THE CENTER
FOR GREEN SCHOOLS

U.S. GREEN BUILDING COUNCIL
USGBC
WHO WE ARE: Global leader in advancing green schools, providing school districts and education leaders with resources and training to create sustainable, healthy, resilient and equitable learning environments.

WHAT WE DO: We support and train those implementing sustainability within school systems to be the most effective change agents they can be, through professional development, peer networks, research, and advocacy.
Through our growing School Sustainability Leaders Network, we equip powerful voices for change within school districts in the U.S.

Geographic distribution of School Sustainability Leaders Network participants

**Network Participants:**
approx. 300

**Scholarships Given:**
36 districts

**Students Served in Districts:**
8 million +
IN THIS PRESENTATION:

1. What we know about environmental health in schools
2. How school districts are acting on IAQ in their schools
3. Federal resources to support environmental health in schools
4. Examples of state action
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FEELING WELL
BIOLOGICAL AND PHYSICAL HEALTH

THINKING WELL
SHORT-TERM COGNITIVE AND MENTAL WELL-BEING

PERFORMING WELL
LONG-TERM ACADEMIC SUCCESS AND ACHIEVEMENT
SCHOOLS FOR HEALTH

FOUNDATIONS FOR STUDENT SUCCESS
HOW SCHOOL BUILDINGS INFLUENCE
STUDENT HEALTH, THINKING AND PERFORMANCE

HARVARD T.H. CHAN SCHOOL OF PUBLIC HEALTH
FOR HEALTH
forhealth.org
Poor IAQ is associated with...

- Asthma, allergies, sick building syndrome, respiratory infections, increased risk of viral infections, cough episodes, and eczema

- Increased student absenteeism, in particular due to respiratory infection

- Impaired attention span, decreased decision making abilities, and fatigue

- Poor academic performance on math and English tests
Uncomfortable classroom temperature and humidity is associated with...

- Tiredness, difficulty breathing, headaches, eye, nose, and throat symptoms, upper respiratory symptoms, and exercise-related cough

- Difficulties in concentration

- Discrepancies in academic achievement on national tests in math, and tests in science and reading
Noisy classrooms are associated with...

- Irritability, stress, higher blood pressure, emotional and conduct problems, and increased hyperactivity

- Impaired listening comprehension, concentration, and memory

- Poor performance on math tests and student achievement tests
Daylight exposure is associated with:

- Improved sleep duration, lower blood pressure, improved mood

Access to outside views is associated with:

- Faster recovery from stress and mental fatigue, and higher attentional functioning

Bright light and blue light exposure is associated with:

- Reduced daytime sleepiness, improved alertness, better attention, faster cognitive processing

- Faster reading speed and increased oral reading fluency performance
Healthy Schools: Environmental Factors, Children’s Health and Performance, and Sustainable Building Practices

EPA awarded seven universities to inform school building (K-12) educational facilities design, construction, and operation practices in order to foster safe and healthy school environments and maximize student achievement and teachers/staff effectiveness.

Request for Applications closing date: October 8, 2013
RESULTS from the RESEARCHERS (~2018)
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• VOCs and formaldehyde exposure is dependent on air circulation: Exposure levels go way down an hour after HVAC comes on.
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- Sources of background noise can be surprising: In one study, the iPad charging stations were the biggest source.
- Sources of VOCs can be surprising: One study found elevated VOCs only in classes with air fresheners and scented candles.
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- VOCs and formaldehyde exposure is dependent on air circulation: Exposure levels go way down an hour after HVAC comes on.
- Sources of background noise can be surprising: In one study, the iPad charging stations were the biggest source.
- Sources of VOCs can be surprising: One study found elevated VOCs only in classes with air fresheners and scented candles.
- Filtration is effective in preventing asthma incidence: Statistical models seem to indicate that asthma incidence is being caused by large particulates.
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Building the Case

The 2022 report builds on previous research, published in April 2021, which helped to make the case for increased COVID-19 funding for schools, including for use on facilities-related expenditures.
2022 National IAQ Survey for School Districts

New report, released in early May 2022:

- Contributes to a national understanding of IAQ implementation in schools
- Helps local, state, and federal policymakers understand what is needed on the ground
- Gives NGOs, researchers, and government officials an understanding of the decision-making process that school districts are going through related to IAQ, COVID relief funding, and facilities upgrades

https://www.usgbc.org/resources/managing-air-quality-during-pandemic-how-k-12-schools-addressed-air-quality-second-year
Managing Air Quality During the Pandemic: How K-12 Schools Addressed Air Quality in the Second Year of COVID-19

Respondents:
- 88 school districts (complete entries)
- 4,000+ schools represented
Managing Air Quality During the Pandemic: How K-12 Schools Addressed Air Quality in the Second Year of COVID-19

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**Interventions implemented**

**Q3: Behavior**
- Promoted handwashing and covering coughs/sneezes: Most schools
- Required mask use: Most schools
- Implemented physical distancing: Most schools
- Promoted vaccination: Most schools

**Q4: Admin**
- Increased surface cleaning: Most schools
- Closed water fountains: Most schools
- Used desk shields between students and/or teachers: Most schools
- Cohort students to minimize number of contacts: Most schools
- Used routine testing to identify cases: Most schools
- Hybrid learning (i.e., some in-person learning and some remote learning): Most schools

Responses by percent: Not applicable, None, Some schools, Most schools, All schools.
Managing Air Quality During the Pandemic:
How K-12 Schools Addressed Air Quality in the Second Year of COVID-19

Interventions implemented

Q1: Vent & filtr
- Increase outdoor air ventilation through HVAC system
- Upgrade to higher MERV rating air filters
- Open windows to increase ventilation
- Implement pre-occupancy and/or post-occupancy air flushing
- Install in-room (including portable) air cleaners with HEPA/high efficiency filters
- Use additional fans in doors and/or windows to increase ventilation
- Disable demand-controlled ventilation (DCV)

Q2: Monitor
- Conduct HVAC assessment to verify outdoor air ventilation
- CO2 monitoring
- Testing, adjusting and balancing (TAB) of HVAC system

Responses by percent

- Not applicable
- None
- Some schools
- Most schools
- All schools
Managing Air Quality During the Pandemic: How K-12 Schools Addressed Air Quality in the Second Year of COVID-19

Guidance utilized in determining strategy for IAQ measures
Managing Air Quality During the Pandemic: How K-12 Schools Addressed Air Quality in the Second Year of COVID-19

Q17: Challenges increasing outside air with HVAC
- HVAC systems not designed to support this strategy (OA)
- Increase in energy use (OA)
- Impact to thermal comfort (OA)
- Questions about effectiveness (OA)
- Impact to building humidity control (OA)
- Changes led to equipment failure (OA)
- Lack of contractors available to help implement changes (OA)
- Did not experience significant challenges (OA)
- N/A (Did not consider implementation) (OA)

Q18: Challenges upgrading to higher MERV in HVAC
- HVAC systems not designed to support this strategy (MERV)
- Procurement difficulties related to supply chain and product availability (MERV)
- Increase in energy use (MERV)
- Increase in staffing and costs to maintain filters (MERV)
- Questions about effectiveness (MERV)
- Changes led to equipment failure (MERV)
- Lack of contractors available to help implement changes (MERV)
- N/A (Did not consider implementation) (MERV)
- Did not experience significant challenges (MERV)
Managing Air Quality During the Pandemic: How K-12 Schools Addressed Air Quality in the Second Year of COVID-19

Q19: Challenges installing in-room air cleaners (filtration)
- High costs of purchasing in-room air cleaners
- Increase in energy use (cleaner)
- Impact on noise (cleaner)
- Questions about effectiveness (cleaner)
- N/A (Did not consider implementation) (cleaner)
- Increase in staffing and costs to maintain in-room air cleaners
- Procurement difficulties related to supply chain and product availability
- Potential for damage by occupants
- Lack of access to technical assistance in selecting and placing equipment
- Purchased equipment was determined not to be suitable for use
- Did not experience significant challenges (cleaner)

Q20: Challenges increasing window opening
- Outdoor air temperature limits when windows can be opened
- Impact to thermal comfort
- Safety and security concerns
- Increase in energy use (windows)
- Lack of windows or appropriately sized windows that can be opened
- Impact on noise (windows)
- Poor outdoor air quality limits when windows can be opened
- Questions about effectiveness (windows)
- N/A (Did not consider implementation) (windows)
- Did not experience significant challenges (windows)
Managing Air Quality During the Pandemic: How K-12 Schools Addressed Air Quality in the Second Year of COVID-19

Odds of using funding sources for IAQ-related improvements
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# COVID-19 RELIEF

<table>
<thead>
<tr>
<th>Bill</th>
<th>Passed</th>
<th>TOTAL Appropriation</th>
<th>PK-12 Public Education Allocation</th>
<th>% Funds to LEAs</th>
<th>Must obligate by</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARES Act (ESSER 1)</td>
<td>March 27, 2020</td>
<td>$2.2 Trillion</td>
<td>$13.5 Billion</td>
<td>90%</td>
<td>December 30, 2021*</td>
</tr>
<tr>
<td>CRRSAAA (ESSER 2)</td>
<td>December 27, 2020</td>
<td>$900 Billion</td>
<td>$54.3 Billion</td>
<td>90%</td>
<td>September 30, 2022*</td>
</tr>
<tr>
<td>American Rescue Plan Act (ESSER 3)</td>
<td>March 11, 2021</td>
<td>$1.9 Trillion</td>
<td>$122.0 Billion</td>
<td>87.5%</td>
<td>September 30, 2023*</td>
</tr>
</tbody>
</table>

* The Tydings Amendment allows for one additional year for expenditure, making these dates September 30, 2022; September 30, 2023; and September 30, 2024.
FIVE GUIDING PRINCIPLES
How Districts Can Use COVID Relief Funds to Advance Healthy, Green Schools

UNDERSTAND FINANCIAL BENEFITS.

In emerging poorer nations, those who offer clean energy solutions, schools are likely to develop an advanced and dynamic strategy that should include the use of clean energy principles. The U.S. Green Building Council (USGBC) has seen great progress in terms of sustainability and clean energy efforts as a result of clean energy technologies. The financial incentives are expected to further encourage schools to adopt clean energy technologies. To make use of this opportunity, districts can invest in clean energy technologies that reduce operating costs and improve the educational environment for students.

THE TAKE-AWAY

Using federal COVID relief funds to advance healthier, green educational environments is an ideal way to support communities and expand educational opportunities.

THE LANDSCAPE

As the nation’s education systems continue to adapt to the COVID-19 pandemic, schools must prioritize the health and well-being of students and staff. This includes ensuring access to clean air, water, and sunlight. This article will provide a brief overview of the current landscape and how schools can foster healthy and sustainable learning environments.

THE INVESTMENT

Investing in healthy, green schools is essential for advancing equity and providing a safe learning environment for all students. This includes ensuring access to clean air, water, and sunlight. This article will provide a brief overview of the current landscape and how schools can foster healthy and sustainable learning environments.

INVESTING IN HEALTHY, GREEN SCHOOLS IS CENTRAL TO ADVANCING EQUITY

Understand financial benefits. It’s important to understand the financial benefits of investing in clean energy technologies. Schools are likely to develop an advanced and dynamic strategy that should include the use of clean energy principles. The U.S. Green Building Council (USGBC) has seen great progress in terms of sustainability and clean energy efforts as a result of clean energy technologies. The financial incentives are expected to further encourage schools to adopt clean energy technologies. To make use of this opportunity, districts can invest in clean energy technologies that reduce operating costs and improve the educational environment for students.

Plan for a clean energy future. The Role of COVID relief funds in providing better conditions for schools and communities is a critical aspect of the effort to ensure healthy and sustainable learning environments. The country’s educational system needs to be reimagined to meet the needs of the 21st century and support a healthier and more sustainable future for all.

Embrace a role in resilience. Schools are well-positioned to play a key role in preparing communities for future challenges. A clean energy future is a key element of this effort, and schools can play a critical role in helping to build a more resilient future for all.

INSPIRATION FROM THE FIELD

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Embrace a role in resilience. Schools are well-positioned to play a key role in preparing communities for future challenges. A clean energy future is a key element of this effort, and schools can play a critical role in helping to build a more resilient future for all.

ADDITIONAL RESOURCES

Additional resources for educators, students, and parents can be found at the following websites:

https://www.usgbc.org/resources/five-guiding-principles
School districts can benefit from many elements of the IIJA. Several opportunities include schools as eligible entities, but schools may not be informed about the resources available.

Funding specifically for schools:
- $5 B for clean school buses (EPA)
- $500 M for energy efficiency and renewable energy (DOE)
- $200 M for lead in school drinking water (EPA)

Funding that schools may be eligible to receive:
- $1.25 B in community grants for EV charging stations (DOT)
- $550 M in Energy Efficiency and Conservation Block Grants (DOE)

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State action on school air quality since the start of COVID-19
States have allocated American Rescue Plan funds (SLRF) to schools for IAQ

Vermont: Act 9, 2021
Massachusetts: Chapter 102, 2021
Virginia: Senate Bill 1303, 2021
States have allocated other sources of funding to schools for IAQ

New York: [Clean Green Schools Initiative](#), 2022
Colorado: [SB21-202](#), 2021
California: [Assembly Bill 841](#), 2020
States have allocated and instituted guidelines for monitoring or assessing IAQ in schools. Nevada: Assembly Bill 257, 2021
RESOURCES
for you and your constituents
For school district administrators, school board members, community stakeholders, and anyone else who wants to be well-informed about IAQ but doesn’t have a technical background.

Fact Sheet Topics:

- Overview of strategies
- HVAC filtration
- HEPA in-room air cleaners
- Ventilation
- Germicidal Ultraviolet (GUV, or UVGI)
- Disinfection (i.e., “fogging”)
- Electronic Air Cleaners

https://www.usgbc.org/resources/school-iaq-fact-sheets-whole-series
Ventilation basics:
Ventilation is outdoor air brought into a building intentionally, to control air contaminants. The required rate of outdoor air is based on occupancy and floor area. Since 1990, the minimum rate for typical classrooms has been approximately 16 cubic feet per minute (CFM) per person, set by ASHRAE Standard 62.1. There are two forms of ventilation: mechanical and natural.

Mechanical ventilation brings in outdoor air via a forced air delivery system, such as a heating, ventilation, and air conditioning (HVAC) system.

Natural ventilation allows in outdoor air via open windows and/or doors that are designed to serve the school's ventilation needs. Natural ventilation is most effective on windy days or when there is strong temperature difference between indoors and outdoors, but its effectiveness can vary based on many factors. For infection control, use High Efficiency Particulate Air (HEPA) cleaners or GermFiltration Air Disinfection (GFAD) systems during periods of low natural ventilation.

Buildings must be designed for current minimum outdoor air rates to get a pass. Confirm that the HVAC system and controls are working as designed to deliver enough outdoor air to classrooms.

Costs and benefits of outdoor air
Outdoor air, particularly humid air, needs to be treated before it can be introduced inside, which taxes energy. The actual cost of outdoor air ranges from a few dollars to a max of $1 per person per year.

The benefits are enormous. Studies show that under ventilated schools are associated with increased transmission of infection, asthma exacerbation, and other respiratory and health issues.

School ventilation in the U.S.:
Research has demonstrated that classroom under-ventilation in the U.S. is far too common. Researchers hypothesize several reasons for low ventilation rates, including lack of certification when systems were installed, deferred maintenance, or attempts to save energy.

The Center for the Built Environment

Carbon dioxide:
CO₂ concentration can be an indicator of ventilation effectiveness. Lower ratios mean that exhausted air is being appropriately diluted.

Monitoring CO₂:
The best use of carbon dioxide monitors in classrooms is to identify issues with the HVAC system or to indicate insufficient ventilation.

To interpret the data correctly, CO₂ levels must be logged throughout the school day in a typical occupied classroom. CO₂ spot checks will not give you the maximum CO₂ or the general trend of the values. For example, at typical occupancy and outdoor air selection that is below code, a reading could be 800 ppm at 8:30am or 2,000 ppm at midday.

Using ventilation to reach your air change rate goal:
eACH is equivalent air change rate, it is calculated by adding all ventilation and air cleaning strategies. A reasonable target for air change rate in a classroom is at least 6 eACH.

Example eACH for a typical 1,000 ft³ classroom
This eACH calculation may vary based on factors such as the amount of air supplied from an HVAC system. The graph is provided as a general comparison between strategies and as an example of how strategies can be combined for infection control.

Benefits of ventilation beyond COVID
1. Reduced incidence of respiratory illnesses including asthma, influenz.
2. Reduced state and student morbidity and prevention of hospitalizations and disabilities.
3. Contributes to better overall student health and to improved educational outcomes.
In-Room Air Cleaner Basics

In-room air cleaners are installed within an occupied space and work by pulling in air and filtering it before sending it back out into the space. They are independent from a heating, ventilation, and air conditioning (HVAC) system. In-room HEPA air cleaners contain high efficiency particulate air (HEPA) filters, which are certified to meet their stated efficiency.

In-room air cleaners come in several types and sizes, including miniature desktop units, portable units operated on the floor or tabletop, and larger fixed units that can be installed on or above ceilings, walls, or floors.

Series: Indoor Air Quality Fact Sheets

This fact sheet is one in a series of white papers that provide background information.

Tips for selecting air cleaners:

- IDENTIFYING HEPA FILTERS: Filters that are HEPA will have their corresponding efficiency rating (99.97% or better) listed on the filter packaging or data sheet. HEPA filters will not be called "HEPA" or "HEPACleaner" on the label as they are misleading.
- PLACEMENT: Place the air cleaner 3-5 feet away from walls or open windows and doors. Do not block the unit with an object or other furniture. Place it close as possible to the heater and between the therapist and the student.
- NOISE: Read manufacturer’s data for noise levels and choose one that meets the recommended sound levels. Air cleaners with noise levels above 50 decibels may increase wind noise levels. The noise levels of air cleaners may vary. Focus on noise levels of lower than 50 decibels.
- COST: Look for the price, availability, and expected lifetime of replacement filters. Incorporate this cost into the total cost of the air cleaner.
- COMPONENTS: Check for spares before you purchase an air cleaner. HEPA filters are the most expensive for replacing particulate filters that may contain the virus, and additional technologies are often more expensive than filters.
- MAINTENANCE: Clean prefilter and replace filters as recommended by the manufacturer.

What is CADR?

An in-room air cleaner should be chosen so that its airflow delivery rate (CADR) meets the needs of the room. The CADR is usually given in cubic feet per minute (CFM) or in cubic meters per minute (CMM). The CADR is the airflow delivered per minute by the air cleaner. It is measured in cubic feet per minute (CFM) or cubic meters per minute (CMM).

DIY in-room air cleaner:

A cheaper alternative to purchasing an in-room air cleaner is to DIY. Create a box filter box made with a box fan, HEPA filter, cardboard, and duct tape.

Myth:

Viruses are too small to be captured by filters.

HEPA filters are more than 99.97% efficient at capturing particles with diameters of 0.3 microns, including those that carry the COVID-19 virus. Using HEPA in-room air cleaners correctly is the most effective way to increase clean air delivery in schools.

Using air cleaners to reach your air change rate goal:

pMCH is equivalent air change rate. pMCH can be calculated by adding ventilation and air cleaning strategies. A reasonable target for air change rate in a classroom is at least 6 pMCH.

Example EACF for a typical 1,000 ft² classroom:

This EACF calculation may vary based on factors such as the amount of air supplied from an HVAC system. The chart is a general comparison between strategies and as an example of how strategies can be combined for infection control.

Benefits of air cleaners beyond COVID

Air cleaners can be used as an added layer of protection when ventilation is inadequate, as there is no guaranteed flow, or during a COVID-19 outbreak.

HEPA filtration is the most effective method at reducing aerosols like COVID-19 in the air and can help reduce symptoms like asthma.

Continuous use of air cleaners is associated with reduced symptoms like wheeze and improved respiratory health and asthma-related outcomes.
USGBC offers best-in-class sustainability and green building education to grow your knowledge and fulfill continuing education for LEED credentials, AIA, and others.

Learn online & in-person
usgbc.org/education
GREEN SCHOOLS
CONFERENCE & EXPO

greenschoolsconference.org
Join a new network of school district professionals working to improve indoor air quality and environmental health across their school systems.

In coordination with U.S. EPA’s Indoor Air Quality Tools for Schools Program

NEW IN 2022:
PEER NETWORK & TARGETED PROFESSIONAL DEVELOPMENT FOR INDOOR AIR QUALITY

Write us to join: schools@usgbc.org