Creating a Game Plan for Indoor Air Quality and Ventilation Improvements for COVID-19 and Long-Term Healthy School Indoor Environments

Ensuring that school buildings have adequate ventilation and filtration is one of the Centers for Disease Control and Prevention's (CDC) recommended strategies to prevent the risk of transmission of SARS-CoV-2 and also is critical to providing healthy indoor air quality (IAQ) in schools now and into the future.

New Federal K–12 Funding for IAQ Ventilation Improvements: The American Rescue Plan provides funding for K–12 schools to maintain healthy facilities and improve ventilation as one of the strategies to reduce the transmission of SARS-CoV-2 in schools. The funds can be used for the following tasks: inspection, testing, maintenance, repair, replacement and upgrade projects to improve IAQ in school facilities, including mechanical and non-mechanical heating, ventilation and air conditioning (HVAC) systems; filtering, purification and other air cleaning methods, fans and control systems; and window and door repair and replacement. To see additional examples of qualified spending, refer to the U.S. Green Building Council's (USGBC) *Five Guiding Principles: How Schools Can Use American Rescue Plan Funding to Ensure Healthy, Resilient Facilities for Students and Reduce Energy Costs and Emissions*.

Implementing IAQ Risk Reduction Strategies for COVID-19 Transmission in Schools as Part of an IAQ Management Program

Strategies that improve IAQ in schools should be implemented as part of a layered risk reduction approach to reduce the transmission of COVID-19 in schools. Improving IAQ in the classroom through control strategies—ventilation, filtration, supplemental air cleaning—will not only reduce the transmission of SARS-CoV-2 but also reduce pollutants in the air.

To ensure continuous healthy IAQ in the long term, implement the IAQ and ventilation improvements as part of a comprehensive IAQ management program, which includes ongoing monitoring and preventive maintenance.

EPA's Framework for Effective School IAQ Management can be used to build and sustain a successful IAQ management program aligned with the *IAQ Tools for Schools* Action Kit and Technical Solutions, as well as to implement IAQ improvements, such as those recommended to reduce the transmission of COVID-19.

Review the CDC's K–12 Schools COVID-19 Mitigation Toolkit and Ventilation in Schools and Childcare Programs to become familiar with the COVID-19 layered risk reduction strategies related to IAQ, ventilation and filtration. Implementing these mitigation strategies as part of a comprehensive IAQ management and preventive maintenance program will help you to make the case for IAQ improvements, ensure sustainability of the IAQ improvements, and maximize your return on investment.

Figure 1. *EPA's Framework for Effective IAQ Management*

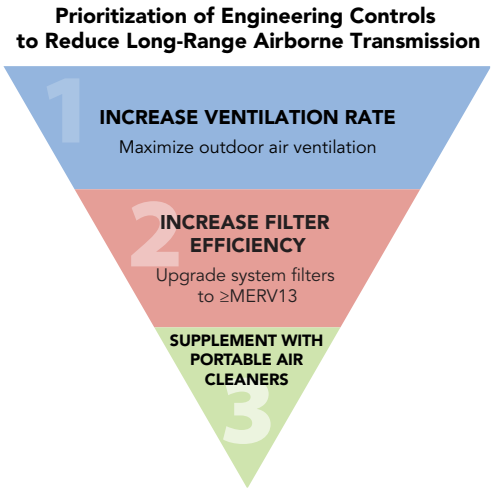

Figure 2. Source: Jones et al., 2020. *Schools for Health: Risk Reduction Strategies for Reopening Schools*. Harvard Healthy Buildings Program.

What steps should we take to improve our IAQ and reduce transmission of SARS-CoV-2?

IAQ and Ventilation COVID-19 Mitigation Recommendations Source: CDC's K–12 Schools COVID-19 Mitigation Toolkit and Ventilation in Schools and Childcare Programs	Resources
1. Increase outdoor air ventilation. • Conduct an HVAC assessment to evaluate the condition of the existing HVAC system components and/or unit ventilation equipment, in accordance with minimum inspection standards of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)/Air Conditioning Contractors of America (ACCA) Standard 180, ASHRAE handbooks, or other equivalent standards and guidelines. During the assessment, note which buildings would benefit from ventilation system upgrades and itemize those upgrades to potentially use in future funding requests. • Ensure there is a scheduled inspection and maintenance program for HVAC systems to allow repair, modification or replacement of equipment, in accordance with ASHRAE/ACCA Standard 180. • Keep unit ventilators clear of books, papers and other items. • Bring in more fresh outdoor air through assessing and servicing your ventilation systems so that they provide acceptable IAQ as defined by ASHRAE 62.1. • Consider other means of bringing in outdoor air, such as opening windows, when HVAC adjustments are not possible or do not bring in enough outdoor air. **2. Filter indoor air.** • Increase filter efficiencies in existing HVAC systems (use the highest Minimum Efficiency Reporting Value [MERV] rating possible per equipment specifications). If possible, increase the level of the air filter to MERV-13 or higher on recirculated air. • Make sure the filters are sized, installed and replaced according to the manufacturer's instructions. **3. Supplement with portable air cleaners, if needed.** • Consider portable high-efficiency particulate air (HEPA) fan/filtration systems to supplement air cleaning as needed.	• IAQ Preventive Maintenance Checklist (EPA) • IAQ Walkthrough and Ventilation Checklists (EPA) • Guide to Air Cleaners in the Home: 2nd Edition, Portable Air Cleaners, Furnace and HVAC Filters (EPA) • ASHRAE Standard 62.1-2019[1] • ASHRAE Epidemic Task Force: Reopening Guide for Schools and Universities • 5 Step Guide to Checking Ventilation Rates in Classrooms (Harvard) • Maximum CO_2 Concentration Calculator (Harvard) • Portable Air Cleaner Purification Calculator (Harvard)

What strategies should we use to build an effective IAQ management program that also will help us implement ventilation, filtration and air purification improvements?

Key Drivers and Strategies	Resources
Organize for Success • **Build an effective team,** which could include facility staff, administrators, engineers, construction staff, health officials/nurses, teachers, parents and others. • **Develop a systematic approach** to your IAQ management and preventive maintenance program by assessing your strengths and weaknesses and incorporating *IAQ Tools for Schools* guidance to address gaps, such as developing formal schedules for HVAC filter replacements, walkthroughs and other maintenance activities to take the guesswork out of preventive action.	• IAQ Preventive Maintenance Guidance—Staffing and Communication (EPA) • Five Guiding Principles: How Schools Can Use American Rescue Plan Funding to Ensure Healthy, Resilient Facilities for Students and Reduce Energy Costs and Emissions (USGBC) • Administrative Staff Checklist and Backgrounder (EPA)

[1] ANSI/ASHRAE Standard 62.1 and Standard 62.2 on ventilation and IAQ offer detailed information on ventilation system design and acceptable IAQ. These standards were expanded and revised for 2019, and both standards specify minimum ventilation rates and other measures to minimize adverse health effects indoors.

Key Drivers and Strategies	Resources
Communicate with Everyone, All the Time • **Make IAQ meaningful.** Make the case for IAQ management or IAQ improvements by crafting a pitch or value proposition of the benefits of IAQ improvements to gain buy-in. • **Communicate results and return on investment.** When communicating about your program, consider these messages: (1) IAQ management can address the causes of poor IAQ and also minimize viruses and pollutants in the air children and staff breathe in schools and (2) integrating IAQ management, preventive maintenance and energy efficiency helps reduce costs and ensure healthy, efficient learning environments and smooth building operations.	• IAQ Preventive Maintenance Guidance—Making the Case (EPA) • IAQ & Preventive Maintenance Value Proposition Worksheet (EPA)
Assess Your Environments Continuously • **Determine a baseline**. Conduct field verification and assessments of all schools' HVAC equipment and proposed design upgrades to (1) achieve increased ventilation, (2) achieve increased filtration, and (3) maintain and monitor improvements. To conduct the initial assessments, consider engaging such professionals as an ASHRAE professional engineer to perform testing, determine ventilation rates, assess HVAC during actual conditions, etc.[2] • **Walk the grounds.** Develop an approach for regular HVAC assessments and building walkthroughs. • **Identity and prevent risks.** Compile a list of campuses at risk for IAQ issues—due to building age, environmental conditions and other factors—and then work with the multidisciplinary team to review conditions and develop solutions to manage and solve each issue. "We're a low-cost, no-cost program, which means communication is our most important prevention tool. We tell our staff, 'We love little problems!' because we hate big problems. Creating that awareness, participation and two-way communication is absolutely critical to our success." –Sean Joyce, Industrial Hygienist, Baltimore County Public Schools[3]	• K–12 Schools COVID-19 Mitigation Toolkit (CDC) • Ventilation in Schools and Childcare Programs (CDC) • IAQ Preventive Maintenance Checklist (EPA) • IAQ Walkthrough and Ventilation Checklists (EPA) • Standards for Ventilation and Indoor Air Quality (ASHRAE) • ASHRAE Epidemic Task Force: Reopening Guide for Schools and Universities • 5 Step Guide to Checking Ventilation Rates in Classrooms (Harvard) • Maximum CO_2 Concentration Calculator (Harvard) • Guide to Air Cleaners in the Home: 2nd Edition, Portable Air Cleaners, Furnace and HVAC Filters (EPA) • Portable Air Cleaner Purification Calculator (Harvard)
Plan Your Short- and Long-Term Activities • **Prioritize actions.** After your assessment, incorporate any additional IAQ and COVID-19 mitigation strategies and actions you have identified into your IAQ Preventive Maintenance Checklist (EPA) and into your IAQ Preventive Maintenance Plan (EPA Template). • **Put goals in writing.** If ventilation system upgrades are required, develop a clearly outlined proposal with prioritization of improvements and pricing. The proposal should include building-specific plans, ventilation targets, risk mitigation goals, design scopes, etc.[2]	• IAQ Preventive Maintenance Checklist (EPA) • IAQ Preventive Maintenance Plan (EPA Template) • Roadmap for K–12 Education: Seven Strategies for Promoting Air Quality (Perkins & Will)

[2] Ventilation and Virus Mitigation in Schools—Creating a Game Plan to Reduce COVID-19 Risk and Make Lasting Improvements to IAQ. EPA webinar held on 2/25/2021.
[3] Baltimore County: Envisioning Excellence: Lessons from Effective School Indoor Air Quality Programs—A Snapshot of Profiles in Excellence (EPA)

Key Drivers and Strategies	Resources
Act to Address Structural, Institutional and Behavioral Issues • **Train occupants to address IAQ risks.** Use training to foster a culture of stewardship and create IAQ champions across the organization. Train all facilities staff members to prevent and identify root causes of IAQ problems. Also, if new technology has been added to your schools, develop a training session to help your staff understand how to use it. • **Educate staff about IAQ to change behavior.** Educate staff by using no-cost, on-demand webinars from EPA, such as Ventilation and Virus Mitigation in Schools—Creating a Game Plan to Reduce COVID-19 Risk and Make Lasting Improvements to IAQ. For example, sharing with teachers the importance of ventilation to improve IAQ and reduce the transmission of COVID-19 will help them keep unit ventilators clear of books, papers and other items.	• Creating Healthy Indoor Air Quality in Schools—COVID-19 Webinar Series (EPA) • DC Public Schools New Air Filter Training Video
Evaluate Your Results for Continuous Improvement • **Measure, assess and track program implementation.** Use tracking sheets or tables to record collected data and develop metrics to allow you to evaluate your program's progress and impact. • **Solicit feedback.** Collect information about the facility IAQ from school staff using the Collection of IAQ Checklists. • **Determine the most effective strategies for continuous improvement.** Capturing return on investment by monitoring metrics—such as the number of IAQ complaints, the cost of IAQ-related repairs, and changes in school nurse visits, attendance rates and test scores over time—can help you assess the success of your work and better understand how you can refine your plan as needed. In addition, IAQ sensors are a newer technology that can be integrated into a building management system to help continuously monitor certain IAQ metrics. For COVID-19 risk reduction, in particular, use such tools as FaTIMA from the National Institute of Standards and Technology (NIST) and COVID-19 Risk Estimator to determine which control measures to put in place and their effectiveness in reducing risk.	• IAQ Preventive Maintenance Guidance—Evaluation (EPA) • IAQ Walkthrough and Ventilation Checklists (EPA) • FaTIMA Model to determine the indoor air fate of microbiological aerosols (NIST) • COVID-19 Risk Estimator (Setty)

Actions We Will Take in Our School/School District to Implement IAQ Improvements and COVID-19 Risk Reduction Strategies

	Ventilation	Filtration	Supplemental Air Purification	Layered Risk Reduction
ORGANIZE				
COMMUNICATE				
ASSESS				
PLAN				
ACT				
EVALUATE				