

Assign students to small groups to answer the following questions and report back to class in two weeks. One group will consider the physical and chemical sciences and the other group will consider the health and ecological sciences. Each group should consider referring to several sources of information to answer the questions. Students could possibly interview a weather reporter or meteorologist at the local television or radio station or airport, or a health scientist from the city or county health department or air quality agency.

- (a) What conditions are necessary to produce smog in the air? Under what circumstances will these conditions exist in the city? How often are they likely? Can they be predicted in advance?
- (b) What are the health effects of smog on people? On plants and trees? Why doesn't everyone in the city get sick or have similar symptoms from smog? What types of people are most sensitive to smog?

## Suggested Reading

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## Acknowledgment

Project A.I.R.E. (Air Information Resources for Educators), U.S. EPA New England Educational Resources Library, Activity 14. URL: [www.epa.gov/region01/students/pdfs/warm\\_e.pdf](http://www.epa.gov/region01/students/pdfs/warm_e.pdf)

# What's "Riding the Wind" in Your Community?

## Summary

Ever wonder what's floating in the air? Wind-blown particles that we can easily see range in size from approximately 20 to 100 microns. For comparison purposes, a human hair is approximately 70 microns in diameter. Although the movement of these wind-blown particles is more horizontal than vertical, a good collecting surface is a vertical plane. Sticky paper wrapped around a jar can be used as a sample collector and will work well to capture the particles. By having students make their own sample collector they will discover what actually floats in our air, determine what the sources of these particles might be, and learn which direction the particles come from.

## Grade Level

Grades 6-8

## Estimated Time

2.5 hours (over 2-3 days)

## Materials

Small glass or plastic jar with a lid. Several jars that fit the same lid will allow for the collection of several samples.

Plywood base (approximately 24" x 24")

Wooden dowel (approximately 3" diameter, 30" long)

2 Wood screws

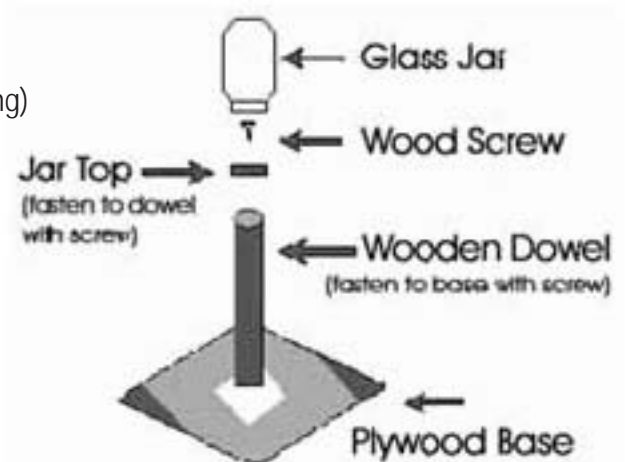
Compass

Spray can of quick drying clear lacquer

Double sided tape, or contact paper

Blank directional graphic (included)

Sample Data Table and Graph (included)



## Relevant National Science and Health Education Standards

*Unifying Concepts and Processes*

Evidence, Models and Explanations

*Science as Inquiry*

Abilities Necessary to do Scientific Inquiry

Understandings About Scientific Inquiry

*Science in Personal and Social Perspectives*

Personal Health

Populations, Resources and Environments

Risks and Benefits

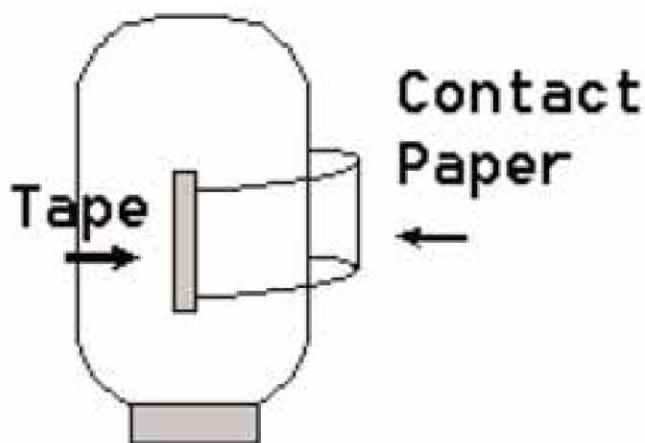
## Objectives

Students will:

- Measure the number of larger particles in the air that are carried on the wind
- Determine the approximate direction these particles are coming from
- Consider sources of particles sampled during this activity

## Directions

1. Assemble the sample collection stand as indicated in the picture above under “Materials”.
2. Place the stand for holding the glass jar on a flat and safe area of the school grounds or roof. Try to keep the sampler as far away from obstructions as possible.
3. Wrap one strip of double-sided tape around the jar. If using contact paper be sure that the sticky side is facing away from the jar. Fasten one edge to the jar with tape and be sure that the edges overlap and stick together so that the paper will stay on the jar. Mark the exposed edge as North.



4. Screw the jar onto the cap on the stand and use a compass to be sure that the edge marked “North” is facing North.
5. Leave the jar exposed for seven days. Then spray the paper with the lacquer to fix the particles collected and to avoid having additional particles adhere to the paper.
6. After the lacquer dries, remove the tape or contact paper from the sampler and divide it into eight equal parts. One section of the strip will represent each direction, i.e., North, Northeast, East, etc. Label each section.
7. Lay the tape on the table and estimate the percent of particle coverage for each section. Use the table below to record the class’s estimates.

Estimated  
Coverage



8. Hand out copies of the blank directional graphic (included) and have the students draw in the data from the table. For our purposes, assume that 2 cm = 10% coverage. The sample site will be at the center of the graph. For an example of how to interpret the data, have students review the attached Sample Data Table and Graph.
9. When the directional graphics are finished, students should be able to look at them and start to form simplified ideas regarding what general direction particle pollution, and possibly other pollutants that affect your community, come from.

After finishing the graphs, be prepared to discuss the following:

1. From what direction did most of the particle pollution appear to come?
2. What do you think the source of the material is?

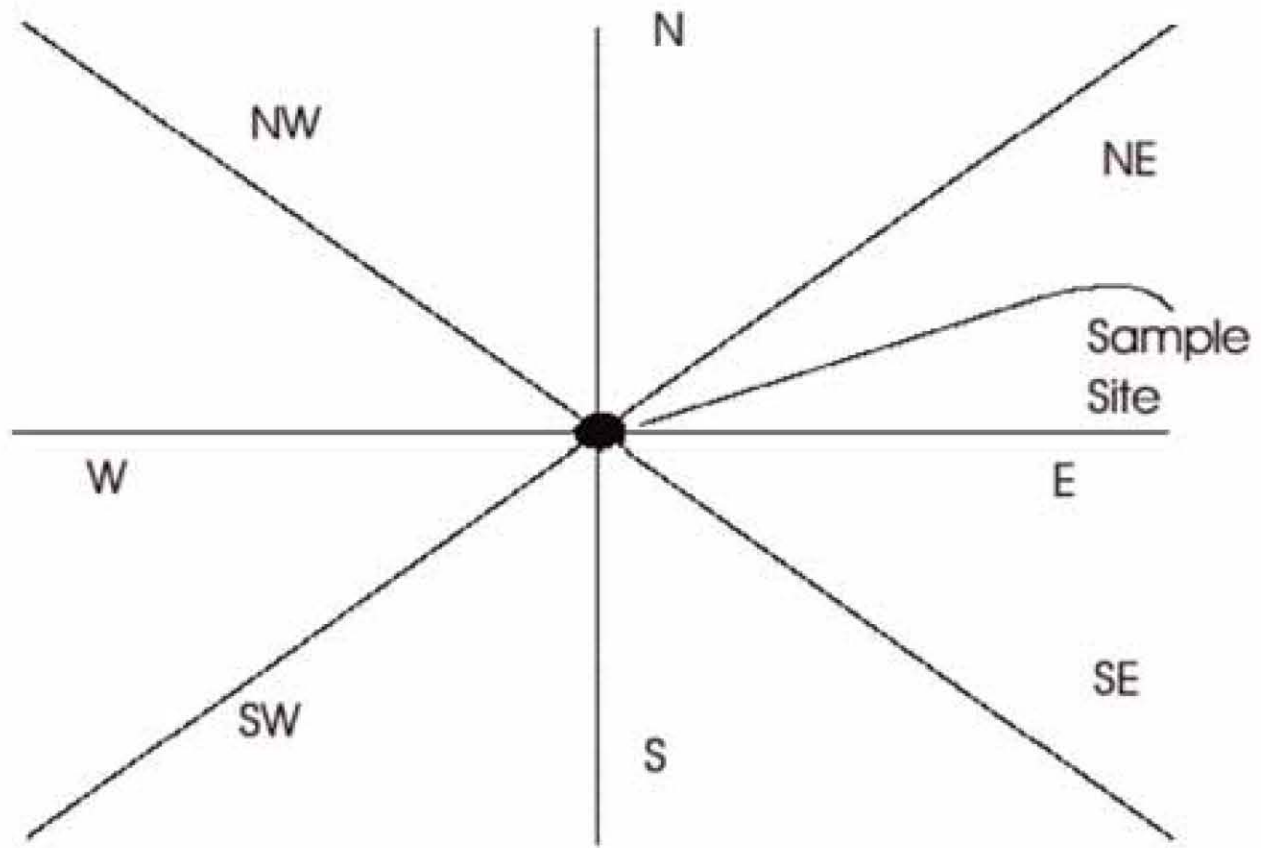
*(Possible answers: Nearby dirt driveways, farm activity, metropolitan areas, vehicle exhaust, factory emissions, etc.)*

## Acknowledgments

Adapted from Air Pollution Control Association, *Air Pollution Experiments for Junior and Senior High School Science Classes*. Pittsburgh, PA, 1972

# What's "Riding the Wind" in Your Community?

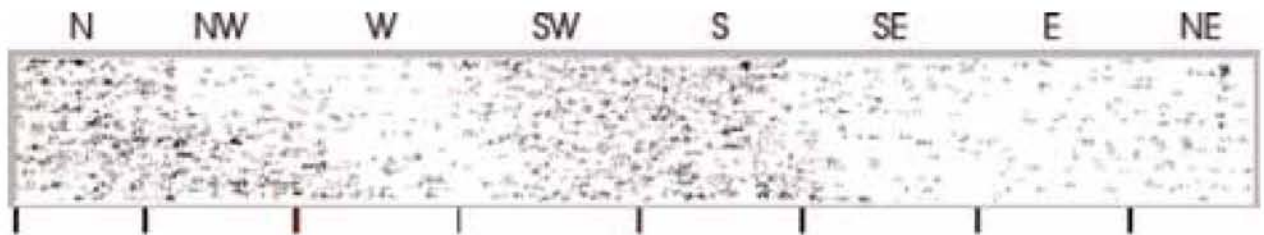
Blank Directional Graphic for Entering Data



Data Collection Site \_\_\_\_\_

Data Collection Dates \_\_\_\_\_

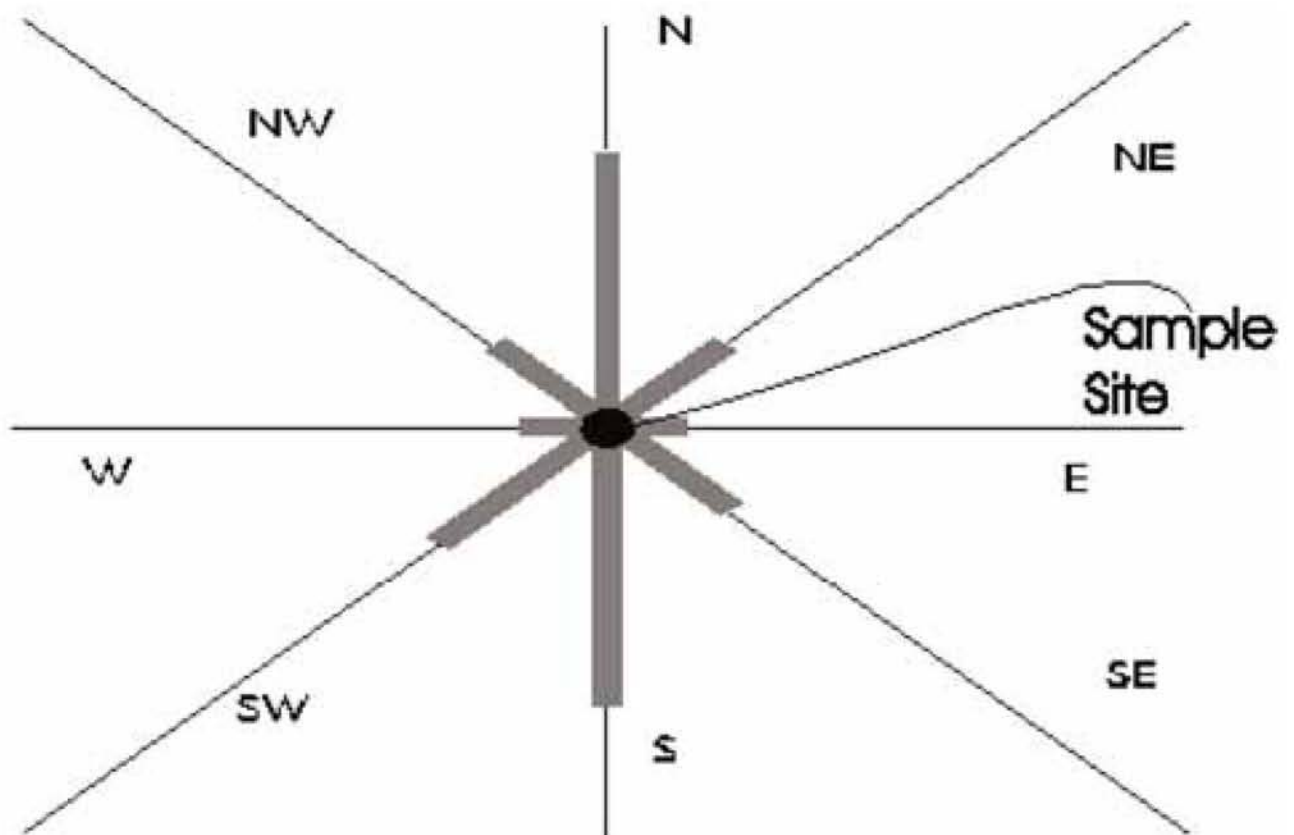
# Sample Data Table and Graph



For example we estimate the strip above is covered as indicated in the table below.

Estimated Coverage	25%	10%	5%	15%	25%	10%	5%	5%
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Start with the estimated particle coverage that came from the north, 25%. Since 2 cm on the graph represents 10% coverage, a 5 cm line will represent 25%. Draw a bar north extending 5 cm from the center of your directional graphic. A 2 cm bar should extend towards the northwest, and so on.



# Smog City

## Summary

The “Smog City” software program is an interactive tool that can help students make the connection between weather, human activities, and air pollution. The “Help” function in the Smog City program provides a brief explanation of ground-level ozone, on which Smog City is based, and of the items in the program that the students will use. For more information on ground-level ozone, see the *Air Pollution and Health Facts* and the *Air Pollution: What’s the Solution? The Ozone Between Us* activity in this toolkit.

## Grade Level

Grades 6-8

## Relevant National Science Education Standards

*Unifying Concepts and Processes*

Evidence, Models and Explanations

*Science as Inquiry*

Abilities Necessary to do Scientific Inquiry

Understandings About Scientific Inquiry

## Materials

Internet access

Presentation screen (optional)

Writing paper

## Objectives

Students will:

- Learn what weather conditions and human activities can affect air pollution
- Make and test hypotheses

## Duration

20 minutes

## Directions

1. Access the Smog City web site at [www.smogcity.com](http://www.smogcity.com) . Click on “Run Smog City” on the left side of the toolbar, and project it on your presentation screen.
2. Point out to the class each of the following items in Smog City:

*Weather conditions*

- Temperature
- Inversion layer (a layer of warm air in the Earth’s atmosphere that traps cold air and pollution, including ground-level ozone, below it)

- Wind speed
- Sunny or cloudy day

*Population level*

*Emissions levels - from:*

- Cars and trucks
- Off-road vehicles
- Industry
- Consumer products

3. Have students access the Smog City program on their computers. Tell the students not to click on anything just yet (it's very tempting!). Ask the students what they think would happen if they raised the emissions levels a lot from cars and trucks?
4. Tell students to go ahead and raise the emissions levels significantly from cars and trucks only, click "Start," and record the results. Did the change they expected to occur happen when they did this?

Get more specific - ask the class:

- What "ozone level" (green, yellow, orange, red, purple) did this change in settings result in? (See display)
  - Did the ozone level go up?
  - Did any associated ozone health warning appear or change when they did this? (See display)
6. Repeat this exercise for the other items listed above, one at a time, as time allows. Each time, have the students press "Reset" before making a change. Ask them what impact they expect the change will have on the ozone levels. Then tell the students to make a dramatic change for one item (so that differences in ozone levels are more likely to occur). Have the students press "Start" and ask them to observe and record what happened and whether their hypothesis was correct.

Mention to students that both emissions levels and population levels are things that are within the control of people, while weather conditions are not.

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*Note: Smog City was developed under a U.S. Environmental Protection Agency grant and is a copyright of the Sacramento Metropolitan Air Quality Management District. Smog City is authorized for use as an educational and demonstration tool and may be downloaded for non-profit use by the general public, other agencies, associations, and educational institutions from [www.smogcity.com](http://www.smogcity.com). Smog City: Copyright 1999 Sacramento Metropolitan Air Quality Management District.*

Coming in 2007—Smog City 2, which will include particle pollution in addition to ozone, at: [www.smogcity2.org](http://www.smogcity2.org)



# **Background Information and Resources for Teachers**

# Air Pollution and Health Facts

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. In fact, about 160 million people—over half the United States population—are exposed to unhealthful 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 or exercising 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. Scientists estimate that about one in three people in the United States is at higher risk for experiencing ozone-related health effects.

## 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 higher 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 high, older adults are more likely to be hospitalized, and some may die of aggravated heart or lung disease, perhaps because they have undiagnosed heart or lung disease. 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. This information is available on the Internet at: [www.airnow.gov](http://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 easier 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. 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. AQI values below 100 are generally thought of as satisfactory. 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](http://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.



# Air Quality Resources for Teachers

## Curricula and Classroom Activities

### ***Air Pollution: What's the Solution?***

This educational project, designed for students in grades 6-12, uses online, real-time air quality and weather data to guide students' understanding of the science behind the causes and effects of ground-level ozone. Available at: [www.k12science.org/curriculum/airproj/](http://www.k12science.org/curriculum/airproj/)

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

The units in this package encourage students to think more critically and creatively about air pollution problems and the alternatives for resolving them. Topics covered include air quality, rainforests, radon, the creation of environmental laws, the greenhouse effect, and ozone. Designed for grades K-12. Available at: [www.epa.gov/region01/students/teacher/aire.html](http://www.epa.gov/region01/students/teacher/aire.html)

### ***Air Quality Lesson Plans and Data for Teachers (Texas Natural Resource Conservation Commission)***

This site provides educators who teach kindergarten through 12th grade with background information, activities, and resources to teach the subject of air quality in the classroom. Available at: [www.tnrcc.state.tx.us/air/monops/lessons/lesson\\_plans.html](http://www.tnrcc.state.tx.us/air/monops/lessons/lesson_plans.html)

### ***Air Quality Index for Kids: For Teachers***

This EPA web site provides links to useful materials to help teach students about the Air Quality Index and related information. Available at: [www.airnow.gov](http://www.airnow.gov) (click on "Teachers" on the menu bar on the left side of the web page).

### ***Eco Badge® Educational Products***

Here you will find the Vistanomics "eco store" which 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) and educational toolkits targeted for elementary, middle, and high school students. The site also provides examples of successful teacher programs using the Eco Badge. Available at: [www.ecobadge.com](http://www.ecobadge.com)

### ***EPA Teaching Center - Air Curriculum Resources***

This page links to curricula and activities on a variety of environmental topics. Explore these links and find creative ways to teach your students about acid rain, indoor air pollution, ozone, radon. Available at: [www.epa.gov/teachers/curric-air.htm](http://www.epa.gov/teachers/curric-air.htm)

### ***Educator Resources for Air Defenders***

This resource provides information about a science module called *Air Defenders: The Quest for Clean Air™*, that is available for purchase. Targeted for students 10 and older, the Air Defenders kit provides resources to help students learn about the science of what happens to garbage when we burn it, the health and environmental consequences of burning waste, and how to analyze alternatives to open burning, such as composting, recycling, and landfilling. Available at: [www.airdefenders.org/teacher/index.htm](http://www.airdefenders.org/teacher/index.htm)

### ***SunWise School Program***

The SunWise School Program is 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 cross-curricular classroom lessons and background information for K-8 learning levels. The Tool Kit consists of a variety of fun, developmentally appropriate activities that combine education about sun protection and the environment with other aspects of learning. Available at: [www.epa.gov/sunwise](http://www.epa.gov/sunwise)

## Web Sites

### ***EPA's AIRNow Web site***

The U.S. EPA's AIRNow web site provides the public with easy access to air quality information. The web site offers real-time air quality conditions and daily air quality forecasts for over 300 cities across the U.S.; provides links to more detailed state and local air quality web sites; and supplies real-time images of air quality and visibility via webcams in a number of locations. Available at: [www.airnow.gov](http://www.airnow.gov)

Note that the AIRNow web site also provides a chart to easily link the AQI colors with air quality and health risks; this chart and related information can be found by visiting the AIRNow web site homepage and clicking on "Air Quality Index" on the menu bar on the left; the chart is on the bottom of this page.

### ***Kid's Air: EPA's Air Quality Index (AQI) Web site for Kids***

This web site explains the Air Quality Index (AQI) to children. It uses games, targeted for K-1 and ages 7-10, to teach children about the AQI and how they can moderate their activity to safely play outside when air pollution is elevated. Available at: [www.airnow.gov](http://www.airnow.gov) (click on "Kids" on the menu bar on the left of the web page).

## Publications

The following U.S. EPA publications are available in pdf and html formats (print versions can be requested free of charge) at: [www.airnow.gov](http://www.airnow.gov) (click on "Publications" on the menu bar on the left of the web page):

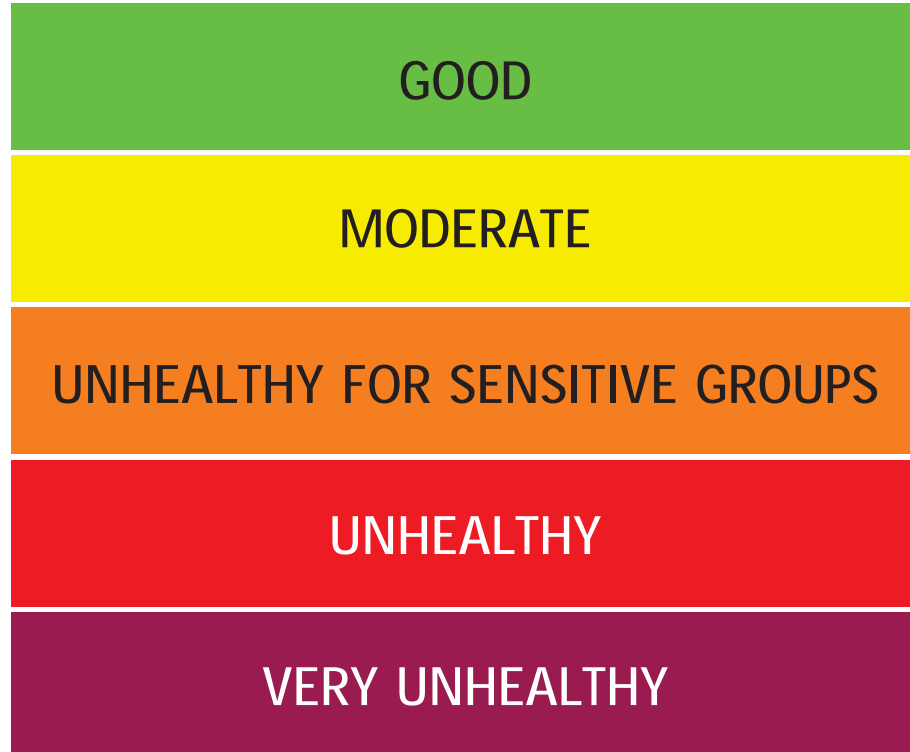
- ***Air Quality Index - A Guide to Air Quality and Your Health.*** This booklet explains EPA's Air Quality Index (AQI) and the health effects of major air pollutants.
- ***Air Quality Guide for Ozone.*** This guide provides information about ways to protect your health when ozone levels reach the unhealthy 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 tells 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 tells 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.
- ***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 Kids Safe from Sun and 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.

- ***Ozone: Good Up High, Bad Nearby.*** Ozone acts as a protective layer high above the earth, but it can be harmful to breathe at ground level. This publication provides basic information about ground-level and high-altitude ozone.

The following publication is available in pdf format at: [www.airnow.gov](http://www.airnow.gov) (search for the title):

- ***Facts About the Expanded AQI Forecasts.*** This brochure provides basic information for the public about AQI forecasts.

# CDs



## **CD #1**

- PowerPoint slide presentations and handouts for Grades 3-5, Grades 6-8, and Civic Groups.

## **CD #2**

- Forecast Earth: Air Aware Video (About Air Pollution and Health). Produced in 2004 by The Weather Channel and U.S. EPA.