

INDOOR AIR QUALITY AT JEFFCO PUBLIC SCHOOLS

In light of the pandemic, the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE), the Center for Disease Control (CDC), and the Environmental Protection Agency (EPA) have all made recommendations on how to mitigate the transmission of SARS-CoV-2 in buildings.

The recommendations pertaining to building operations include: **increasing outside air intake through HVAC equipment, flushing building air before and after occupation, increasing the filtration of the HVAC provided air, UVGI air disinfection, and providing portable HEPA air filters.**

Many news outlets and researchers have honed in on providing portable HEPA air filters as “the” solution -- because these units are effective in cleaning the air and are an easy option for building operators who may not have the means to provide increased ventilation and filtration through their HVAC systems. With regard to high indoor air quality there are many means to meet the end.

At Jeffco, we are committed to providing safe and clean spaces for our students, educators and staff. We are doing so through implemented, well researched solutions that ensure consistent, fresh air in our buildings and classrooms.

HELPFUL TERMS

American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE):

ASHRAE is a diverse organization dedicated to advancing the arts and sciences of heating, ventilation, air conditioning and refrigeration to serve humanity and promote a sustainable world.

Ultraviolet Germicidal Irradiation (UVGI):

The use of ultraviolet (UV) energy to kill viral, bacterial, and fungal organisms.

Heating, Ventilation, and Air Conditioning (HVAC):

A heating and cooling system that uses fresh air from outdoors to provide high indoor air quality.

High Efficiency Particulate Air (HEPA) Filter:

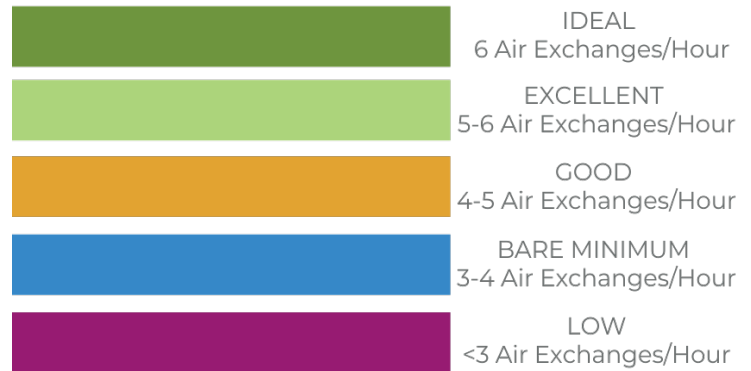
A type of air filter that can theoretically remove at least 99.97% of dust, pollen, mold, bacteria, and any airborne particles with a size of 0.3 microns (μm).

Minimum Efficiency Reporting Values (MERV):

A value that reports a filter's ability to capture larger particles between 0.3 and 10 microns (μm).

WHAT IS CLEAN AIR?

ASHRAE defines proper ventilation rates for various space types and occupancies — which are often adopted for building codes — as 4-6 Air Changes per Hour (ACH), depending on the size of room. Hospitals provide 6-15 ACHs depending on the room application, according to the CDC. The chart to the right shows a general scale and targets for air exchanges per hour.

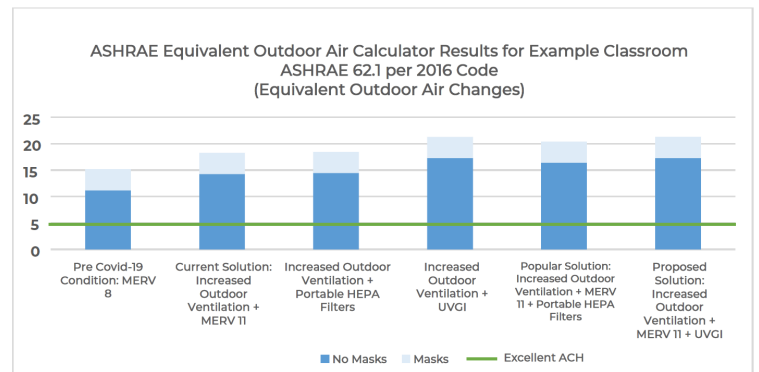
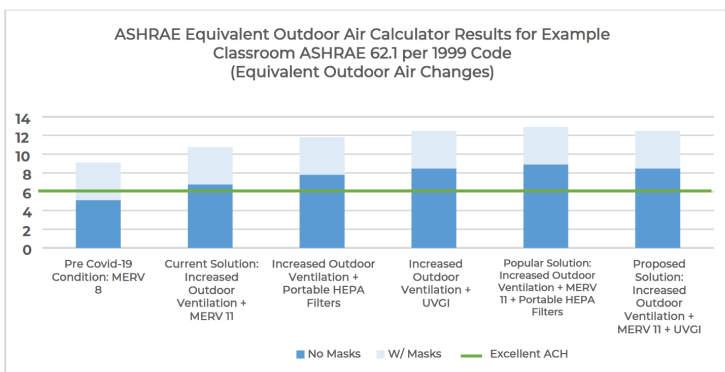


Source: Harvard T.H. Chan School of Public Health

At Jeffco Public Schools, we have studied ACH rates through a sampling of various district classrooms — illustrated in the chart below. In column three, you can see the number of air changes per hour for a sample of Jeffco classrooms. Columns six through eight show the increase in outside air ventilation being provided since start of school 2020.

Increase in Outside Air (OA) Changes per Hour (ACH) August 2019 vs. August 2020-Current							
Room/Air Handler	Room Volume (ft ³)	Total Air Changes per Hour	2019 Outside Air %	2019 Outside ACH	2020 Outside Air %	2020 Outside ACH	Increase in OA ACH
Alameda HS A116 / AHU2	8,389	7.9	10%	0.79	35%	2.78	2.0
Alameda HS A219 / AHU1	11,657	6.9	10%	0.69	35%	2.43	1.7
Edgewater ES 212/ RTU1	5,508	13.3	19%	2.53	34%	4.52	2.0
Summit Ridge MS 403 / AHU2	8,064	12.2	11%	1.33	27%	3.25	1.9
Witt ES A102 / AHU1	5,536	8.0	30%	2.41	40%	3.21	0.8
Kyffin ES Classroom pre-construction	7,614	10.6	20%	2.13	35%	3.72	1.6
Kyffin Classroom post-construction	7,614	17.3	20%	3.47	35%	6.07	2.6
Maple Grove ES Classroom	8,289	9.0	15%	1.36	35%	3.17	1.8
Mitchell ES Classroom	7,359	8.5	10%	0.85	25%	2.12	1.3
Shelton ES Classroom	7,299	9.2	10%	0.92	25%	2.30	1.4

The charts below show how many equivalent outdoor air changes we are providing in a typical classroom that meets code requirements for 1999 and for 2016, for mask wearing and no mask wearing, and for current and proposed increased indoor air quality (IAQ) methods. These values were found using the ASHRAE's Equivalent Outdoor Air Calculator. Given the high levels of Outdoor Air Equivalent ACH, **Jeffco Public Schools is providing excellent IAQ.**



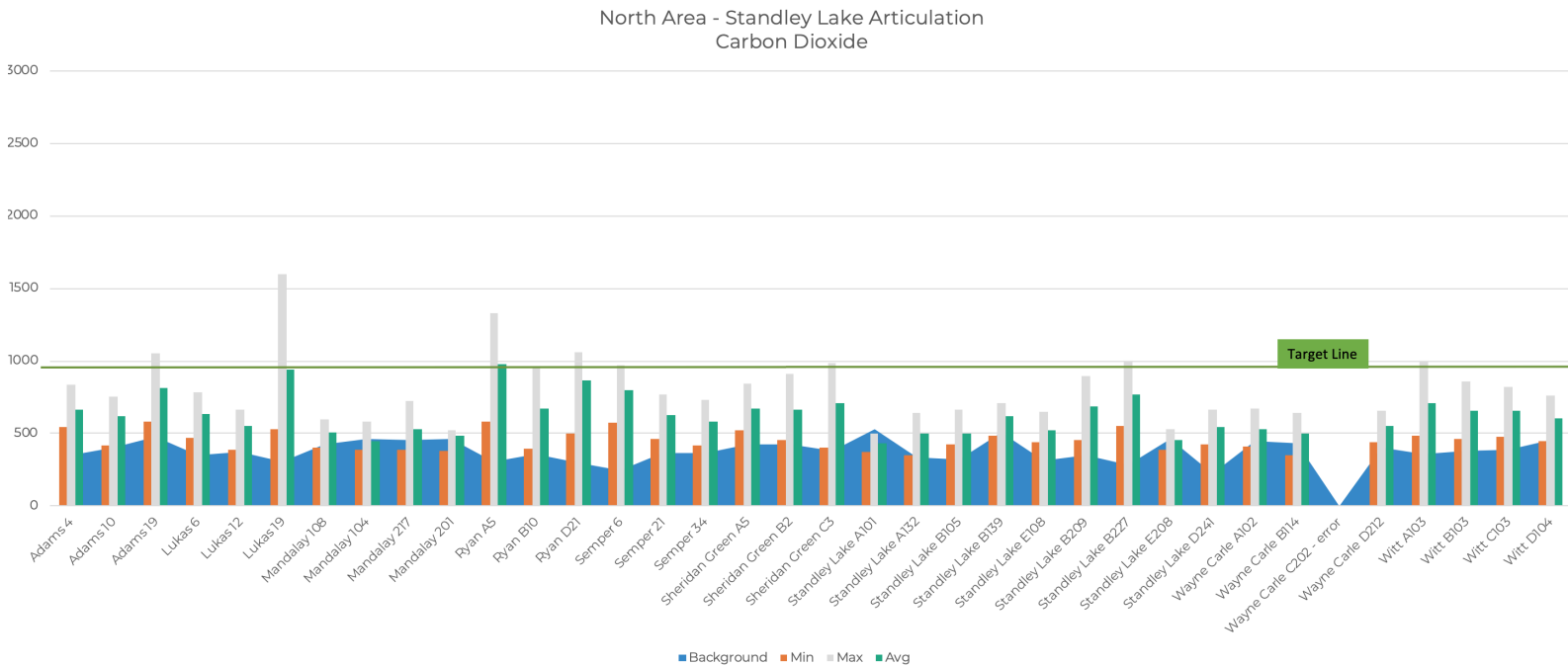
MEASURING CLEAN AIR

ASHRAE targets CO2 concentration as less than 700 parts per million (ppm) above the background (outside) value.

The chart below illustrates our findings for CO2 sampling in classrooms in the Standley Lake Articulation Area. Any consistent **measurement above 1000 ppm resulted in a maintenance work order to address airflow issues with that classroom's air handler.**

Please know that many high max CO2 measurements are often the result of a short spike when a curious occupant breathes directly on the meter. So a high max measurement in your school does not necessarily mean poor ventilation.

Sampling and re-sampling will resume this fall (2021) to ensure proper ventilation in all articulation areas. **Given the low levels of CO2 ppm, Jeffco Public Schools is providing excellent IAQ.**



Want to learn more?
Visit jps.click/AirQuality

WHAT ABOUT HEPA FILTERS?

Many resources also argue that providing increased filtration through HEPA filters can't hurt. This is a broad assumption.

Jeffco Public Schools' Facilities Department **has not been using these methods, because as experienced facility caretakers, we see faults in them.**

ASHRAE and CDC both recommend high filtration methods, but also warn against providing increased filtration to the point of creating equipment failures or significantly decreasing ventilation rates. The recommendations given are made for a multitude of building operators and building types. They are meant to be layered as appropriate for your building's operational capabilities. Not all solutions will be the same for all buildings and operators. Not all building operators have the capability to program their building automation software to increase ventilation at all sites. **Jeffco Public Schools can and has automated their systems to increase ventilation at all sites since start of the 2020 school year.**

Not all school districts have a robust Environmental Services group who can sample the entire district to ensure low CO2 levels and proper IAQ in classrooms. **Jeffco Public Schools has such a team and started this sampling when students returned to buildings in April, 2021.**

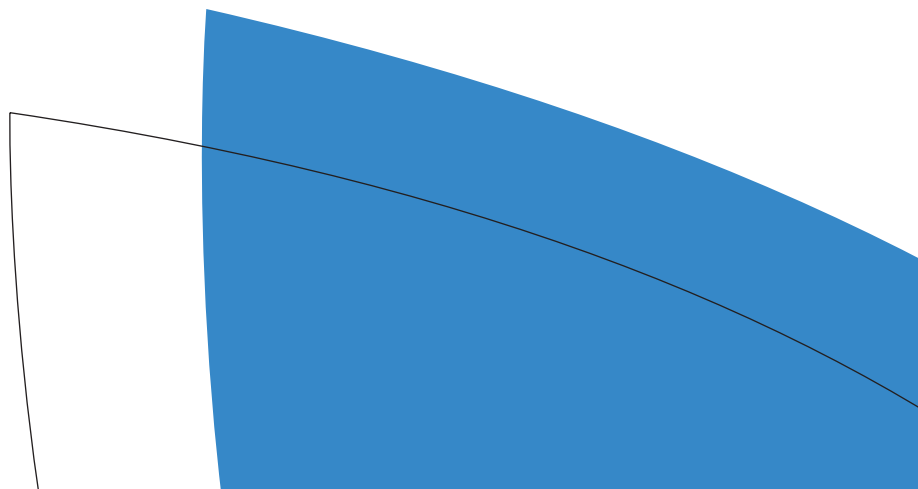
These actions will continue throughout the pandemic to ensure excellent IAQ in all Jeffco Public Schools' buildings.

WHY MASKS ARE STILL IMPORTANT

The path of viral laden vapors starts by being projected from an infected occupant — be it from a sneeze or a conversation.

This concentrated projection lingers near occupants' breathing zone until it eventually dissipates. If the projection of these vapors is mitigated by a mask, our body heat will help deliver them up and away from the breathing space to the HVAC returns in the ceiling.

[Masks also protect the wearer against these concentrated vapor sources](#) so that discussions and sneezes can take place without exposure. Increasing ventilation and filtration of air in a space will decrease the overall concentration of virus in the air, but it does not target concentrated sources of vapors. So we need multiple mitigation strategies.



Why we are not implementing MERV 13 Filters or higher in our HVAC equipment:

These filters are very dense and trap a lot of particulates so they will...

- Need to be replaced 4x per year, we simply cannot keep up with the cost and replacement of these filters;
- Create considerable drag on our HVAC equipment which leads to failures and lack of ventilation;
- Retransmit pathogens to the airflow when filters are dirty;
- Work against our chosen method of increasing outside air ventilation by putting drag on fans.

Upgrading our filters to MERV 11 is the *sweet spot* for being able to filter out larger droplets in the air and provide higher outside ventilation rates, while also keeping our systems operating continuously for the school year.

Why we are not implementing portable HEPA filters in classrooms:

- If these filters are not changed often they will retransmit pathogens to the airflow -- there is no notification for when this happening;
- These units create a small amount of noise, 25-50 dB. It's not much, but we try to limit the HVAC noise level in the classroom to 30dB. When noises are layered, they build upon each other. Having these units in the classroom can lead to students and teachers not being able to hear - which may encourage removal of masks in order to be heard while speaking;
- It is difficult to place one to two portable units in our classrooms in a way that they will not draw air from infected occupants across healthy occupants. All portable HEPA air filter manufacturers warn against improper placement, so does ASHRAE and the EPA;
- In [a recent CDC experiment](#), portable HEPA filters are shown to be effective, but also create higher exposures for occupants placed between an infected occupant and the portable HEPA filter. This study **also makes a strong case for wearing masks**;
- The Jeffco Public Schools Facilities Department is pursuing a district wide implementation of Ultra Violet Germicidal Irradiation (UVGI) equipment for our HVAC equipment. UVGI achieves the same level of air filtration as HEPA filters in the HVAC.

SUMMARY

Our **air handling systems have an ACH range of 5-13**, while portable units have an ACH range of 0.5 -3. Even if you put two portable units in the room, they can't keep up with the HVAC system.

We can do so much more by combining mask wearing and body heat with increased ventilation and centralized filtration and not take on the risk, maintenance, and nuisances of individual filtration units.

So we are putting our focus on our HVAC systems.