



United States
Environmental Protection
Agency

Air Quality Index

A Guide to Air Quality and Your Health



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“Local air quality is unhealthy today.”

“It’s a code red air quality day for ozone.”

Increasingly, radio, TV, and newspapers are providing information like this to local communities. But what does it mean to you ...if you are planning outdoor activities that day? ...if you have children who play outdoors? ...if you are an older adult? ...if you have asthma? This booklet can help you understand what you can do to protect yourself from air pollution.

“Today’s Air Quality Index is 105, which is unhealthy for sensitive groups.”

Air Quality Index

A Guide to Air Quality and Your Health

Local air quality affects how you live and breathe. Like the weather, it can change from day to day or even hour to hour. The U.S. Environmental Protection Agency (EPA) and others are working to make information about outdoor air quality as easy to understand as the weather forecast. A key tool in this effort is the Air Quality Index, or AQI. EPA and local officials use the AQI to provide you with simple information on local air quality, the health concerns for different levels of air pollution, and how you can protect your health when pollutants reach unhealthy levels.

What is the AQI?

The AQI is an index for reporting daily air quality. It tells you how clean or polluted your air is, and what associated health effects might be a concern for you. The AQI focuses on health effects you may experience within a few hours or days after breathing polluted air. EPA calculates the AQI for five major air pollutants regulated by the Clean Air Act: ground-level ozone, particle pollution (also known as particulate matter), carbon monoxide, sulfur dioxide, and nitrogen dioxide. For each of these pollutants, EPA has established national air quality standards to protect public health.



Air quality directly affects our quality of life.



How does the AQI work?

Think of the AQI as 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

The purpose of the AQI is to help you understand what local air quality means to your health. To make it easier to understand, the AQI is divided into six categories:

Air Quality Index (AQI) Values	Levels of Health Concern	Colors
<i>When the AQI is in this range:</i>	<i>...air quality conditions are:</i>	<i>...as symbolized by this color:</i>
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. The six levels of health concern and what they mean are:

- **“Good”** The AQI value for your community is between 0 and 50. Air quality is considered satisfactory, and air pollution poses little or no risk.
- **“Moderate”** The AQI for your 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.

AQI colors

A specific color is assigned to each AQI category to make it easier for you to understand quickly whether air pollution is reaching unhealthy levels in your community. For example, the color orange means that conditions are “unhealthy for sensitive groups,” while red means that conditions may be “unhealthy for everyone,” and so on.

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 the specific pollutant. If two or more pollutants have AQI values above 100 on a given day, agencies must report all the groups that are sensitive to those pollutants. Many smaller communities also report the AQI as a public health service.



Children active outdoors can be sensitive to some air pollutants.

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 strenuous activities for a time when air quality is better.

The AQI is a national index, so the values and colors used to show local air quality and the levels of health concern will be the same everywhere you go in the United States. Look for the AQI to be reported in your local newspaper, on television and radio, on the Internet, and on many state and local telephone hotlines.

■ AQI in the Newspaper

Newspapers in many U.S. cities, and some national newspapers, carry AQI reports each day. Here is one example:



■ AQI in Television and Radio Weather Reports

Many local television or radio weathercasters use the AQI to provide air quality information in your area. Here's the type of report you might hear:

Tomorrow will be a code red air quality day for Center City. The cold winter air, morning traffic, and wood smoke are expected to cause particle pollution to rise to unhealthy levels. People with heart or lung disease, older adults, and children should avoid strenuous activities.

■ AQI on the Internet

EPA's AIRNow web site (www.epa.gov/airnow) contains general information about air pollution plus real-time and forecast air quality data. It also contains facts about the health and environmental effects of air pollution, steps you can take to protect your health and to reduce pollution, and links to state and local air pollution agency web sites.

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.

How can I avoid being exposed to harmful air pollutants?

The following AQI charts tell you how to protect your health from air pollution. Each chart contains cautionary language to help you when air quality levels are unhealthy. In general, you can reduce your risk by “reducing prolonged or heavy exertion.” Prolonged exertion is an activity that occurs over several hours and makes you breathe slightly harder than normal. Reducing prolonged exertion could mean reducing the time you spend on this type of activity. You can also reduce your risk by cutting back on heavy exertion—more intense activities that cause you to breathe hard. This might mean walking instead of jogging, or jogging for half your usual time. Your breathing rate is a guide to how hard you are exerting yourself. If you experience any unusual coughing, chest discomfort, wheezing, or breathing difficulty, you should reduce your activity level.

Charts are provided for four pollutants: ozone, particle pollution, carbon monoxide, and sulfur dioxide. Another common pollutant, nitrogen dioxide, can cause respiratory symptoms such as coughing, wheezing, and shortness of breath in children and adults who have respiratory diseases, such as asthma. The AQI for nitrogen dioxide is not included in this booklet because nitrogen dioxide levels across the country have been below the national air quality standard for the past several years. Nitrogen dioxide levels are usually so low that they pose little direct threat to human health. Nitrogen dioxide, however, is a concern because it plays a significant role in the formation of ozone, particle pollution, haze, and acid rain.

Air Quality Index (AQI): Ozone

Index Values	Levels of Health Concern	Cautionary Statements
0 - 50	Good	None
51 - 100*	Moderate	Unusually sensitive people should consider reducing prolonged or heavy exertion outdoors.
101 - 150	Unhealthy for Sensitive Groups	Active children and adults, and people with lung disease, such as asthma, should reduce prolonged or heavy exertion outdoors.
151 - 200	Unhealthy	Active children and adults, and people with lung disease, such as asthma, should avoid prolonged or heavy exertion outdoors. Everyone else, especially children, should reduce prolonged or heavy exertion outdoors.
201 - 300	Very Unhealthy	Active children and adults, and people with lung disease, such as asthma, should avoid all outdoor exertion. Everyone else, especially children, should avoid prolonged or heavy exertion outdoors.
301 - 500	Hazardous	Everyone should avoid all physical activity outdoors.

*An AQI of 100 for ozone corresponds to an ozone level of 0.08 parts per million (averaged over 8 hours).

What is ozone?

Ozone is a gas composed of three atoms of oxygen. Ozone occurs both in the Earth’s upper atmosphere and at ground level. Ozone can be good or bad, depending on where it is found:

- **Good Ozone.** Ozone occurs naturally in the Earth’s upper atmosphere—6 to 30 miles above the Earth’s surface—where it forms a protective layer that shields us from the sun’s harmful ultraviolet rays. This beneficial ozone is gradually being destroyed by manmade chemicals.



An area where the protective “ozone layer” has been significantly depleted—for example, over the North or South pole—is sometimes called “the ozone hole.”

- **Bad Ozone.** In the Earth’s lower atmosphere, near ground level, ozone is formed when pollutants emitted by cars, power plants, industrial boilers, refineries, chemical plants, and other sources react chemically in the presence of sunlight. Ozone at ground level is a harmful air pollutant.



The risk of exposure to unhealthy levels of ground-level ozone is greatest during summer months.

What are the health effects and who is most at risk?

Roughly one out of every three people in the United States is at a higher risk of experiencing problems from ground-level ozone.

- One group at high risk is active children because they often spend a large part of the summer playing outdoors.
- People of all ages who are active outdoors are at increased risk because, during physical activity, ozone penetrates deeper into the parts of the lungs that are more vulnerable to injury.

- People with respiratory diseases, including asthma, that make their lungs more vulnerable to ozone may experience health effects earlier and at lower ozone levels than other people.
- Though scientists don’t yet know why, some healthy people are unusually sensitive to ozone. They may experience health effects at more moderate levels of outdoor exertion or at lower ozone levels than the average person.
- Ozone can irritate the respiratory system, causing coughing, throat irritation, and/or an uncomfortable sensation in the chest.
- Ozone can reduce lung function and make it more difficult to breathe deeply and vigorously. Breathing may become more rapid and shallow than normal. This may limit a person’s ability to engage in vigorous activities.
- Ozone can aggravate asthma. When ozone levels are high, more people with asthma have attacks that require a doctor’s attention or use of medication. One reason this happens is that ozone makes people more sensitive to allergens such as pets, pollen, and dust mites, which are common triggers of asthma attacks.
- Ozone can increase susceptibility to respiratory infections.
- Ozone can inflame and damage the lining of the lungs. Within a few days, the damaged cells are shed and replaced—much like the skin peels after a sunburn. Studies suggest that if this type of inflammation happens repeatedly over a long time period (months, years, a lifetime), lung tissue may become permanently scarred, resulting in permanent loss of lung function and a lower quality of life.



Air Quality Index (AQI): Particle Pollution

Index Values	Levels of Health Concern	Cautionary Statements
0 - 50	Good	None
51 - 100*	Moderate	Unusually sensitive people should consider reducing prolonged or heavy exertion.
101 - 150	Unhealthy for Sensitive Groups	People with heart or lung disease, older adults, and children should reduce prolonged or heavy exertion.
151 - 200	Unhealthy	People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion. Everyone else should reduce prolonged or heavy exertion.
201 - 300	Very Unhealthy	People with heart or lung disease, older adults, and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion.
301 - 500	Hazardous	People with heart or lung disease, older adults, and children should remain indoors and keep activity levels low. Everyone else should avoid all physical activity outdoors.

*An AQI of 100 for particles up to 2.5 micrometers in diameter corresponds to a level of 40 micrograms per cubic meter (averaged over 24 hours). An AQI of 100 for particles up to 10 micrometers in diameter corresponds to a level of 150 micrograms per cubic meter (averaged over 24 hours).

What is particle pollution?

Particle pollution (also known as “particulate matter”) in the air includes a mixture of solids and liquid droplets. Some particles are emitted directly; others are formed in the atmosphere when other pollutants react. Particles come in a wide range of sizes. Those less than 10 micrometers in diameter are so small that they can get into the lungs, potentially causing serious health problems. Ten micrometers is smaller than the width of a single human hair.

- **Fine particles.** Particles less than 2.5 micrometers in diameter are called “fine” particles. These particles are so small they can be detected only with an electron microscope. Sources of fine particles include all types of combustion, including motor vehicles, power plants, residential wood burning, forest fires, agricultural burning, and some industrial processes.
- **Coarse dust particles.** Particles between 2.5 and 10 micrometers in diameter are referred to as “coarse.” Sources of coarse particles include crushing or grinding operations, and dust stirred up by vehicles traveling on roads.

What are the health effects and who is most at risk?

Particles smaller than 10 micrometers in diameter can cause or aggravate a number of health problems and have been linked with illnesses and deaths from heart or lung diseases. These effects have been associated with both short-term exposures (usually over a 24-hour period, but possibly as short as one hour) and long-term exposures (years).

- Sensitive groups for particle pollution include people with heart or lung disease, older adults (who may have undiagnosed heart or lung disease), and children.
- People with heart or lung diseases—such as congestive heart failure, coronary artery disease, asthma, or chronic obstructive pulmonary disease—and older adults are more likely to visit emergency rooms, be admitted to hospitals, or in some cases, even die. When exposed to particle pollution, people with heart disease may experience chest pain, palpitations, shortness of breath, and fatigue. Particle pollution has also been associated with cardiac arrhythmias and heart attacks.
- When exposed to particles, people with existing lung disease may not be able to breathe as deeply or vigorously as they normally would. They may experience symptoms such as coughing and shortness of breath. Healthy people also may experience these effects, although they are unlikely to experience more serious effects.
- Particle pollution also can increase susceptibility to respiratory infections and can aggravate existing respiratory diseases, such as asthma and chronic bronchitis, causing more use of medication and more doctor visits.



Air Quality Index (AQI): Carbon Monoxide (CO)

Index Values	Levels of Health Concern	Cautionary Statements
0 - 50	Good	None
51 - 100*	Moderate	None
101 - 150	Unhealthy for Sensitive Groups	People with heart disease, such as angina, should reduce heavy exertion and avoid sources of CO, such as heavy traffic.
151 - 200	Unhealthy	People with heart disease, such as angina, should reduce moderate exertion and avoid sources of CO, such as heavy traffic.
201 - 300	Very Unhealthy	People with heart disease, such as angina, should avoid exertion and sources of CO, such as heavy traffic.
301 - 500	Hazardous	People with heart disease, such as angina, should avoid exertion and sources of CO, such as heavy traffic. Everyone else should reduce heavy exertion.

* An AQI of 100 for carbon monoxide corresponds to a CO level of 9 parts per million (averaged over 8 hours).

What is carbon monoxide?

Carbon monoxide (CO) is an odorless, colorless gas. It forms when the carbon in fuels does not completely burn. Vehicle exhaust contributes roughly 60 percent of all carbon monoxide emissions nationwide, and up to 95 percent in cities. Other sources include fuel combustion in industrial processes and natural sources such as wildfires. Carbon monoxide levels typically are highest during cold weather, because cold temperatures make combustion less complete and cause inversions that trap pollutants close to the ground.

What are the health effects and who is most at risk?

Carbon monoxide enters the bloodstream through the lungs and binds to hemoglobin, the substance in blood that carries oxygen to cells. It actually reduces the amount of oxygen reaching the body's organs and tissues.

- People with cardiovascular disease, such as angina, are most at risk. They may experience chest pain and other cardiovascular symptoms if they are exposed to carbon monoxide, particularly while exercising.
- People with marginal or compromised cardiovascular and respiratory systems (for example, individuals with congestive heart failure, cerebrovascular disease, anemia, chronic obstructive lung disease), and possibly young infants and fetuses, also may be at greater risk from carbon monoxide pollution.
- In healthy individuals, exposure to higher levels of carbon monoxide can affect mental alertness and vision.



Vehicle exhaust contributes roughly 60 percent of all carbon monoxide emissions nationwide.



Air Quality Index (AQI): Sulfur Dioxide (SO₂)

Index Values	Levels of Health Concern	Cautionary Statements
0 - 50	Good	None
51 - 100*	Moderate	None
101 - 150	Unhealthy for Sensitive Groups	People with asthma should consider reducing exertion outdoors.
151 - 200	Unhealthy	Children, asthmatics, and people with heart or lung disease should reduce exertion outdoors.
201 - 300	Very Unhealthy	Children, asthmatics, and people with heart or lung disease should avoid outdoor exertion. Everyone else should reduce exertion outdoors.
301 - 500	Hazardous	Children, asthmatics, and people with heart or lung disease should remain indoors. Everyone else should avoid exertion outdoors.

* An AQI of 100 for sulfur dioxide corresponds to an SO₂ level of 0.14 parts per million (averaged over 24 hours).

What is sulfur dioxide?

Sulfur dioxide (SO₂), a colorless, reactive gas, is produced when sulfur-containing fuels such as coal and oil are burned. Major sources include power plants and industrial boilers. Generally, the highest levels of sulfur dioxide are near large industrial complexes.

What are the health effects and who is most at risk?

Sulfur dioxide is an irritant gas that is removed by the nasal passages. Moderate activity levels that trigger mouth breathing, such as a brisk walk, are needed for sulfur dioxide to cause health effects.

- People with asthma who are physically active outdoors are most likely to experience the health effects of sulfur dioxide. The main effect, even with brief exposure, is a narrowing of the airways (called bronchoconstriction). This may cause wheezing, chest tightness, and shortness of breath. Symptoms increase as sulfur dioxide levels and/or breathing rates increase. When exposure to sulfur dioxide ceases, lung function typically returns to normal within an hour.
- At very high levels, sulfur dioxide may cause wheezing, chest tightness, and shortness of breath even in healthy people who do not have asthma.



Children and adults with asthma who are active outdoors are most vulnerable to the health effects of sulfur dioxide.

- Long-term exposure to sulfur dioxide can cause respiratory illness, alter the lung's defense mechanisms, and aggravate existing cardiovascular disease. People with cardiovascular disease or chronic lung disease, as well as children and older adults, may be most susceptible to these effects.



Where can I get more information?

For information on air quality in your area, visit EPA's AIRNow web site at www.epa.gov/airnow.

For information on programs under way to improve air quality, visit www.epa.gov/air.

The AQI focuses on outdoor air quality. For information on indoor air quality, contact EPA's Indoor Air Quality Information Hotline at (800) 438-4318 or visit www.epa.gov/iaq.