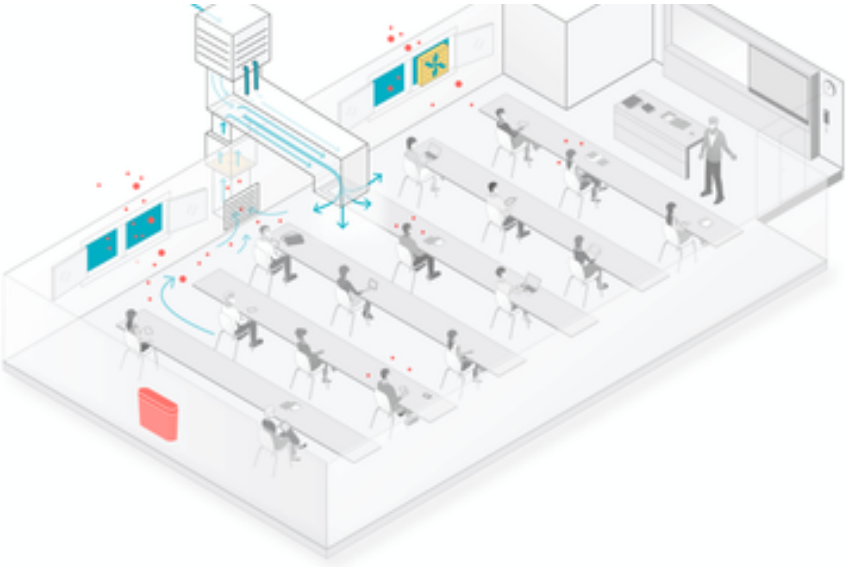


Ventilation and air filtration play a key role in preventing the spread of COVID-19 indoors

As schools and offices open up, here's what building managers should do to reduce SARS-CoV-2 particles in the air we breathe

Ramon Padilla, USA TODAY

Updated 7:38 p.m. EDT Oct. 19, 2020

As the nation reopens after COVID-19 restrictions, people across the country are making decisions about going back to the office or putting their children back in classrooms. But how can you make the right call? We asked the experts how to improve indoor air quality, and what questions to ask your boss or school administrator.

“Often indoors, people are the source of contaminants,” says Dr. Shelly Miller, a professor of mechanical engineering at the University of Colorado Boulder.

Your chances of being infected depend on the size of the room and the number of people infected with COVID-19 inside.

“When they talk, talk loudly, when they breathe, small respiratory aerosols are released,” Miller said.

If you’re in a classroom, office or other enclosed space, these aerosols can build up over time.

“It’s like if you’re in a smoky bar,” Miller says. “When it opens, there’s not a lot of smoke, but the more people smoke, it becomes a cloudy room. You can think of virus being released like that.”

What is ventilation rate and air change, and why is it important for COVID-19?

As you consider going back to the office or putting your kids back in school, knowing air quality terminology can help you ask the right questions.

The **ventilation rate** is the volume of outside air provided per unit of time.

Air change rate is the ventilation rate of a space divided by the volume of that space.

“The air change rate tells you how fast you can clear the room from any airborne contaminants," Miller says. “And specifically for coronavirus, If you can clear any airborne virus out quickly, you’ll reduce the transmission risk.” Most air-conditioning and heating systems cycle about 20 percent of fresh air into a building while recirculating the remaining 80 percent or so for energy efficiency.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers provides outside air ventilation standards for commercial buildings, including schools, day cares, computer labs and woodshops. These minimum ventilation rates vary depending on the type of activity occurring in the room. Outdoor air dilutes contaminants produced by the occupants and by the building itself, so rates are based on both the maximum number of people the room is designed to hold and the size of the room. A woodshop for example, has a higher recommendation compared with a classroom based on activities like sanding or cutting wood.

What was the recommended ventilation rate before the pandemic?

For a 1,000 square foot classroom designed for 35 people, including teachers and students ages 9 and older, ASHRAE recommends a ventilation rate of 500 cubic feet per minute of outside air.

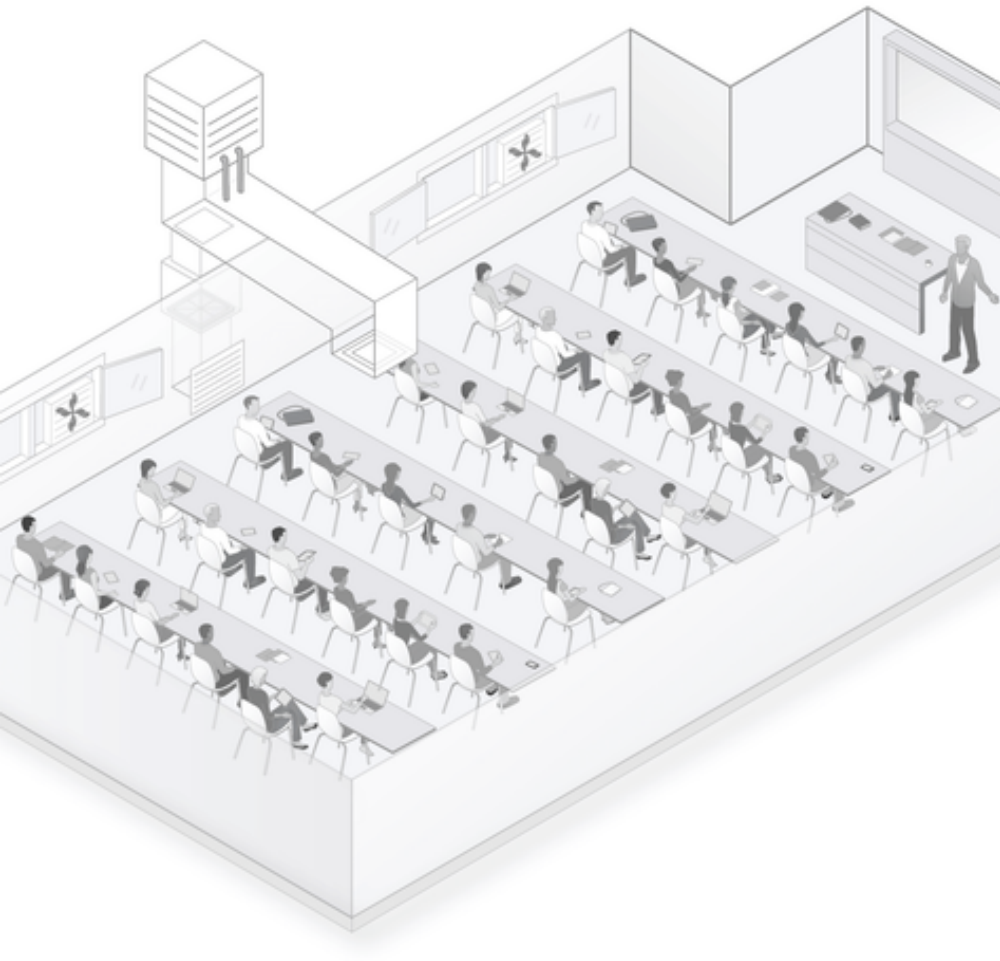
“If the ceiling height in the classroom is 10 feet, that’s three total outside air changes per hour,” says Miller, who is also an indoor air quality expert. “During the pandemic we’re recommending trying to double that.”

Experts recommend reducing occupancy to improve air quality during the pandemic

One of the best ways to reduce the risk of transmission is to reduce the number of people in your office or classroom. This allows for social distancing that reduces risk of close contact transmission. It also reduces the number of probable infections that will occur if there is an infected person in the classroom And as an added benefit, more outside air is provided per person, which contributes to better overall air quality.

“If I drop the number of students from 35 to 17 now, the ventilation provides twice as much outside air per person, and that’s awesome,” Miller says.

Increasing ventilation with outside air has been proven to reduce transmission of airborne diseases by lowering the concentration of infectious particles in the air. In a 2019 study of an outbreak of tuberculosis at Taipei University in Taiwan, rooms were under-ventilated with a rate of 3.6 cubic feet per minute/per person and carbon dioxide levels were found to be in a range of 1,200 parts per million to 3,000 PPM. Tuberculosis, like COVID-19, is an airborne disease. The university increased the ventilation rate to 51 CFM/per person, resulting in carbon dioxide levels dropping to 600 PPM, and the outbreak ended.



Ideally, your office or school will make multiple improvements

As mentioned above, lowering occupancy is important. In our classroom example, the class size was reduced from 35 to 17.

Now, everyone is getting 26 CFM per person of outside air from the ventilation alone, compared with the standard 13.

The reduced class size now allows space for social distancing. Mask use reduces the risk of

infection and limits the amount of particles released during talking or sneezing.

An upgraded MERV-13 filter removes at least 85% of particles greater than 1 micron as they pass through the room's HVAC system, which recirculates indoor air.

A certified HEPA air cleaner is appropriately sized for the room. A HEPA filter can remove more than 99% of airborne particles that pass through it.

The windows are open when possible to allow the fresh air to flow in and out. This dilutes the concentration of the virus.

Fans are positioned to blow inside air out. Avoid blowing air around the room, which could spread the virus.

“If you’re in a space with other people that may be infectious, you want to blow the air from inside out,” Miller says. “You’re taking the virus that might be in the air in the room and blowing it outside, and when you’re blowing the air outside fresh air will come in from other places.”

Improving HVAC filtration of indoor air decreases COVID-19 risk

As mentioned, air filters play a big role in improving indoor air quality. While you want to increase the amount of outside air that is brought into the room, you also want to filter the air that is recirculated. One thing you might want to ask your office building manager or school representatives is whether the HVAC filtration has been improved.

Minimum efficiency reporting value, or **MERV**, is a rating that reflects the efficiency with which a filter can collect particles in different size ranges in a single pass. The higher the number, the better filtration a room will have. Many HVAC systems are built to run MERV-8 filters that allow air to flow faster with less resistance. But this higher flow comes at a cost: They trap only 40% of particles in the 1-micron size. On the other hand, if the system

can handle the resistance of a MERV-13, the filtration is significantly improved.

“For a MERV-13, the filtration efficiency for a 1-micron particle is 85% or more,” Miller says. “We’d like to be able to efficiently remove particles around 0.5 to less than 5-micron because we know particles that size can contain the virus.”

Mechanical filters increase in efficiency as particle size gets larger, and due to diffusion and electrostatic attraction, also increase in efficiency as particles get smaller.

“Particles need not be larger than the space between fibers to be captured, so filters can effectively capture the fine particles produced by respiration that may contain SARS-CoV-2 or other respiratory pathogens,” adds Dr. William P. Bahnfleth, an engineer and a professor of architectural engineering at Penn State and chair of the ASHRAE Epidemic Task Force. The same task force has created a building readiness plan to help guide reopenings.

Again, reducing occupancy is the primary and most effective way to reduce risk. In situations where HVAC filters cannot be improved or windows are nonexistent, portable air filters and germicidal ultraviolet light can help.

Do HEPA filters help? Scientists say portable air cleaners (also called air purifiers) with HEPA filtration can

remove virus particles that cause COVID-19

Portable **HEPA** (high efficiency particulate air) rated air filters remove more than 99 percent of airborne particles regardless of the particle size. Dr. Miller's team partnered with Harvard University to created a calculator to help you find the right **air cleaner** for your room size and type. Look for a certification from the Association of Home Appliance Manufacturers (AHAM). You can find a list of verified units here. You will also want to make sure the **clean air delivery rate** (CADR) matches or exceeds the square footage of the room you are trying to clean.

"When supplemental air cleaning is needed, in-room filter units containing HEPA filters are recommended because they remove nearly all particles in the size range of concern on a single pass," Dr. Bahnfleth says.

Germicidal ultraviolet light to combat COVID-19 indoors

Germicidal ultraviolet light (UVC) involves different wavelengths than UVA or UVB. UVC can be very effective at damaging viruses.

“Germicidal UV has the ability to damage the DNA of microorganisms and they can no longer replicate,” Miller says. “Coronavirus is very susceptible to germicidal UV, so if it’s irradiated for a certain amount of time it’s inactivated, and it can no longer infect you.”

There are two air disinfection applications on the market. One uses fixtures that are attached to the wall, and light is beamed overhead across a room. Bahnfleth notes that “these "upper room" systems can reduce the amount of active virus in the air by an amount equal to 10 air changes per hour or more of outdoor air at a much lower energy cost.” The other application involves placing a UVC light in the recirculating air duct that takes air from the room you are in, irradiates it, then cycles the clean air back into that same room.

Originally Published 11:19 p.m. EDT Oct. 18, 2020
Updated 7:38 p.m. EDT Oct. 19, 2020