



WASHINGTON DOH GUIDANCE ON INDOOR AIR QUALITY SENSOR USE

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WA DOH School Env. Health & Safety and IAQ Program
October 2023 • ELI Fall Workshop

Overview

- Air quality groups at DOH
 - “Climate and Health” section
 - Wildfire Smoke Impacts Advisory Group
- WA Children and Youth Activities Guide for AQ
 - What it is
 - New sensors guidance (**appendices**)
- (For your review later - ongoing work at WA DOH)

AQ Groups at WA DOH

Air Quality at WA DOH: Two Groups

Environmental Public Health Division

Office of Environmental Health & Safety

Local Health Support Section

School Environmental
Health & Safety and
Indoor Air Quality
Program

Office of Environmental Public Health Sciences

Climate & Health Section

Air Quality Unit

Other groups in our offices cover topics such as wildfire event health data, tobacco smoke, radon, toxicology

Air Quality at WA DOH: Climate & Health Section

- Environmental justice*
- **Wildfire smoke, AQ**
 - Smoke From Fires
- Harmful algal blooms*
- Extreme Heat
 - Hot Weather Precautions
- Pollen (new)
- Vector-borne disease



*Positions coming soon

Wildfire Smoke response across our offices

Review evidence
& best practices

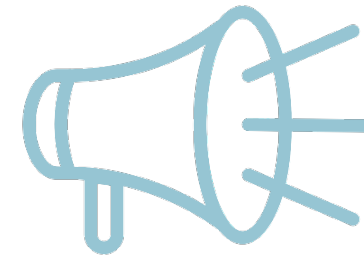


Develop guidance
& materials

Work with
partners



Emergency
Preparedness
& Response



Share
resources



Syndromic Surveillance

(to be applied to other pollutants)

Washington Wildfire Smoke Impacts Advisory Group

Formed at the request of local health jurisdictions in 2018.

Goals

- Develop and improve evidence-based health guidance
- Achieve more consistent health messaging across agencies

33 Members, including:

- WA Dept of Health and local health jurisdictions
- WA Depts of Ecology, Labor & Industries, and Natural Resources
- Regional clean air authorities
- Tribal communities
- University of Washington
- EPA and USFS

One-Pager: [333-242-WFSImpactsAdvisGroupFINAL.pdf \(wa.gov\)](#)

WA Children and Youth Activities Guide for AQ

Washington Children and Youth Activities Guide for Air Quality



Check current and forecast air quality at AirNow.gov, or during wildfire smoke at WasSmoke.blogspot.com
(See Appendix A)

The following public health recommendations are to protect children and youth (18 years and younger) from fine particle air pollution (PM2.5). 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.

Outside Air Quality Index (AQI): PM2.5

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 PM2.5 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 PM2.5 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 PM2.5 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 PM2.5. See Appendix C. To measure indoor PM2.5 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).

Wildfire Smoke - Partner Toolkit | WA DOH

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, "General Physical Activities Defined by Level of 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 PM2.5 below 150.5 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 .

Plus Appendices A, B, and C

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 (PM2.5). 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](#) or during wildfire smoke at [WashMoka.blog.gov.wa.gov](#). (See Appendix A)

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ADDITIONAL CONSIDERATIONS

Close windows and doors when activities are moved indoors. Pay attention to the indoor air quality.

Indoor air filtration can reduce elevated levels of indoor PM2.5. See Appendix C. To measure indoor PM2.5 levels, see Appendix B.

Consider time spent in transit as part of 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).

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.

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Outdoor Air Monitoring: Use air pollution forecasts and government agency monitors on [AirNow.gov](https://www.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.

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New to Activities Guide: Sensors

- Regional agencies, local health already deploying sensors to schools
 - School, public health partners asking for guidance
- Sensors fill important gap when used appropriately: Real-time info for decisions
- Not simply “plug-and-play” and require resources (marketing).

It would be great if people were using these sensors with guidance.

See the appendices.

Activities Guide: Appendix A

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

Appendix B: Indoor Air Quality Monitoring

Appendix C: Improving Indoor Air Quality

- Where to find data:
 - Airnow - sensors on Fire & Smoke Map
 - WA Smoke Blog
- Data quality, caveats
- Decision scenarios

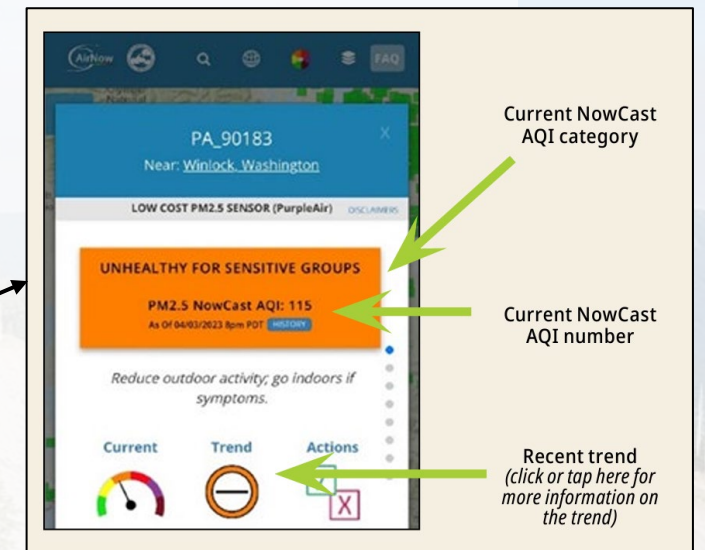
Appendix A: Outdoor Air Quality Monitoring for Decision Making During Wildfire Smoke Events

- Low-cost sensor data can be inaccurate
 - Correction factors help: AirNow Fire and Smoke Map –for wildfire smoke.
 - Proximity affects: Data differ by distance, elevation, terrain, weather...
- Data quality unknown
 - Location, indoor/outdoor could be wrong.
 - Sensor could be at someone's barbecue.

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

Decision-making scenarios

- Athletic events with logistics (in the future)
 - Use AQI forecasts - 24 hours; smoke can fluctuate
- Summer camp activities (long-duration)
 - Use [NowCast](#) (hourly), keep checking
- Recess (within the hour)
 - Use 30 min sensor data: click on “trend”



Activities Guide: Appendix B

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

Appendix B: Indoor Air Quality Monitoring

Appendix C: Improving Indoor Air Quality

- If you don't have indoor sensors
- Selection
- Decisions:
 - Comparing indoor to outdoor
 - Correction factors
 - Getting fresh air
 - Handheld data

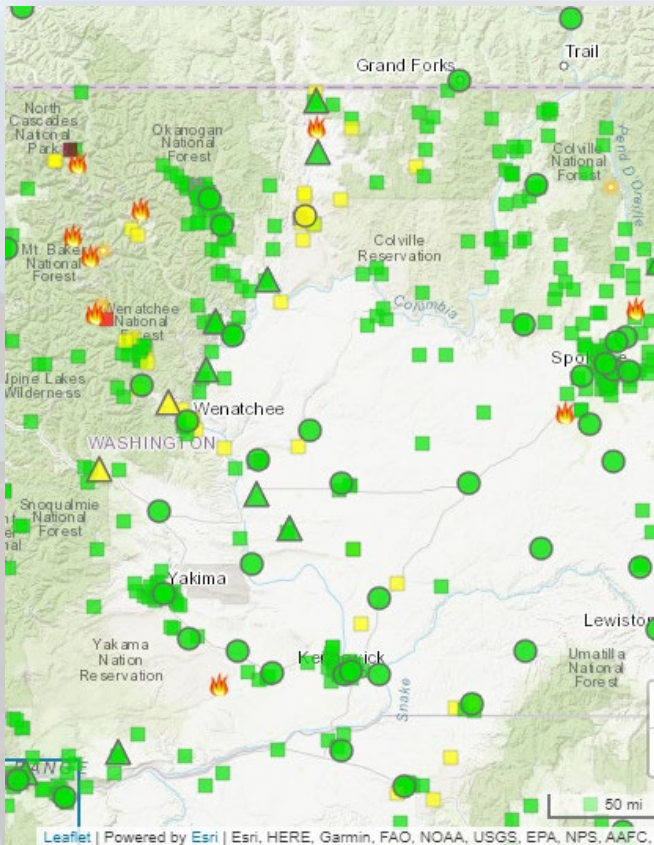
Appendix B: Indoor Air Quality Monitoring

- **Hardly anybody has indoor sensors yet**
 - Assume indoor conc same as outdoor, take measures
- **When and where to deploy indoor sensor types**
 - Stationary sensors: track changes in IAQ over longer periods
 - Portable handheld sensors: variation throughout a facility
 - Do when “Unhealthy for Sensitive Groups” outside
 - Focus where AQ worst, activity vigorous, sensitive kids
 - Goal: choose which rooms to occupy

An Indoor “Threshold”

- We kind of use $35.5 \mu\text{g}/\text{m}^3$ - effectively threshold for limiting outdoor activities
- Was on front table; now just in Appendix B
 - *“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).”*
 - This concentration still not healthy
 - Not every school needs an indoor sensor

Appendix B: Indoor Air Quality Monitoring

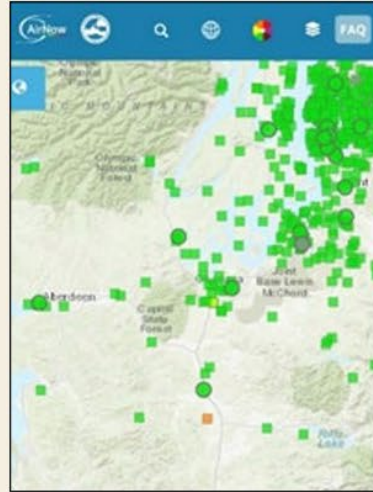


<https://wasmoke.blogspot.com/>

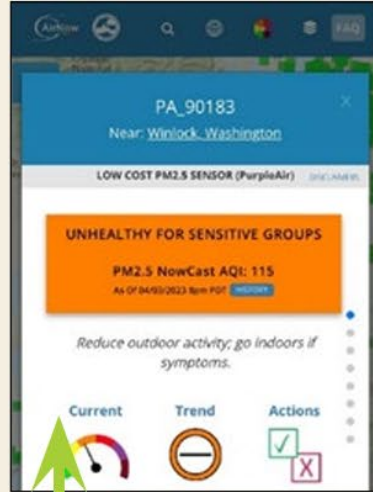
- Compare to verify – must be the same:
 - Correction factors applied
 - Averaging time interval
 - Measurement (AQI or PM_{2.5} conc.)
- *Indoor/outdoor ratios - can't scale from non-wildfire*

Appendix B: Indoor Air Quality Monitoring

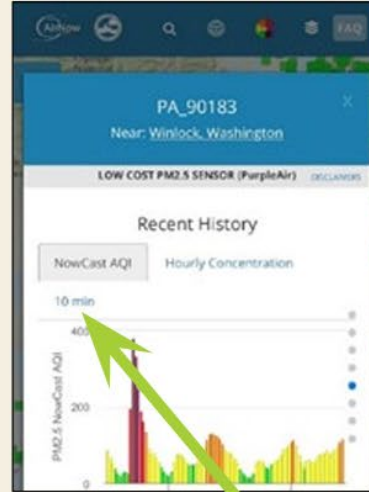
How to get 10-minute (corrected sensor data) or hourly (agency monitor) PM2.5 concentrations from the [Washington Smoke Blog](#) or [Fire and Smoke Map](#):



1. Click or tap on the monitor (circle) or low-cost sensor (square) closest to you



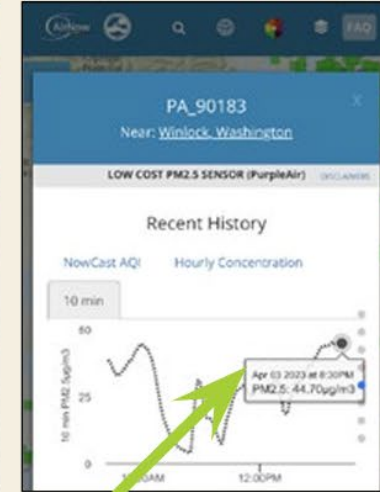
2. A window like this should pop up



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.)

Activities Guide: Appendix C

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

Appendix B: Indoor Air Quality Monitoring

Appendix C: Improving Indoor Air Quality

Tips for better IAQ:

- Reducing other pollutants
- Ventilation, filtration
 - Portable units - no added technologies
- Overlapping heat, airborne illness
 - *Also see [Recommendations for wildfire smoke and COVID-19](#) (heat too)*

Ongoing Work on Sensors and Smoke in Washington

- **Sensor protocol** – how to use sensors (Climate & Health, in progress)
 - Benefits and limitations of different types of PM_{2.5} sensors
 - Siting stationary sensors, instructions for using handheld sensors
 - Using sensor data for decision-making
- **Children and Youth Activities Guide**
 - Continuous, annual review through engagement, feedback, and revision
- **DOH School EHS Fall Workshop** – indoor air monitoring on the agenda
 - Updates to school, local health staff – to include sensor thoughts, case studies
- **Rulemaking on outdoor workers in wildfire smoke** (WA Labor and Industries)
 - Voluntary, required interventions at specific extreme PM_{2.5} concentrations
- **Studies** (Climate & Health with partners) – in childcares (sensors), long-term care facilities (filtration), schools (HVAC), homes (cleaner air rooms)

Questions & Discussion

Thank You

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Washington State Department of Health



@WADeptHealth



To request this document in another format, call 1-800-525-0127. Deaf or hard of hearing customers, please call 711 (Washington Relay) or email civil.rights@doh.wa.gov.

Read the following slides later for ongoing projects



Carbon Monoxide HB 1779 - 2023-24: Interagency Workgroup Formed

- Spurred by state patrollers in their vehicles
- Purpose of workgroup:
 - Look into tracking of exposures, causes
 - Recommend policy, other actions
 - Identify federal funding
- ***Please share ideas! Thanks to Florida DOH and Minnesota DOH.***



Image Source: CC BY 2.0 2019 Fred Barr, Flickr Creative Commons

Temperature in Schools (Forthcoming Two-Pager)

- Students do not learn well at elevated temperatures
- **Min temp** ([WAC 246-366-090](#)) **65 °F** (60 °F gym)
- **No statewide max temp**
 - “Excessive heat” is prohibited ([WAC 246-366-080](#))
- Recommend [ASHRAE 55](#) for thermal comfort
 - [Washington Sustainable Schools Protocol](#)
- ***Please share resource ideas!***

Resources We Like So Far:

[ASHRAE Center for the Built Environment \(CBE\) Thermal Comfort Tool](#)

[Cooling indoor spaces without air conditioning \(wa.gov\)](#)

[Child Care Weather Watch \(c-uphd.org\)](#)

[Protecting-Californians-with-Heat-Resilient-Schools.pdf \(ucla.edu\)](#)

Our IAQ Website! www.doh.wa.gov/iaq



Indoor Air Quality

Indoor air quality can have a significant effect on your health. Studies show that people spend 65 to 90 percent of their time indoors, and indoor air can be two to five times more polluted than outdoor air. The young, elderly, chronically ill, and those with respiratory or cardiovascular disease are often the most impacted by poor indoor air quality.

[Asbestos](#)

[Mold](#)

[Asthma](#)

[Outdoor Air](#)

[Bleach Mixing Dangers](#)

[Pesticides](#)

[Carbon Monoxide](#)

[Radon](#)

[Fiberglass](#)

[Renters, Landlords, and Mold](#)

[Formaldehyde](#)

[School Indoor Air Quality](#)

[Hiring an Investigator or Contractor](#)

[Tobacco](#)

[Mercury](#)

[Vapor Intrusion](#)

Handouts and Resources -
Ventilation and cooling:

[Ventilation and Air Quality for Reducing Transmission of Airborne Illnesses \(PDF\)](#)

[Cooling Indoor Spaces Without Air Conditioning \(PDF\)](#)

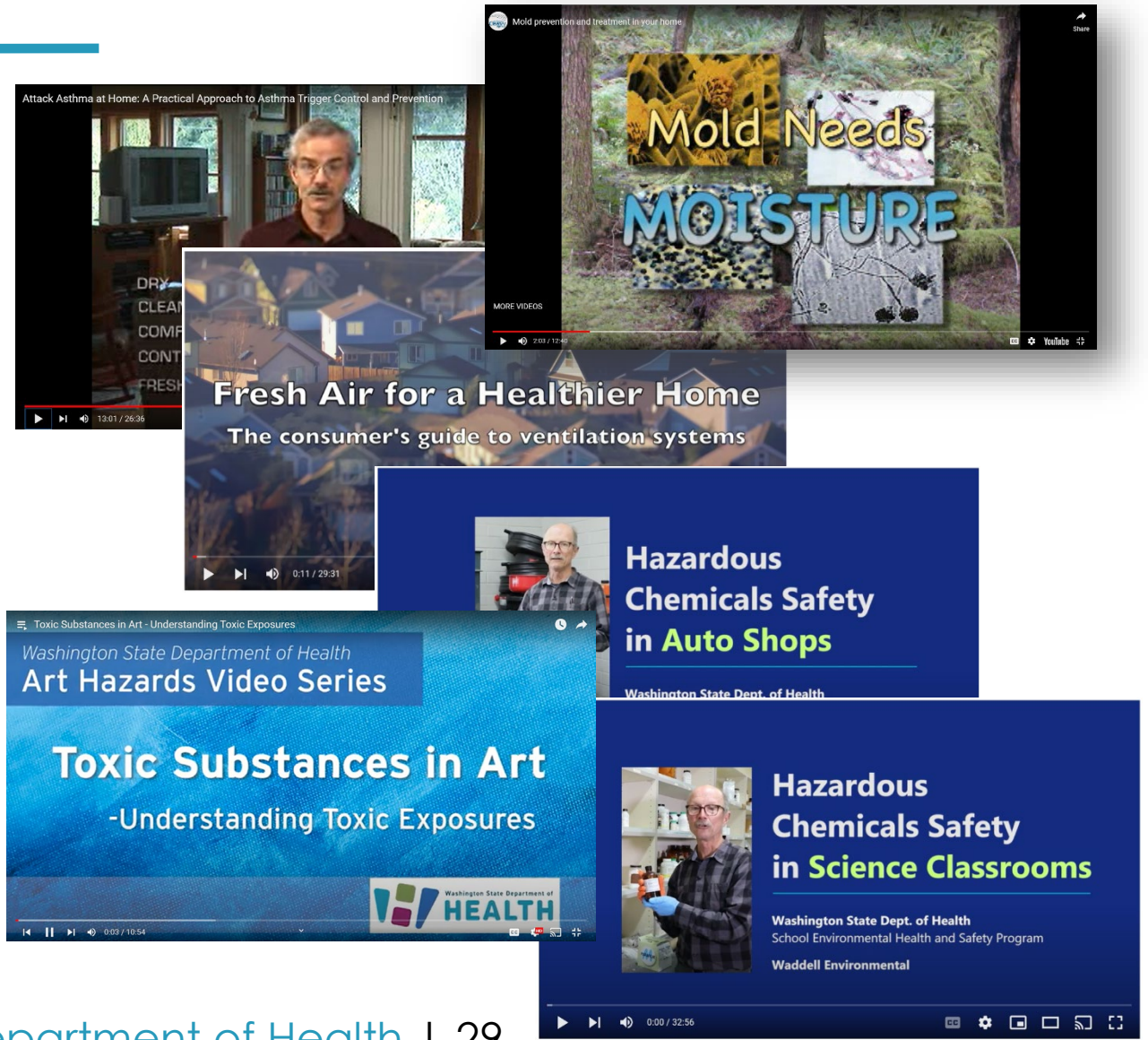
Contacts:

Email: indoorairquality@doh.wa.gov

Mold information line: 360-236-3090

Our IAQ Website! www.doh.wa.gov/iaq - Videos

- [Mold Prevention](#)
- [Asthma Trigger Control](#)
- [Healthy Home Air](#)
 - Ventilation and exhaust systems
 - HRV/ERV systems
 - Installation, inspection, upgrades
- Schools - Hazardous Chemical Safety in:
 - [Auto Shops](#)
 - [Art Classrooms](#)
 - [Science Classrooms](#)
- [Toxic Substances in Art Series](#)



Activities Guide: Key Technical Issues and Questions

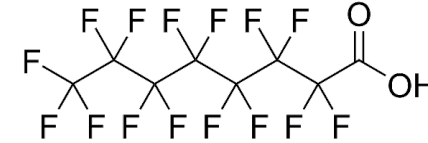
Other 2023 Updates

- Changed guidance language: “Consider canceling” 1-4 hour activities at Unhealthy for Sensitive Groups (AQI 101-150)
 - *Language is key: recently added [FAQs](#) to address what “consider canceling” means*
 - *Concern from athletics organizers about opportunity for exercise, achievement*
 - *Some areas of WA inundated with smoke for weeks or longer:
[Clean Air Methow](#) • [The Fifth Season community listening project](#)*
 - *With research on short-term smoke impacts for kids still developing, how much precaution should we recommend?*
- Activity durations (broader, camps)
 - *How do organizations match this guidance with their activities?*
- Added “youth”
 - *What is the definition of “child”? 18 or 21?*

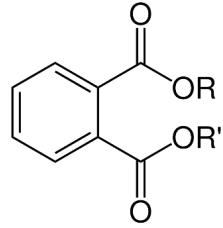
Measure of success: Vermont DOH adopted Washington’s Air Quality Guidance for schools.

Safer Products for Washington

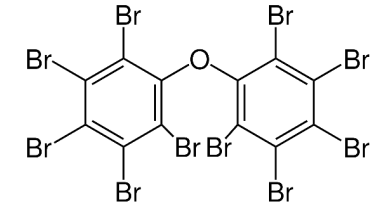
- Regulates chemicals by class, reduces the likelihood of swapping out one toxic chemical for another (Department of Ecology, 2019).
- Cycle 1: Rule adopted May 2023. Manufacturers must restrict use if there is a safer alternative or report to Ecology (Jan 2025).
 - Priority chemical classes:
 - **PFAS** in aftermarket stain- and water-resistance treatments, carpets and rugs, and leather and textile furnishings.
 - **Ortho-phthalates** in vinyl flooring and in personal care product fragrances.
 - **Organohalogen flame retardants** in electric and electronic products.
 - **Flame retardants** (as defined in RCW 70A.350.010) in recreational polyurethane foam.
 - **Phenolic compounds** in laundry detergent, food and drink can linings, and thermal paper.
- Cycle 2: In Phase 1 (Identifying chemicals). Open for public comment.
 - Draft priority chemical classes:
 - **Lead and lead compounds**
 - **Brominated and/or chlorinated substances** (very broad)
 - **BTEX substances**
 - **Formaldehyde and releasers**
 - **cVMS** (cycle volatile methylsiloxanes such as D4, D5, D6)
 - **6PPD** (N-(1,3-Dimethylbutyl)-N'-phenyl-p-phenylenediamine)



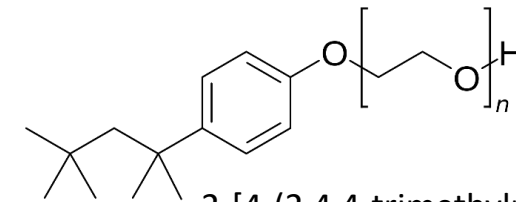
Perfluorooctanoic acid (PFOA; Wikipedia)



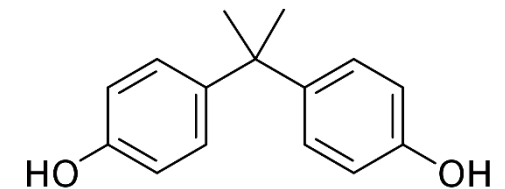
Orthophthalates (Wikipedia)



Decabromodiphenyl ether (decaBDE; Wikipedia)



2-[4-(2,4,4-trimethylpentan-2-yl)phenoxy]ethanol (Wikipedia)



Bisphenol A (BPA; Wikipedia)