

Washington Children and Youth Activities Guide for Air Quality



The following public health recommendations are to protect children and youth (18 years and younger) from fine particle air pollution (PM_{2.5}). Apply this guide to school, child care, athletic practices and games, before and after school programs, camps, field trips, and other outdoor programming and activities.

Check current and forecast air quality at [AirNow.gov](https://www.airnow.gov) or during wildfire smoke at wasmoke.blogspot.com

(See Appendix A)

Outside Air Quality Index (AQI): PM_{2.5}

Activity Duration	Good (0-50 AQI)	Moderate (51-100 AQI)	Unhealthy for Sensitive Groups (101-150 AQI)	Unhealthy, Very Unhealthy, or Hazardous (≥151 AQI)
15 mins to 1 hour (e.g., recess, PE, classes typically held outside)	No restrictions.	Allow children and youth with health conditions to opt out or stay indoors. Limit intensity of activities for these children and youth if needed.	Limit to moderate intensity activities outside. For children and youth with health conditions, further limit intensity or move to an area with safer air quality if needed.	Cancel outdoor activity or move to an area with safer air quality, either indoors with filtered air or to a different location. Limit to light intensity activities indoors if indoor PM _{2.5} levels are elevated.
1-4 hours (e.g., athletic events and practices)	No restrictions.	Allow children and youth with health conditions to opt out or stay indoors. Limit intensity of activities for these children & youth if needed.	Limit to light intensity activities or to a 1-hour total duration with moderate intensity activities. If intensity level and time cannot be modified, consider canceling outdoor activity or move to an area with safer air quality, either indoors or to a different location. For children & youth with health conditions, further limit time or intensity if needed.	Cancel outdoor activity or move to an area with safer air quality, either indoors with filtered air or to a different location. Limit to light intensity activities indoors if indoor PM _{2.5} levels are elevated.
> 4 hours (e.g., outdoor school or programming, day camp, overnight camp)	No restrictions.	Move children and youth with health conditions to an area with safer air quality, either indoors or to a different location if needed. Allow children and youth without health conditions to opt out or stay indoors and limit intensity of activities.	Limit to light intensity activities and under 4-hr total duration. If intensity level and time cannot be modified, cancel outdoor activity, or move it to an area with safer air quality, either indoors or to a different location. For children and youth with health conditions, further limit time or intensity if needed.	Cancel outdoor activity or move to an area with safer air quality, either indoors with filtered air or to a different location. Limit to light intensity activities indoors if indoor PM _{2.5} levels are elevated.

ADDITIONAL CONSIDERATIONS

Close windows and doors when activities are moved indoors. Pay attention to heat.

Indoor air filtration can reduce elevated levels of indoor PM_{2.5}. See Appendix C. To measure indoor PM_{2.5} levels, see Appendix B.

Consider time spent in transit in activity duration.

All children and youth 18 and younger are considered a sensitive group. Health conditions include but are not limited to asthma and other lung disease, heart disease, diabetes, and respiratory infection (e.g., RSV and pneumonia).

Sources of PM2.5	The primary sources of PM2.5 are typically wildfire smoke during warmer months and smoke from home heating during colder months, though this varies by location. Other sources include vehicle exhaust, industrial emissions, and prescribed burning.
Children's Health & Increased Risk	Children and youth are more sensitive to health effects from breathing in PM2.5 because they breathe in more air than adults for their body weight. This increases their total dose of air pollution. The respiratory system also develops until about age 21. Children and youth with health conditions (including asthma and other lung diseases, heart disease, and diabetes) have a higher risk of emergency department visits and hospitalizations compared to children without health conditions. Children and youth may also be at risk for declines in academic performance, neurodevelopmental problems, and chronic conditions in adulthood. Children with asthma should follow their Asthma Action Plan .
Symptoms	Symptoms of PM2.5 exposure include burning eyes, coughing, throat and nose irritation, fatigue, headache, wheezing, and shortness of breath. Monitor symptoms. If symptoms become serious, seek medical attention. Symptoms can continue or appear in the week following exposure to PM2.5.
Physical Activity	CDC recommends children and youth 6-17 years old exercise an hour or more every day as an important part of health. WAC 110-300-0360(2)(c) requires minimum outdoor activity/active play in child care programs with an exception for extreme weather. Safe outdoor play when PM2.5 levels are high, especially for days or weeks, requires precautions. People breathe deeper and take more air into their lungs when exercising, thus taking in more air pollution. Children and youth's breathing rates increase over 2 times during light intensity physical activity, over 4 times during moderate intensity activity, and over 8 times during high intensity activity compared to being at rest. Intensity level is related to the exertion and varies individually, but as examples: <ul style="list-style-type: none"> » Light Intensity Activities: playing board games, playing catch, and stacking blocks » Moderate Intensity Activities: climbing on playground, dodgeball, four-square, golf, gymnastics, hopscotch, lightly riding a tricycle/bicycle, marching band, moderate or brisk walking, shooting basketballs, softball/baseball, table tennis, volleyball, weight training, and yoga » Vigorous Intensity Activities: aerobic dance, basketball, cheer, competitive swimming, football, jogging, jumping jacks, jump rope, karate, race walking, running, soccer, swimming, tennis, and vigorous bicycling For a more detailed list see CDC's guidance, Measuring Physical Activity Intensity .
Reducing Exposures	As PM2.5 pollution increases, each action is increasingly important to protect health: limit duration and intensity of outside physical activity (e.g., increase rest periods), stay indoors when possible and keep indoor air clean. Consider a child's total exposure throughout the day and night, including time spent at school, home, and in transit. Walking, biking, or riding in a bus with windows opened is time outdoors. Some children may not have cleaner air at home.
Masks & Respirators	A NIOSH approved N95 or other particulate respirator can be an option when you have no other way to avoid wildfire smoke. NIOSH approved respirators do not come in suitable sizes for very young children and have not been tested for broad use in children. Effective use requires proper selection, size and fit. See Western States PEHSU guidance on respirator use by children. More NIOSH information here.
Air Quality Monitoring & Low-Cost Sensors	Outdoor Air Monitoring: Use air pollution forecasts and government agency monitors on AirNow.gov for non-wildfire smoke pollution. Use the Washington Smoke Blog for wildfire smoke. The Smoke Blog includes low-cost sensors and has the most relevant forecasts for Washington wildfire smoke. See Appendix A. Indoor Air Monitoring: Indoor low-cost sensors can be used for indoor activities. Do not compare uncorrected sensor data to the AQI. Compare sensor data in locations throughout the facility and indoors vs outdoors. See Appendix B.
Indoor Air Quality	During high levels of PM2.5 or extended durations of poor air quality, taking steps to improve indoor air quality is extra important because PM2.5 will seep into buildings. If you're not sure whether indoor PM2.5 levels are lower than outside, assume levels are similar and increase steps to reduce exposure. Indoor air filtration (HVAC systems with enhanced filtration or HEPA portable air cleaners) can reduce indoor levels of PM2.5. Do not use air cleaners that produce ozone or have additive technology, such as ionization and plasma. See Appendix C.
Adult Staff & Volunteers	Adult staff and volunteers can be impacted by air pollution, see WA Air Quality Guide for Particle Pollution . For policies on outdoor workers during wildfire smoke, see WA L&I's Wildfire Smoke Workplace Safety & Health webpage .
School Closures	Consider school and facility closures if you cannot maintain indoor 125.5 µg/m3 (AQI value of 201). See Summary Wildfire Smoke Guidance for Closing Schools , which includes factors to consider.
Resources	Websites: WA DOH's Air Quality and Health or Smoke from Fires and Health , EPA's Air Quality Flag Program . For technical assistance: airquality@doh.wa.gov .

Appendix A: Outdoor Air Quality Monitoring for Decision Making During Wildfire Smoke Events

Wildfire smoke can fluctuate throughout the day, or it can linger and be stable. It is difficult to predict. This makes it challenging to plan activities in advance. Forecasts and current measurements can inform your decision-making around canceling, modifying, delaying, or ending activities early. For longer duration activities, check measurements throughout the day. When decisions need to be made several hours in advance, it may not reflect conditions at the time of the activity.

The Washington Smoke Blog (<https://wasmoke.blogspot.com>) is the best source of outdoor air quality information when making decisions about outdoor activities when there is wildfire smoke. Use a combination of forecasts and current measurements from agency monitors and/or outdoor low-cost air sensors, as described below. Your [regional clean air agency](#) may have additional information for your area.

For activities planned in advance, use forecasts for your area or in the area the activity is occurring. Forecasts up to 5 days in advance, including the current day, are available on the WA Smoke Blog map by regions. The forecasts for the first 2 days are more accurate than for days 3-5. Written blog posts and comments often include additional forecast information. Keep in mind that forecasts are for daily (24-hr) conditions, and the real-time conditions may be better or worse due to fluctuations throughout the day.

In the hours leading up to the activity (or throughout the day for long duration activities, such as summer camp), track the current measurements as described below.

Important: *Low-cost sensor measurements on their own can be very inaccurate during wildfire smoke events. It is important to follow the steps below to view low-cost sensor data on public agency websites, where it has been corrected for wildfire smoke. We do not recommend using private or third-party websites (including third-party weather apps) where the data may not have been verified and adjusted.*



To view current outdoor air quality data near you:

Step 1:

Use the Fire and Smoke Map on the WA Smoke Blog (<https://wasmoke.blogspot.com>) or on the "Smoke" tab of the AirNow app.

Step 2:

Find the agency PM2.5 monitor (circles on the map) and/or low-cost PM2.5 sensor (squares on the map) closest to your event. Low-cost PM2.5 sensors are commercially available devices that can be operated by anyone. Low-cost sensors are generally less accurate than the agency monitors, and since many are operated by members of the public, their performance, siting, and maintenance are unknown. Low-cost sensor data can be inaccurate, but on the WA Smoke Blog and Fire and Smoke Map, sensor data are adjusted for wildfire smoke.

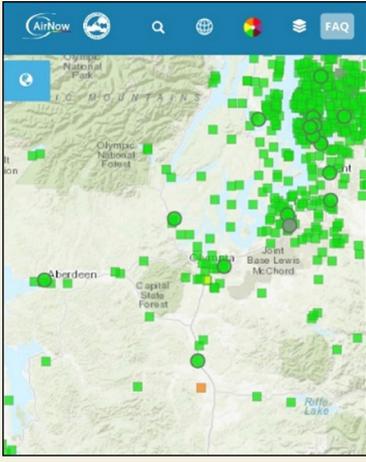
The monitor and sensor data you view on the map will be more or less similar to your actual location based on how far away the monitor/sensor is from your location and other factors. Consider differences in elevation, terrain, wind direction, and weather between your location and the monitor/sensor location. For example, a nearby monitor/sensor in a location with similar elevation and weather and is not separated from your location by a ridge, will probably provide better

information for your location than a monitor/sensor that is on the other side of a ridge or at a different elevation, like in a valley. You might find that you need a sensor at your specific location.

Remember to also consider the air quality along routes of transit that people will be exposed to when they travel to and from your event.

The markers on the map show the color of the NowCast Air Quality Index (AQI) hazard level, which is approximately based on the conditions over the past few hours and is updated hourly. For tracking data over the last 30 minutes, see steps 3 and 4.

Click or tap on the monitor (circle) or low-cost sensor marker (square) closest to your event



(Screenshots are from the "Smoke" tab of the AirNow phone app, April 2023.)

A window like this should pop up





Current NowCast AQI category

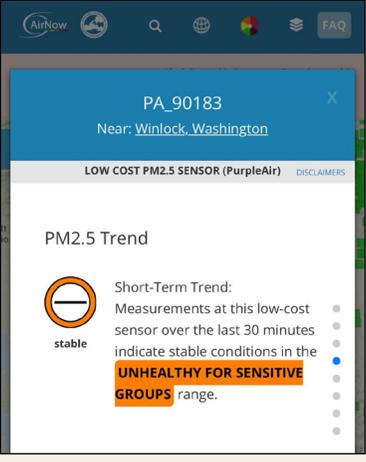
Current NowCast AQI number

Recent trend (click or tap here for more information on the trend)

To view the NowCast AQI number, click or tap on the circle or square marker. A new window should pop up, showing you the NowCast AQI number and category, as well as a trend (air quality is getting better, getting worse, or staying the same). Click or tap on "Trend" to see more information about the trend.

In addition to using a forecast and NowCast AQI for planning purposes, use the trend information to make a decision about activities happening within about an hour. This is especially important if the current conditions are changing quickly or seem different from the forecast or the NowCast AQI. The trend shows how recent values compare to the NowCast. If the recent values are higher, then the trend is increasing (worsening air quality). If the recent values are lower, the trend is decreasing (improving air quality). The AQI Trend category is what was observed in the past 30 minutes for sensors and monitors with sensors nearby, or from the last hourly concentration for monitors without sensors nearby.

Use this AQI category to decide about activities happening within about the next hour. If more than one category is displayed, use the higher (worse) category.



(Screenshots are from the "Smoke" tab of the AirNow phone app, April 2023.)

In Step 2 (above): Click or tap on the "Trend" icon. This will take you to another section called "PM2.5 Trend" as shown to the left.

Step 3:

Use this AQI category to decide about activities happening within about the next hour. If more than one category is displayed, use the higher (worse) category.

Step 4:

Repeat step 3 every 30 minutes, or sooner if it appears that conditions are changing rapidly and change your activity decisions accordingly.

Example scenario 1:

You are deciding whether to have outdoor recess, and you do not need to make this decision in advance. Earlier in the morning, the NowCast AQI category was “Unhealthy.” Now it is time for recess and the current Trend AQI category is “Moderate.” Based on the Trend AQI category of “Moderate” you decide to have outdoor recess but allow children and youth with health conditions to opt out or stay indoors.

Example scenario 2:

You are deciding whether to hold an athletic event and this decision must be made several hours in advance due to the logistics involved. The forecast for the day is “Unhealthy for Sensitive Groups” but the NowCast is “Unhealthy.” You decide to follow the guidance for the “Unhealthy” category. This is a challenging decision because the air quality conditions could change by the time of the event, but because you need to plan several hours in advance, you decide to cancel using the best information that you have.

Alternatively, you decide to move forward with planning the activity with the understanding that it may not be possible. You check the Trend AQI category at the start time of the activity and decide based on that AQI category. If you decide to start the event, you continue checking the Trend AQI category every 30 minutes to see if the AQI category worsens and the event needs to end early.

Example scenario 3:

You are planning a day of summer camp. Based on the forecast of “Good” the day before, you had planned a day of vigorous activity. Prior to starting the activity, you check the Trend AQI category, and it is “Moderate.” Therefore, you come up with an alternate activity indoors for children and youth with health conditions, and those without health conditions who wish to opt out of the vigorous activity. You continue checking the Trend AQI category every 30 minutes to see if the vigorous activity needs to be modified later in the day.

Why does my sensor/commercial weather app/sensor map display different AQI numbers or colors from what I see on the Washington Smoke Blog, Fire and Smoke map, or AirNow?

- » Sensors use a variety of averaging times to display the AQI, for example the Purple Air map default is to show the AQI level from the last 10 minutes. The numbers on government sites, such as AirNow and the Fire and Smoke Map, use a NowCast averaging time of 3-12 hours. If the air quality is changing rapidly, the two numbers could be very different.
- » Even when a correction factor is applied to sensors (for example, Purple Air data on the Fire and Smoke Map), sensors are less accurate than government air quality monitors.
- » A commercial site or device may use a different color scheme or AQI category cut-off than the official AQI.
- » Sometimes the air quality is different even over a short distance. If your closest agency monitor is not very close, your local air quality measured by a nearby sensor may be different than the air quality around the agency monitor.

Appendix B: Indoor Air Quality Monitoring

A portable handheld sensor can show how indoor PM2.5 levels vary throughout a facility. A stationary indoor sensor can track changes in indoor air quality over longer periods. See [Wildfire Smoke Guidance for Canceling Events or Activities and Closing Schools](#) section “Indoor PM2.5 Measurement in Schools” for more information about using indoor sensor data for decisions that need to be made in advance. Use the information below for immediate decision-making.

If you don't have an indoor air sensor:

If you're not sure whether indoor PM2.5 levels are lower than outside, assume levels are similar and increase steps to reduce exposure, including filtration methods. Using a low-cost sensor can give you a better idea of your indoor PM2.5 levels. If you're considering purchasing a low-cost PM2.5 sensor, check the performance evaluations developed by the [South Coast AQMD](#). A Field R-squared value near 1 and a relatively low Field MAE indicate a better-performing sensor.

If you do have an indoor air sensor and/or a portable handheld sensor:

Low-cost sensors can be used to take PM2.5 measurements to check indoor air quality. They are generally less accurate than agency air monitors, though correction factors can be applied to reduce bias. Sensor measurements can vary in three important ways: whether correction factors are applied (for example, a Purple Air that is used indoors with the US EPA correction factor applied), the time interval used for data averaging, and whether the sensor displays the AQI or the PM2.5 concentration in $\mu\text{g}/\text{m}^3$ units. To the extent possible, only compare data that is similar in these three ways (e.g., do not compare uncorrected sensor data to corrected sensor data or AQI breakpoints; do not compare real-time sensor data to longer-term averages). EPA provides a calculator to convert between PM2.5 concentrations and AQI values: <https://www.airnow.gov/aqi/aqi-calculator>.

If indoor sensor shows...	...then...
<p>Corrected real-time or 10-minute PM2.5 concentrations in $\mu\text{g}/\text{m}^3$</p>	<ul style="list-style-type: none"> » Compare sensor data to 10-minute or 1-hour data from Washington Smoke Blog or Fire and Smoke Map (see screenshots below). » Prior to each decision-point (e.g., before starting indoor recess or indoor PE class), check that the indoor real-time or 10-minute PM2.5 concentration is not elevated when deciding about activity intensity. During smoke periods, the threshold of $35.5 \mu\text{g}/\text{m}^3$ is a useful target of indoor concentration (the lower the better). Check sensor measurements again every 30 minutes and change activity decisions accordingly.
<p>Uncorrected real-time or 10-minute PM2.5 concentrations in $\mu\text{g}/\text{m}^3$</p>	<ul style="list-style-type: none"> » No direct comparison to the AQI or a specific target concentration is possible. » Instead, compare indoor and outdoor sensor measurements to each other to estimate indoor concentrations. For example, if the indoor PM2.5 sensor measurements are half of the outdoor PM2.5 sensor measurements, assume that the indoor PM2.5 concentrations are half what is reported by the nearest 10-minute or 1-hour data from Washington Smoke Blog or Fire and Smoke Map (see screenshots below). » Example: outdoor sensor measurement = $100 \mu\text{g}/\text{m}^3$ and indoor sensor measurement = $50 \mu\text{g}/\text{m}^3$ indoor is half of outdoors. » Washington Smoke Blog measurement = $76 \mu\text{g}/\text{m}^3$ new indoor concentration estimate is half of 76, which is $38 \mu\text{g}/\text{m}^3$. » Use this new indoor concentration estimate: Prior to each decision-point (e.g., before starting indoor recess or indoor PE class), check that the indoor real-time or 10-minute PM2.5 concentration is not elevated when deciding about activity intensity. During smoke periods the threshold of $35.5 \mu\text{g}/\text{m}^3$ is a useful target of indoor concentration (the lower the better). Check sensor measurements again every 30 minutes and change activity decisions accordingly.

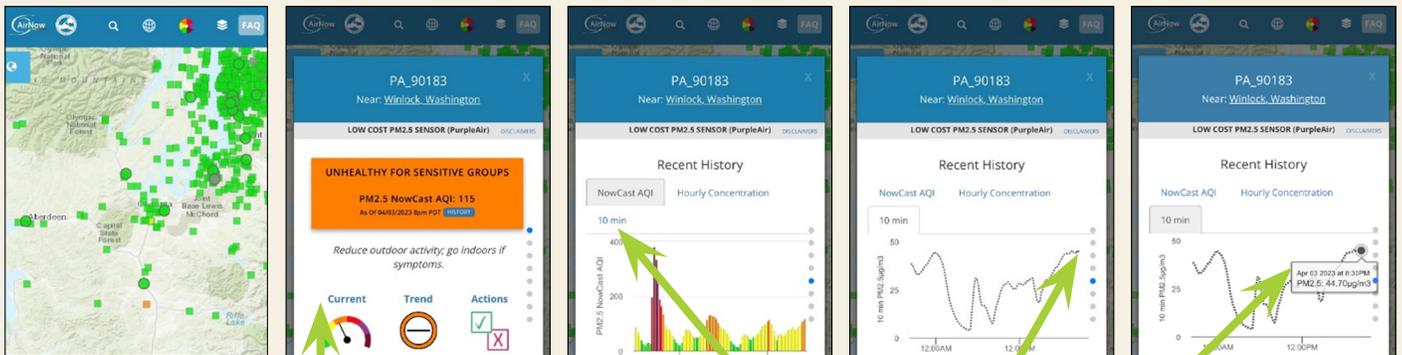
When indoor PM2.5 concentrations are higher than outdoor, opening windows can help clear out indoor PM2.5. When outdoor PM2.5 concentrations are higher than indoor, closing windows can help keep PM2.5 out. At the same time, pay attention to the indoor and outdoor temperatures when opening or closing windows to keep it from becoming too hot or cold indoors. When opening windows, continue checking sensor measurements every 30 minutes.

If you have a portable handheld sensor:

When outside PM2.5 levels reach “Unhealthy for Sensitive Groups,” assess variation across the building(s)

- » Include measurements in rooms used by children and youth that are expected to have worse ventilation or indoor air quality (like no air filtration), rooms where physical activity is usually more vigorous (like the gym), rooms with external doors opened frequently, any external buildings (like portables), and rooms with children who may be more sensitive to air pollution.
- » Wait for sensor measurements to stabilize in each room (about 1-2 minutes for measurements that appear to change in real-time on a screen).
- » Repeat the portable sensor measurements in different conditions, such as changes in occupancy, and repeat prior to each decision-point.
- » If you have more than one option for where to hold indoor recess, use a portable sensor to choose the location with lower PM2.5.
- » Prioritize steps to reduce exposure in the rooms with highest PM2.5 levels.

How to get 10-minute (corrected sensor data) or hourly (agency monitor) PM2.5 concentrations from the [Washington Smoke Blog](#) or [Fire and Smoke Map](#):



1. Click or tap on the monitor (circle) or low-cost sensor (square) closest to you
2. A window like this should pop up
3. Scroll down within the pop-up window to get to “Recent History”
4. Select the “10 min” tab if available, otherwise select “Hourly Concentration”
5. Tap, click, or hover on the end of the graph
6. This number is NOT THE AQI. This is the PM2.5 measurement.

(Screenshots are from the “Smoke” tab of the AirNow phone app, April 2023.

Indoor air pollution is made up of outdoor air pollution that comes inside, and pollution that comes from indoor sources. Consider monitoring for air pollutants besides PM2.5, such as carbon monoxide (CO) and carbon dioxide (CO2).

Appendix C: Improving Indoor Air Quality

During outside air pollution events, reducing additional air pollution as much as possible to reduce exposures is especially important. Limiting both outdoor activities, like vehicle idling, vehicle transit, and outdoor burning, as well as indoor activities, like vacuuming (without a HEPA filter) or burning candles, all help reduce exposure.

Outside PM2.5 gets indoors through windows, doors, small openings, and some ventilation systems. Buildings with well-maintained and enhanced filtration (i.e., MERV 13 or higher) in the ventilation system have improved indoor air quality and should run the HVAC fan continuously. Supplementing with HEPA portable air cleaners or DIY box fan filters can reduce PM2.5 in single rooms. Use HEPA portable air cleaners that are [AHAM Verifide](#) to have a Clean Air Delivery Rate (CADR) indicating it is properly sized and [CARB-Certified](#) to generate little or no ozone. Do not use ozone generators, ionizers, UV or other additive technologies in air cleaners. See [Improving Ventilation and Indoor Air Quality During Wildfire Smoke Events](#) and [ASHRAE Protecting Building Occupants from Smoke](#)

Extreme heat can overlap with wildfire season. Have plans for keeping buildings cooler to avoid the need to open windows during wildfire smoke if there is no air conditioning. See [Cooling Indoor Spaces Without AC](#).

If wildfire smoke events are occurring at the same time as transmission of respiratory viruses, such as COVID-19 or other respiratory infections, it is important to balance the risk of both hazards when bringing children and youth inside to reduce exposure to smoke. Indoor air filtration mitigates the risk of both smoke and respiratory viruses. For more information, see [WA DOH's Recommendations for wildfire smoke and respiratory viruses](#).