Santa Clara County Office of Education

Ventilation Strategies to Control COVID-19 Transmission and Improve Health in Schools

Equity • Diversity • Inclusion • Partnership

Santa Clara County Office of Education

Mary Ann Dewan,Ph.D., Santa Clara County Superintendent
David Putney, Ed.D., Administrator Of Special Projects
Kyle Peerless, MPH, California Department of Public Health
Robert Stepp,CIH CSP ARM REHS(Ret) California Department of Public Health

Equity • Diversity • Inclusion • Partnership

Today's Topics

- **Context**: *Recent Environmental and Health Events*
- **Impact**: *Indoor Air Quality, Attendance Disruptions, and Leaning Loss*
- **Solutions**: *Ventilation Strategies to Control COVID-19 Transmission and Improve Health in Schools*
- **Pilot Study**: *Santa Clara County Office of Education, Orchard School District, and CDPH Pilot Study on the Effectiveness of Portable Air Purifiers During Daily Instruction*
- **Q&A**
- **Next Steps**

Environmental & Pandemic Impacts

- Wildfires
- Spare the Air Days
- Natural Allergies
- Environmental Pollutants
- Regional Environmental Accidents
- Regional, State, and Global Emergencies
- COVID-19

‘Smoke Waves’: Assessing the Public Health Threat from Wildfires

As wildfires increase in frequency and severity due to climate change, more communities are threatened by prolonged exposure to harmful levels of smoke. To identify the areas at highest risk, a team of researchers from Yale and Harvard Universities, including Biostat’s **Francesca Dominici**, used fire-prediction and advanced atmospheric modeling to identify air pollution caused by wildfires and track the likely movement of smoke.

The team coined a new term, “smoke wave,” to describe two or more consecutive days of unhealthy levels of fine particles ($PM_{2.5}$) from fires. Under future climate change conditions, the team found that more than 82 million individuals will experience a 57% and 31% increase in the frequency and intensity, respectively, of Smoke Waves, with counties in Northern California, Western Oregon and the Great Plains likely to suffer from the highest rates of exposure.

Wildfire smoke may have contributed to thousands of extra COVID-19 cases and deaths in western U.S. in 2020

For immediate release: Friday, August 13, 2021

Boston, MA – Thousands of COVID-19 cases and deaths in California, Oregon, and Washington between March and December 2020 may be attributable to increases in fine particulate air pollution (PM2.5) from wildfire smoke, according to a new study co-authored by researchers at Harvard T.H. Chan School of Public Health.

The study is the first to quantify the degree to which increases in PM2.5 pollution during the wildfires contributed to excess COVID-19 cases and deaths in the U.S. It was published online August 13, 2021, in Science Advances.

Climate change will drive major changes in student learning needs:

“Climate change introduces several new social forces with the potential for dramatic impacts on the times, places and modes of schooling.

Consider the impact of human migration. Whether in the short term as families escape natural disasters like hurricanes and floods, or in the long term as weather impacts where we can sustainably live, farm, and work, the children of climate change will be more likely to move around the country during their 13 years of primary and secondary schooling.

Within the United States alone, 13.1 million people could be forced to migrate by 2100 due to climate change — equivalent to the size of the Great Migration of the early 20th century.”

Recent Research illustrates the impact pollution on cognition.

- **Something in the air? Air quality and children's educational outcomes**: "Poor air quality has been shown to harm the health and development of children. Research on these relationships has focused almost exclusively on the effects of human-made pollutants, and has not fully distinguished between contemporaneous and long-run effects. This paper contributes on both of these fronts."
- **Hazardous air pollutants are associated with worse performance in reading, math, and science among US primary schoolchildren**: "Emerging evidence demonstrates that chronic exposure to air pollution may negatively impact children's cognitive processing and memory."

Health Place. 2020 May; 63: 102355.
doi: 10.1016/j.healthplace.2020.102355
PMCID: PMC7214342
PMID: 32543438

Impact of air pollution on educational attainment for respiratory health treated students: A cross sectional data linkage study

Amy Mizen,[a] Jane Lyons,[a] Ai Milojevic,[b] Ruth Doherty,[c] Paul Wilkinson,[b] David Carruthers,[d] Ashley Akbari,[a] Iain Lake,[e] Gwyneth A. Davies,[a] Mohammad Al Sallakh,[a] Richard Fry,[a] Lorraine Dearden,[f] and Sarah E Rodgers[g,*]

▸ Author information ▸ Article notes ▸ Copyright and License information Disclaimer

Office air quality may affect employees' cognition, productivity

For immediate release: Thursday, September 9, 2021

Boston, MA – The air quality within an office can have significant impacts on employees' cognitive function, including response times and ability to focus, and it may also affect their productivity, according to new research led by Harvard T.H. Chan School of Public Health.

The one-year study, which included participants in offices across six countries working in a variety of fields, including engineering, real estate investment, architecture, and technology, found that increased concentrations of fine particulate matter (PM2.5) and lower ventilation rates (measured using carbon dioxide (CO_2) levels as a proxy) were associated with slower response times and reduced accuracy on a series of cognitive tests. The researchers noted that they observed impaired cognitive function at concentrations of PM2.5 and CO_2 that are common within indoor environments.

Negative Impact on in-person instruction.

Map: Coronavirus and School Closures in 2019-2020

March 06, 2020 | Updated: October 13, 2021 2 min read

The coronavirus pandemic forced a near-total shutdown of school buildings in the spring of 2020—an historic upheaval of K-12 schooling in the United States.

Education Week tracked and documented the closures—first at the school district level and ultimately, state-by-state, from March 6 to May 15, 2020.

At their peak, the closures affected at least 55.1 million students in 124,000 U.S. public and private schools. Nearly every state either ordered or recommended that schools remain closed through the end of the 2019-20 school year.

Camp Fire 2018

Wildfires

School closures associated with the November 2018 Camp Fire in and around the community of Paradise in Butte County, the largest and deadliest wildfire to date in California history.

YEAR 2018-19

TOTAL CLOSURE DAYS	SCHOOLS IMPACTED	STUDENTS IMPACTED
3,058	1,649	935,431
62% of state total	15% of state total	15% of state total

Ventilation Strategies to Control COVID-19 Transmission and Improve Health in Schools

Kyle Peerless

California Department of Public Health

Santa Clara County Office of Education
Webinar, March 22, 2022

Ventilation In Schools: A Chronic Problem

~85% of schools inspected in 2019 study found to not meet minimum requirement

- Decreased student performance
- Communicable diseases
- Chemical exposures
  - Asthma
  - Chronic disease

Image Credit: Environmental Protection Agency

Ventilation and Absenteeism

"Increasing classroom ventilation rates from their current low level to the State ventilation rate standard would decrease illness absence by 3.4% and would increase attendance-linked State funding by $33 million annually, while increasing energy costs by only $4 million."

Mendell et al. (2013) Association of classroom ventilation with reduced illness absence: a prospective study in California elementary schools. *Indoor Air*

Agenda

- Why and how ventilation reduces COVID-19 transmission
- Ventilation strategies that can be implemented, along with funding considerations
- Discussion and Q&A

Image Credit: Zeptive, Northeastern University

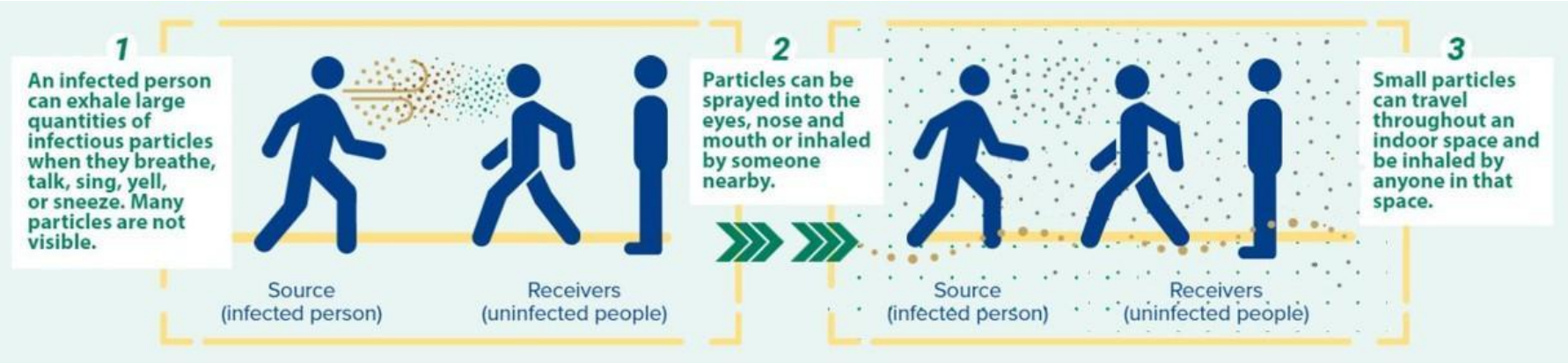
Dominant Transmission Routes of COVID-19

I. Inhalation of virus particles from close contact

II. Inhalation of virus particles that have remained suspended in air and "build-up" because of poorly-ventilated indoor environments (not necessarily from close contact)

III. Direct exposure to virus particles in the eyes, nose, or mouth from "splashes and sprays"

Virus Transmission Diagram



What Will Ventilation Help Most With?

I. Inhalation of virus particles from close contact

II. Inhalation of virus particles that have remained suspended in air and "built-up" because of poorly-ventilated indoor environments (not necessarily from close contact)

III. Direct exposure to virus particles in the eyes, nose, or mouth from "splashes and sprays"

Cigarette Smoke Analogy

Image Credit: Wikimedia Commons

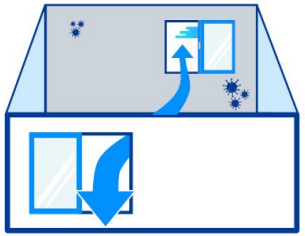
What Would Reduce Secondhand Smoke Inhalation Risk?

- **Dilute** the smoke with outdoor air, open the windows, etc.
- **Filter** out smoke particles in the air with air filter/HEPA filter
- **Exhaust/remove** the smoke from the indoor space

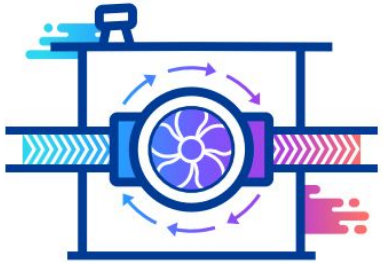
How Do We Improve Indoor Air Quality?

Ventilation

Natural

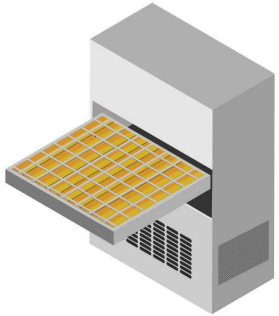


Mechanical



Filtration

HVAC



Portable

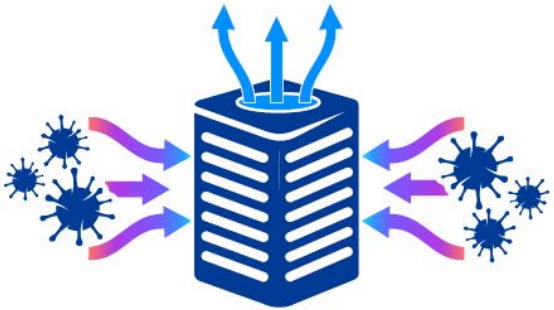


Image Credit: California Department of Public Health and UC Davis

Natural Ventilation

- Fully open windows and doors
- Windows on opposite walls most effective
- Total openable window area must be

  >4% of the floor space area (Title 24)
- Not as controllable as mechanical
  - Temperature and wind dependent
  - Noise, security concerns, poor outdoor air quality, comfort

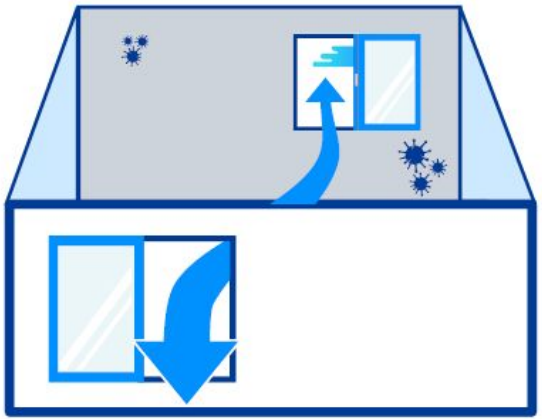


Image Credit: California Department of Public Health

Mechanical Ventilation

- Ventilation systems can supply buildings with a mixture of fresh and recirculated air
- Ventilation system should be adjusted to maximize outdoor air
- Set system to “ON” instead of “AUTO”
- Run ventilation before occupancy

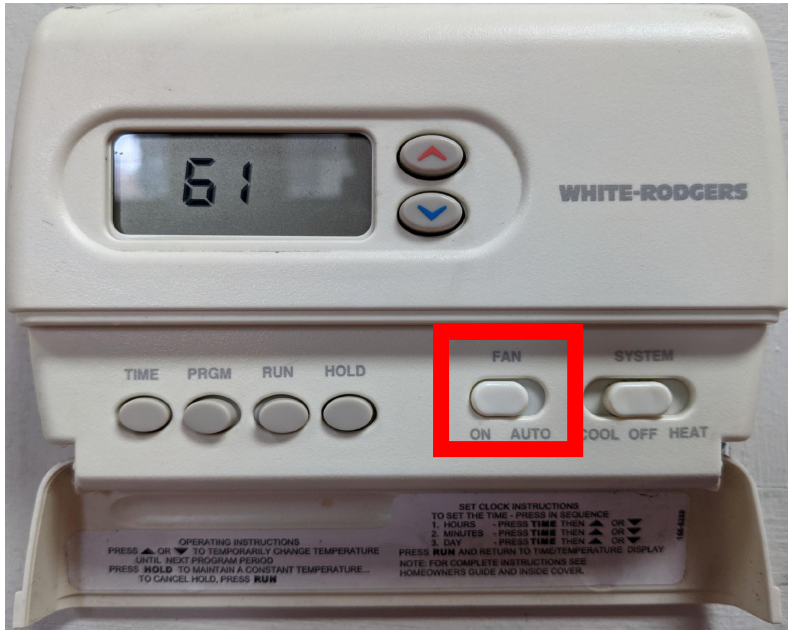


Image Credit: Elon Ullman, CDPH

Mechanical Ventilation System Diagram

*Air Handling Unit houses the fan that moves the air and the MERV filters that clean the air

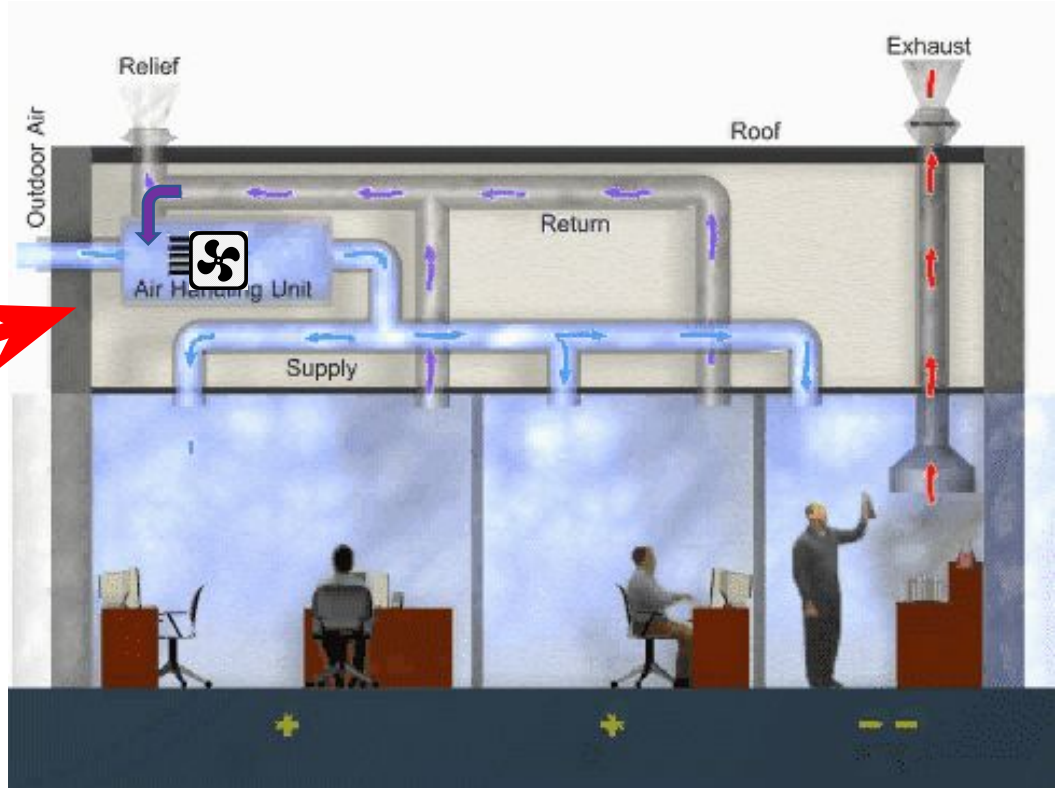


Image Credit: EPA

Air Handling Unit on Roof

Image Credit: Wikimedia Commons

Maximizing Outdoor Air Explained

- Ventilation systems supply buildings with a mixture of fresh and recirculated air
- Ventilation outdoor air damper can be adjusted to supply more fresh air
- Work with facilities staff or HVAC contractors to do this

Adjustable Ventilation Damper

Image Credit: Wikimedia Commons

Maintenance

- Important but often overlooked
- Need to maintain regularly like a car
- Change filters, check ducts, inspect and balance system

Image Credit: Wikimedia Commons

Filtration

- Upgrade filtration in ventilation system to as high as possible if facility recirculates indoor air (goal is to have MERV 13 or higher)
- Filter upgrade may not be possible in some facilities
- Location of filter within system extremely important
- Maintenance
  - Inspect filters **regularly** for proper installation/fit
  - Change based on manufacturer recommendations
  - Wear PPE

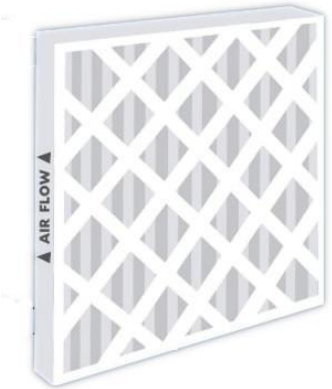


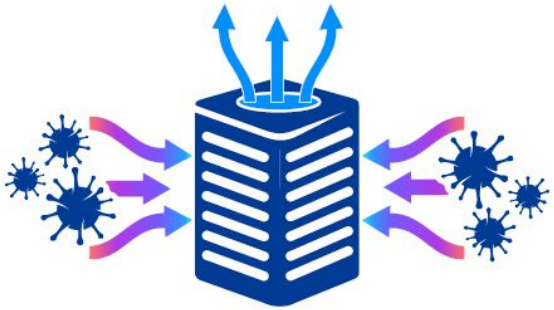
Image Credit: Yale School of Public Health

Portable Air Cleaners

- Equipped with HEPA filters (99.97% capture efficiency)
- Designed to take in “dirty air,” filter particles, and release cleaned air back into the room
- HEPA filtration is proven; ozone and “ionizers” not recommended

Image Credit: Elon Ullman, CDPH

Portable Air Cleaners



- Supplemental, not primary control measure
  - Classroom where outdoor air is not sufficient
  - Place in higher-risk areas (cafeterias, nurse's office)
- Do not place near open windows, in corners, under desks
- See CDPH guidance on ventilation for selecting and sizing portable air cleaners
- Emergency preparedness – keep on hand!

Image Credit: California Department of Public Health

DIY Air Cleaners

- Cheaper and may be better performing than traditional PACs
- See guidance from EPA and UC San Diego on how to construct and maintain them

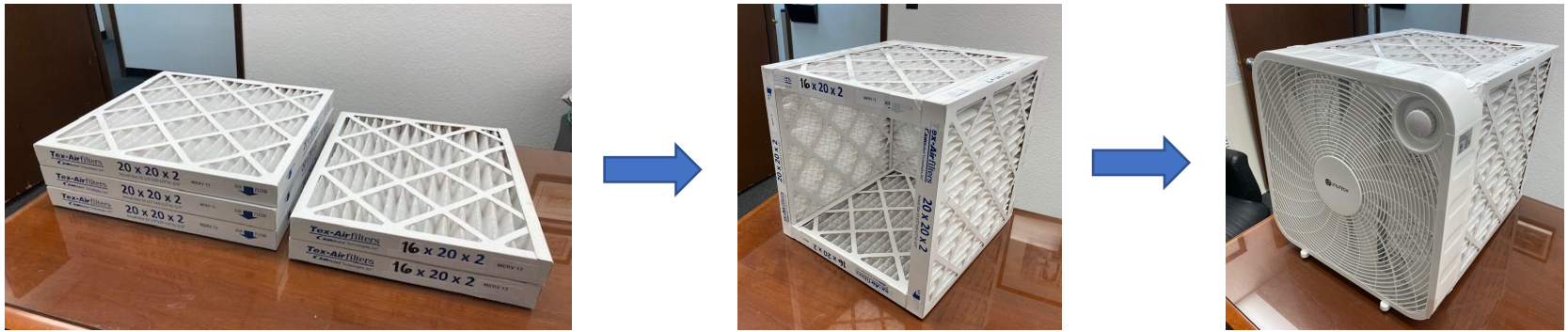


Image Credit: Dr. Richard Corsi and Jim Rosenthal

Ultraviolet Germicidal Irradiation (UVGI) Technology

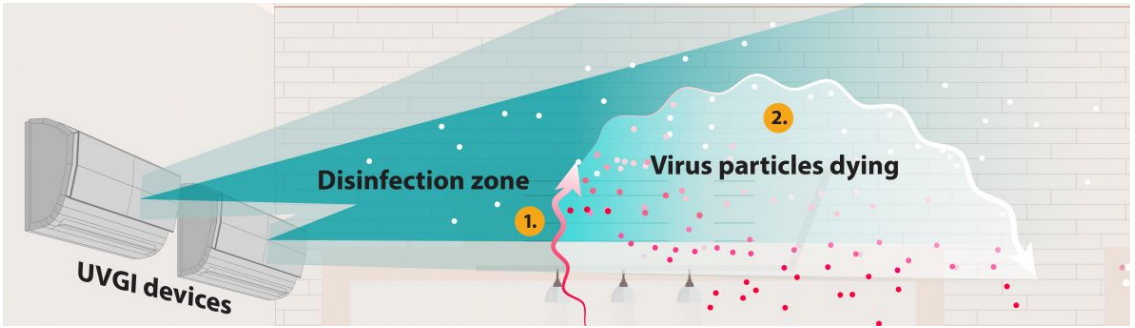


Image Credits: CDC

UVGI Considerations

- Established technology that has been used against other diseases (TB)
- See guidance from CDC
- No recognized regulatory standard to ensure quality and safety; only install with licensed professional!
- Recommended to install wall-mounted or HVAC units only, to ensure eye and skin safety (not portable floor units)

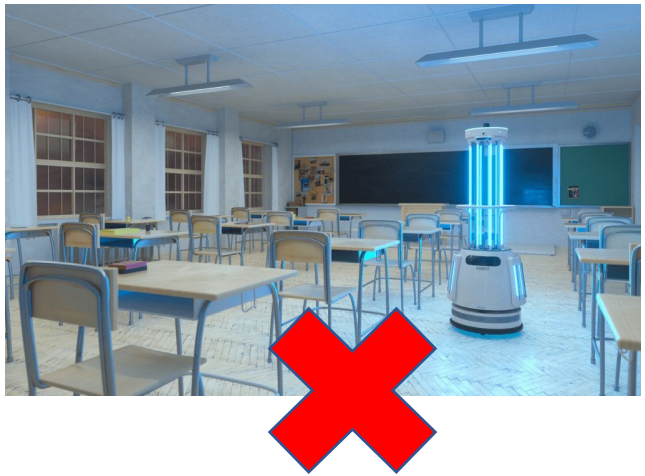


Image Credit: Rennsealear Polytechnic University, Alfa UV

Evaluating Indoor Air Quality

- Carbon dioxide monitors
  - Proxy measure for ventilation effectiveness
  - Doesn’t take into account filtration
- Air supply/exhaust measurements
- Regular system inspections
- Consult with facility, engineer or industrial hygienist

Image Credit: Elon Ullman, CDPH

Investment for Long-term Benefits

- Health and Safety: Future pandemics/wildfire events
- Increased attendance/student performance
- Potential for large energy cost savings

Intervention	Unit Cost*
HVAC Upgrade	~ $30-$50 per sq. ft
Filter Upgrade	~ $0.50 per sq. ft
UVGI	$3-$5 per sq. Ft.
PAC	$100-$1000 per unit
DIY Air Cleaner	$50-$150 per unit

*Sources: ASHRAE Epidemic Task Force, CDC, Dr. Richard Corsi and Jim Rosenthal

Funding Opportunities

- California Department of Education maintains list of federal stimulus funding opportunities to fund ventilation improvements in schools

- Federal stimulus funding from American Rescue Plan within Elementary and Secondary School Emergency Relief (ESSER) Program

- CalSHAPE Program (AB 841 Funding): “Round 2” funding applications can be submitted March 28th – May 31st, 2022

Pilot Study on Portable Air Cleaner (PACs) Usage and Performance in Classrooms

- Focus: Study the “real-world” use of PACs to gather field data on their use and effectiveness
- Results will be used to give further guidance and recommendations on PAC use for COVID-19 and wildfire smoke events
- Initial 1-2 month measurement before June 2022, expanded study involving multiple classrooms in Fall 2022
  - PAC usage pattern: Electricity monitor
  - Classroom ventilation rate: CO_2 monitor
  - Indoor and outdoor particles: Particle monitor

Photos of PAC Study Equipment

Resources

- NEW CDPH Factsheet: COVID-19 and Improving Indoor Air Quality in Schools
- CDPH - Interim guidance for Ventilation, Filtration, and Air Quality in Indoor Environments
  - All employers must review according to Cal/OSHA Emergency Temporary Standard
- CDPH - Ventilation and Filtration to Reduce Long-Range Airborne Transmission of COVID-19: Considerations for Schools
  - Technical guidance for facilities staff, engineers, and industrial hygienists
- ASHRAE- Reopening Schools and Universities COVID-19 Guidance
  - Includes startup checklist for HVAC systems prior to occupancy

Thanks for your participation!

Contact:

Safe Schools for All Technical Assistance Portal

- Ventilation Subject Matter Experts!

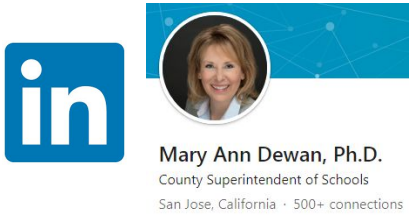
Kyle Peerless

Kyle.Peerless@cdph.ca.gov


Q & A

Thank you!

Mary Ann Dewan, Ph.D.
County Superintendent
Santa Clara County Office of Education
MDewan@sccoe.org



Connect with SCCOE

- Social Media
- Ed Bulletin (e-newsletter)
- www.sccoe.org