Council of State Science Supervisors

PREPARING STEM CLASSROOMS FOR THE NEXT PANDEMIC

Sanitation, Disinfection, Distancing, and Hygiene for Safer STEM Instruction

Built on COVID-19 Lessons Learned: A nationally aligned framework supporting public health readiness, laboratory safety alignment, and sustainable infection-prevention systems in K–12 science / STEM instructional spaces

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This guidance was developed in response to lessons learned during the COVID-19 pandemic and reflects the shared responsibility of educators, administrators, public health officials, and safety professionals to maintain both instructional continuity and student protection.

The authors acknowledge the guidance of national organizations including the Centers for Disease Control and Prevention (CDC), the Occupational Safety and Health Administration (OSHA), the National Science Teaching Association (NSTA), the National Fire Protection Association (NFPA), and state-level science leadership organizations whose standards and public health guidance informed this work.

The authors and the Council of State Science Supervisors gratefully acknowledge Ward's Science, a division of VWR, for their valued partnership in supporting the development of the CSSS Safety Reference Manuals. Their sustained commitment to advancing science education and strengthening laboratory safety continues to benefit STEM classrooms nationwide. We are especially appreciative of their collaboration in providing high-quality scientific illustrations, imagery, and technical insight, which enhance clarity, reinforce safer STEM practices, and support effective, engaging instruction across Science, STEM, and CTE programs.

The Council of State Science Supervisors also recognizes state science supervisors, district leaders, and classroom educators who provided insight into the practical realities of sustaining safer STEM instruction during periods of public health disruption.

About CSSS

The Council of State Science Supervisors is a national organization composed of leaders responsible for science education at the state level. Members guide statewide policy implementation, professional learning systems, standards alignment, and instructional improvement initiatives across K–12 systems.

CSSS provides a collaborative forum where states exchange evidence-informed practices, address emerging challenges, and strengthen science education while supporting educators in fulfilling their professional responsibilities, including student safety and risk management.

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EXECUTIVE SUMMARY

Hands-on STEM instruction depends on shared materials, close collaboration, and physical environments that cannot be replicated virtually.

The COVID-19 pandemic revealed that public health readiness must be integrated into instructional planning, not treated as a temporary overlay.

Preparing STEM Classrooms for the Next Pandemic provides a nationally aligned framework for sustaining safer STEM instruction during periods of infectious disease risk. It recognizes that infection-prevention strategies must align with laboratory safety principles.

Measures that reduce viral transmission but introduce potential hazards and resulting safety risks, including chemical exposure, ventilation conflicts, PPE misuse, or compromised emergency access do not strengthen safety.

They shift risk.

This document emphasizes layered protection systems. No single control is sufficient.

Effective pandemic response in STEM environments combines:

- Layered infection prevention practices
- Adaptive instructional design
- Evidence-based cleaning and disinfecting
- Reduced material sharing
- Structured student flow
- Proper PPE alignment
- Ventilation coordination
- Embedded hygiene routines

The guidance reflects recognized public health and occupational safety standards, including CDC recommendations for K–12 schools, OSHA workplace guidance, and NSTA laboratory safety principles. It is intended to complement, not replace, local and state public health requirements.

The central lesson of COVID-19 is clear: preparedness is not a temporary response plan. It is a sustained system of professional practice that protects learning, protects people, and strengthens the resilience of STEM programs during both routine operations and emerging public health threats.

Sanitation, Disinfection, Distancing, and Hygiene for Safer STEM Instruction

Built on COVID-19 lessons learned

Public health readiness is now inseparable from educational readiness, particularly in hands-on STEM environments where shared equipment, close collaboration, and high-touch surfaces are routine.

The COVID-19 pandemic demonstrated that preparedness cannot rely on supplies alone. It depends on systems that educators can implement consistently, sustain over time, and integrate without creating new potential hazards and resulting safety risks (CDC).

Federal public health guidance emphasizes everyday protective actions such as hand hygiene, respiratory etiquette, appropriate cleaning and disinfecting, and improved ventilation. These measures reduce transmission risk for a wide range of respiratory viruses, not only COVID-19.

In science / STEM instructional spaces, however, infection-control measures must also align with laboratory safety principles. Practices that reduce viral transmission but introduce chemical exposure, ventilation conflicts, PPE misuse, or unsafe substitutions undermine overall safety (NSTA; OSHA).

This section provides a Pandemic-Ready Playbook for STEM Spaces, applicable to classrooms, laboratories, makerspaces, and CTE environments. The framework prioritizes sustainability, scientific defensibility, and compatibility with safer STEM practices.

Local and state public health requirements take precedence during declared public health events and must be implemented in alignment with laboratory safety and fire code requirements.

I A PANDEMIC-READY MODEL FOR STEM SPACES

Infection control measures must not introduce chemical, ventilation, or emergency access hazards. Risk reduction strategies must be evaluated holistically.
— James Palcik, CHO, Safer STEM

Layered Safety Plus Layered Learning

Pandemic response is most effective when layered infection-prevention strategies are paired with layered instructional design. No single control is sufficient on its own.

Layered Infection Prevention

CDC K–12 guidance emphasizes the combined use of multiple protective actions, including hand hygiene, respiratory etiquette, staying home when sick, routine cleaning, targeted disinfecting, and improved ventilation.

When applied consistently, these layers reduce transmission risk across instructional settings (CDC).

Layered Learning for STEM Instruction

This manual applies to all secondary science instructional settings, including:

- **Tier 1: Default Instruction** Individual workstations, minimal sharing, teacher demonstrations, simulations, and data analysis
- **Tier 2: Controlled Group Work** Small-group investigations with assigned kits, timed rotations, reduced proximity, and defined workflows
- **Tier 3: High-Contact Laboratories** Used only when community risk is low and mitigation controls are feasible and supported

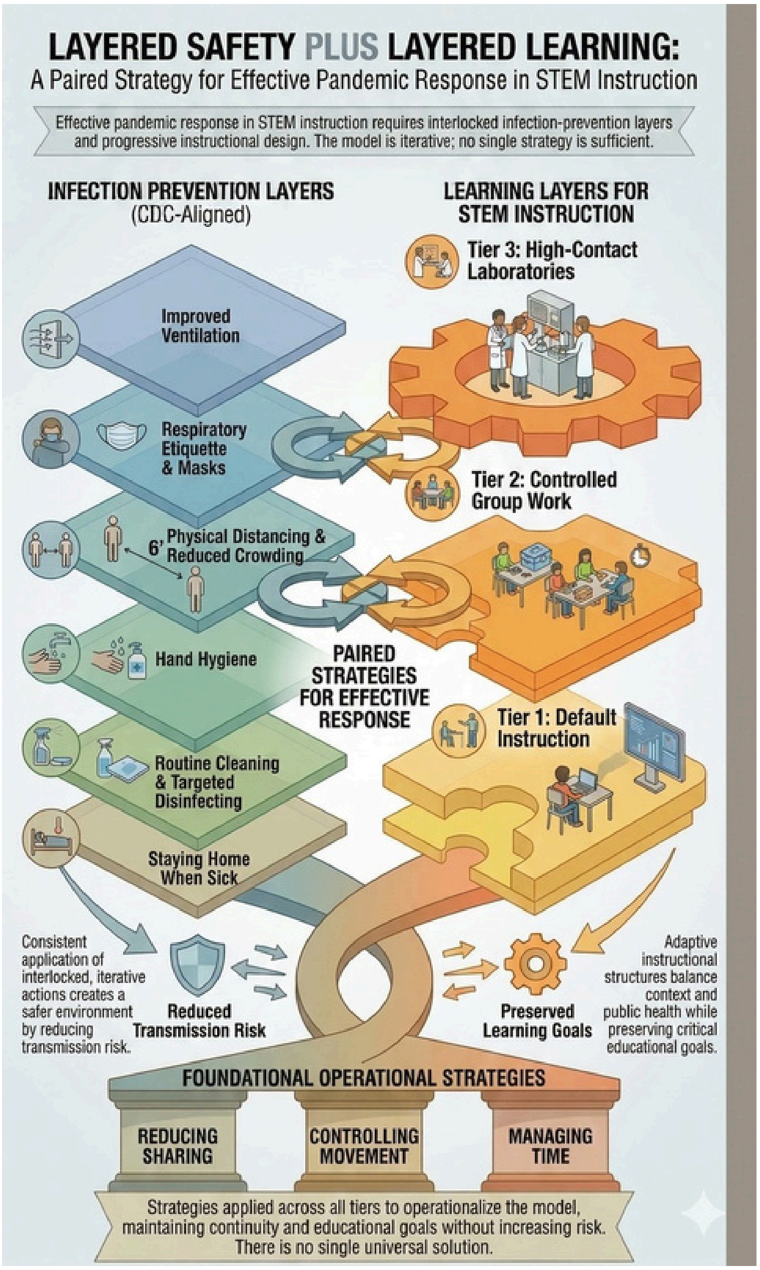
There is no universal instructional solution.

Reducing sharing, controlling movement, and managing time are among the most effective ways to maintain continuity without increasing risk.

Layering controls is not redundancy. It is resilience. Infection prevention works much like laboratory safety: no single measure carries the entire burden. When hand hygiene, ventilation, surface cleaning, instructional structure, and supervision operate together, each layer reduces strain on the others. Remove one layer, and the system becomes more fragile.

Figure 1

This figure helps teachers plan instruction that balances hands-on learning with multiple, simultaneous safety layers, showing that no single strategy is sufficient on its own. Use it to design lessons that intentionally combine instructional approaches (e.g., individual, group, lab work) with aligned infection-prevention practices to maintain both safety and learning continuity.



II SANITATION VS DISINFECTION

Cleaning, sanitizing, and disinfecting are not interchangeable. Clean first. Disinfect when warranted. Misuse of disinfectants can create chemical exposure potential hazards and resulting safety risks, and may violate OSHA Hazard Communication or labeling requirements. Precision protects. Over-application exposes.

— James Palcik, CHO, Safer STEM

Using the Right Tool for the Right Purpose

One of the most common errors during COVID-19 was treating cleaning, sanitizing, and disinfecting as interchangeable practices.
They are not.

- Cleaning removes dirt and many germs using soap or detergent and water.
- Sanitizing reduces germs to safer levels and is commonly used for food-contact surfaces.
- Disinfecting kills germs using EPA-registered disinfectants and is used when warranted.

CDC guidance emphasizes routine cleaning and targeted disinfecting of high-touch surfaces when appropriate. In STEM environments, NSTA guidance reinforces a critical sequencing rule: clean first, disinfect second (CDC; NSTA).

Safer STEM Application

Disinfection practices must never introduce new potential hazards and resulting safety risks, including:

- Mixing incompatible chemicals such as bleach and ammonia
- Aerosolizing cleaners or disinfectants
- Degrading ANSI/ISEA-certified eye and face protection
- Compromising indoor air quality

OSHA cautions that improper disinfectant use can create chemical exposure risks. Hand sanitizers containing methanol or methyl alcohol are prohibited due to toxicity and volatility; only approved formulations should be used (OSHA; FDA).

Chemical storage must align with compatibility and hazard class, including separation of acids and bases, oxidizers and organic materials, and proper storage of flammables.

During COVID-19, many schools treated cleaning, sanitizing, and disinfecting as interchangeable. They are not. Using disinfectants where routine cleaning would suffice is like using a fire extinguisher to wash a window. Stronger chemicals do not automatically mean stronger protection. The right tool, used correctly and in sequence, prevents both potential infection and chemical exposure.

Figure 2

This figure guides teachers in selecting the appropriate level of cleaning by emphasizing the correct sequence - clean first, then disinfect only when necessary. It supports safer classroom practice by helping educators avoid overuse of chemicals while still targeting high-risk situations effectively.

III HIGH-TOUCH STEM SURFACES

Cleaning, sanitizing, and disinfecting are distinct controls. Overuse of disinfectants does not increase safety. It increases chemical exposure risk. Follow the sequence. Match the control to the specific hazard.
- James Palcik, CHO, Safer STEM

What to Prioritize

CDC guidance identifies desks, doorknobs, keyboards, and sink handles as high-touch surfaces.

In STEM environments, this list expands significantly.

Priority Areas

Student Contact Points

- Lab benches, stools, drawer pulls, sink handles
- Goggles, face shields, aprons, glove storage
- Shared probes, calculators, and devices

Workflow Points

- Entry and exit hardware
- Chemical cabinet handles
- Shared sign-out tools should be minimized or replaced with structured, low-contact distribution systems where feasible

Equipment Contact Points

- Balances, microscope focus knobs
- Power supply dials, clamps, emergency stops
- Robotics controllers, 3D printer touchscreens

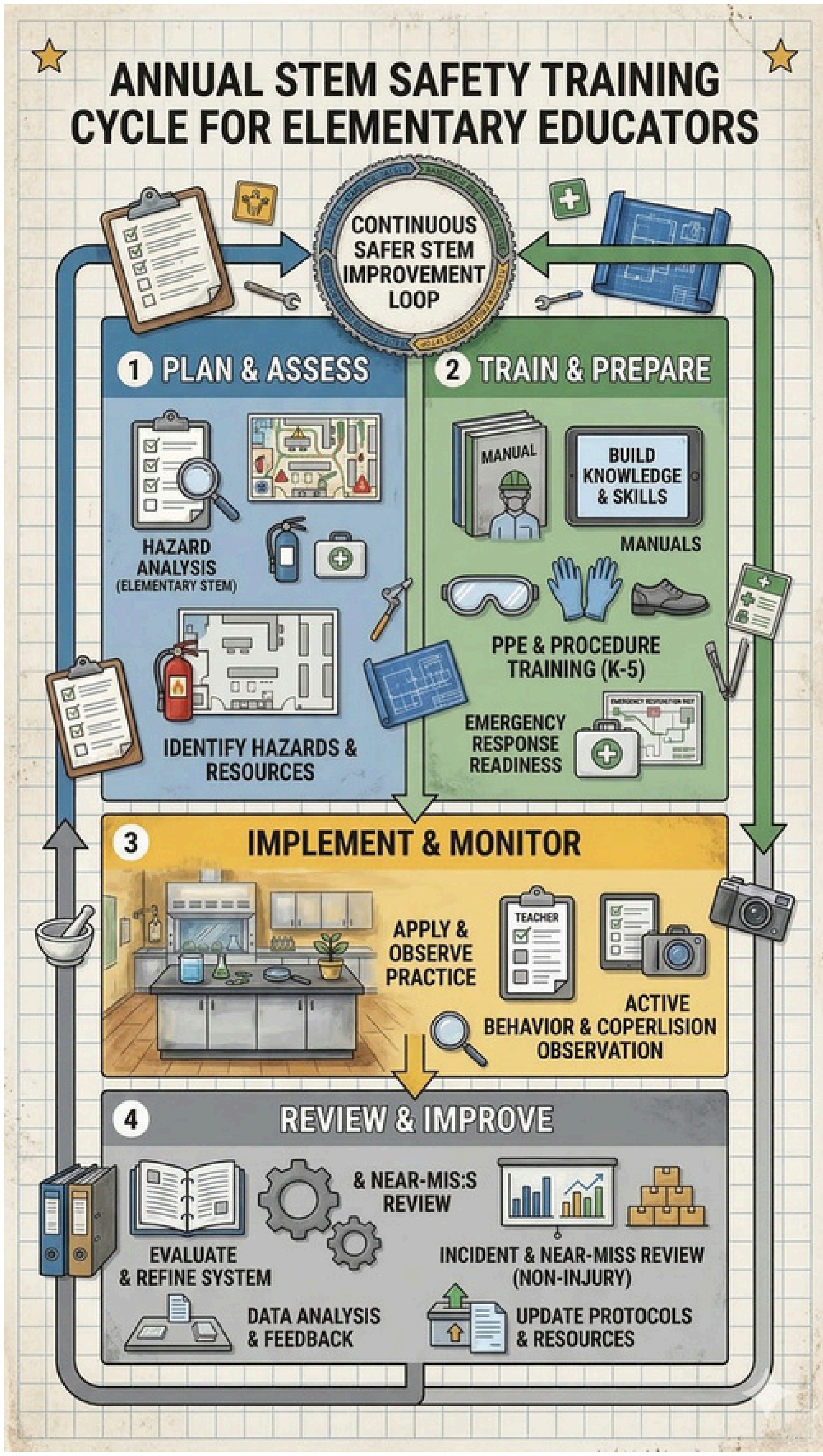
Reducing sharing remains one of the most effective infection-control strategies in STEM spaces (CDC; NSTA).

Materials should be distributed directly by the teacher. Students should not independently access shared storage or supply areas.

In STEM classrooms, high-touch surfaces extend far beyond desks and door handles. Balances, microscope knobs, power supply dials, and robotics controllers become shared contact points. Infection control in these spaces is less about wiping everything and more about reducing unnecessary sharing. The most effective disinfectant is often planned and purposeful workflow design.

Figure 3

This figure expands teachers' awareness of high-touch areas beyond typical classroom surfaces to include specialized lab equipment and shared tools. Use it to prioritize cleaning routines and redesign workflows that reduce unnecessary sharing of materials.



IV DISTANCING AND STUDENT FLOW

Distancing is managed through structure. Assigned stations, staggered transitions, and controlled movement reduce contact risk without interrupting instruction. Design the flow with purpose. Do not leave it to chance.
— James Palcik, CHO, Safer STEM

Space-Plus-Time Strategy

Distancing in STEM spaces is dynamic and managed through both space and time.

Space Controls

- Assigned seating and lab stations
- Minimized face-to-face positioning
- Marked pathways and no-congregation zones
- Separate teacher demonstration areas

Time Controls

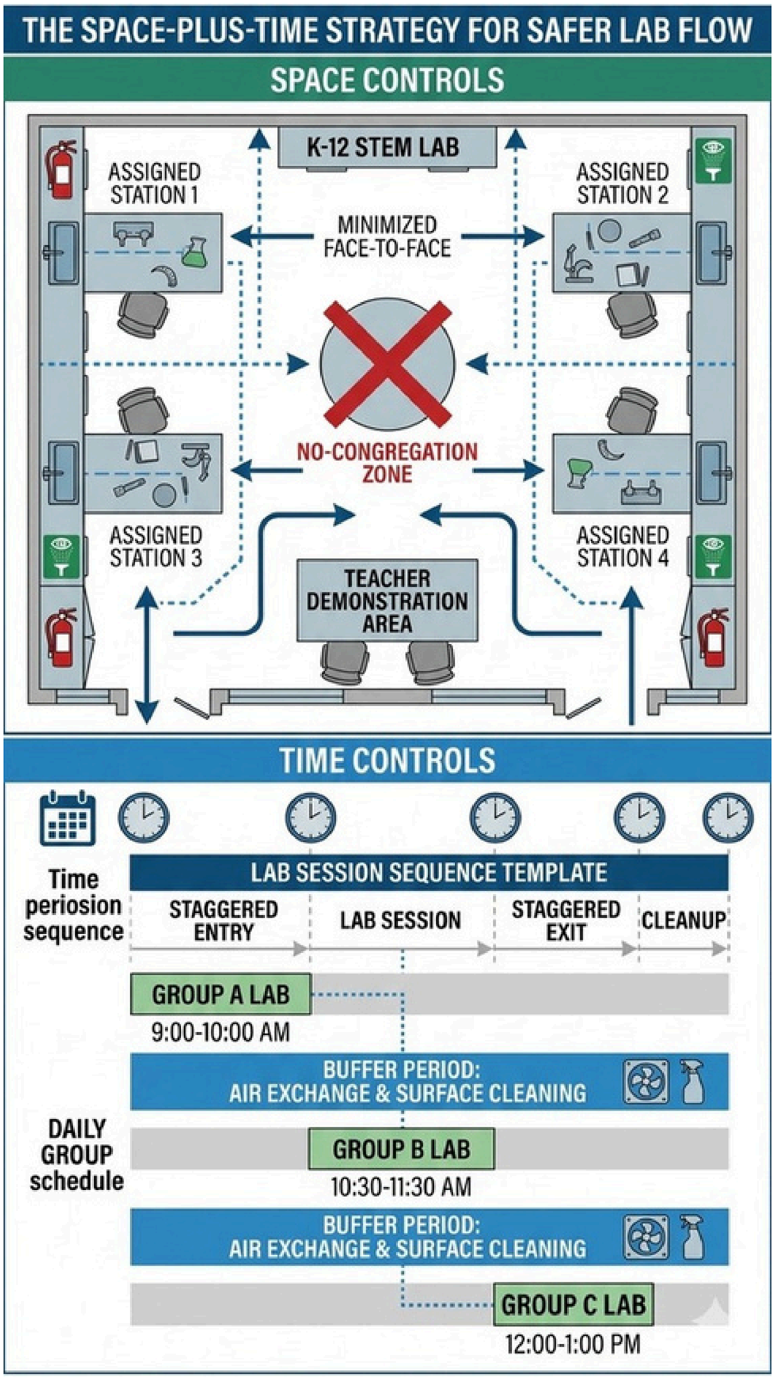
- Rotating lab groups
- Staggered entry, exit, and cleanup
- Buffer periods for air exchange and surface cleaning

Layered controls support both safer practice and instructional continuity.

Distancing in STEM spaces is not static. It is managed through both space and time. Assigned stations reduce movement; staggered transitions reduce crowding; buffer periods allow cleaning and air exchange. Think of it as choreography rather than restriction. When flow is intentional, safety improves without halting instruction.

Figure 4

This figure illustrates how teachers can structure both physical space and class timing to reduce crowding and improve safety during lab activities. It provides a practical model for organizing stations, transitions, and buffer periods without sacrificing instructional time.



V HYGIENE PROCEDURES THAT WORK IN SCHOOLS

Effective hygiene relies on routines, not reminders.
— James Palcik, CHO, Safer STEM

Hand Hygiene

- Scheduled handwashing at arrival, before and after labs, and after high-touch tasks
- Soap and water as the default
- Sanitizer used as a supplement, not a replacement

Respiratory Etiquette

- Coughing or sneezing into a tissue or elbow
- Immediate hand hygiene afterward
- Readily available tissues and lined waste containers

Annex A is a structured, phase-by-phase hygiene integration guide that embeds handwashing, surface inspection, PPE distribution, spill response, material handling controls, waste disposal, and emergency readiness into the natural rhythm of STEM instruction.

> **Hygiene routines must fit the workflow, or they will not be sustained.**

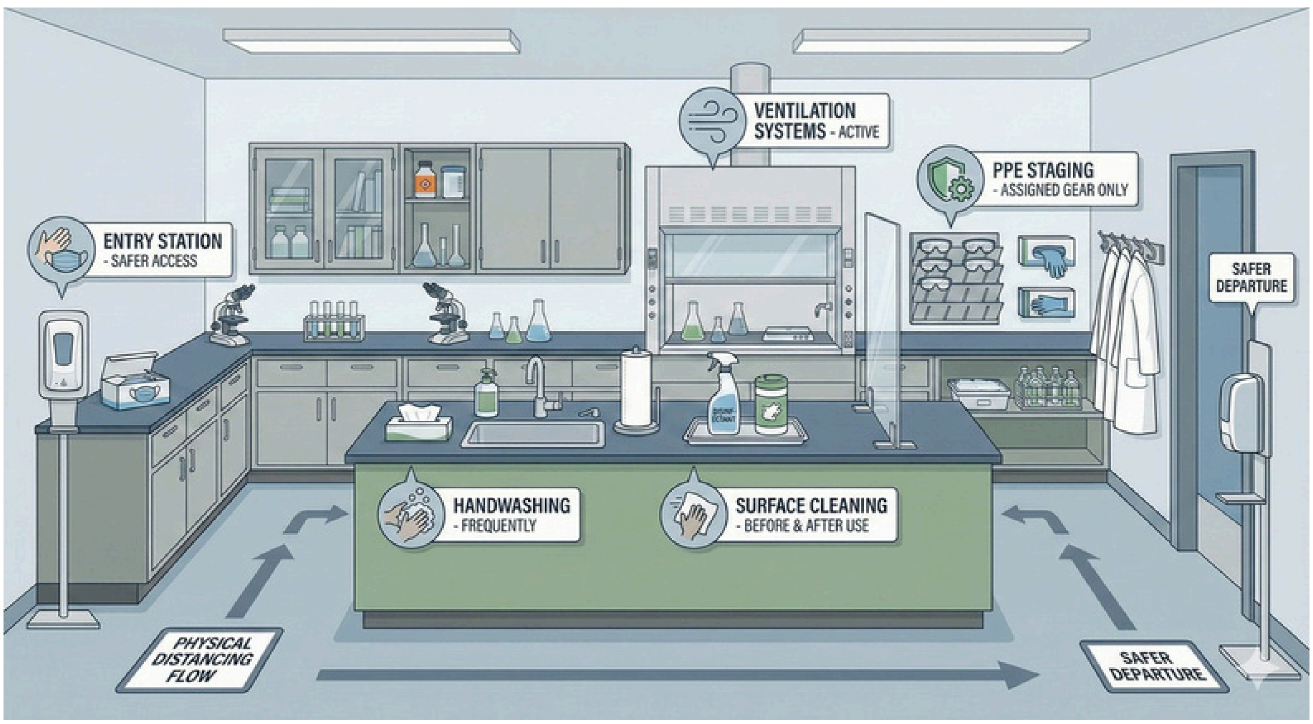
The annex aligns hygiene practices with OSHA, ANSI/ISEA, and CDC expectations while preventing risk transfer from infection control to laboratory hazards.

Students must not apply sanitizer near ignition sources, use cleaning chemicals without instruction, or mix disinfectants.

Chemical waste disposal must follow district hazardous waste procedures and applicable environmental regulations.

Figure 5

This figure demonstrates how hygiene practices, such as handwashing and surface cleaning, can be built directly into everyday lab routines. Teachers can use it to create consistent procedures that students follow automatically as part of normal scientific practice.



VI PPE DURING A PANDEMIC

Pandemic PPE does not replace laboratory PPE. Face coverings do not substitute for ANSI/ISEA-compliant eye protection. Protection must match the hazard to meet professional standards.
- James Palcik, CHO, Safer STEM

Do Not Confuse Purposes

Pandemic PPE does not replace laboratory PPE. Face coverings do not substitute for ANSI/ISEA-certified eye protection, gloves, or protective clothing (NSTA).

Availability of PPE alone does not constitute compliance. Educators are responsible for enforcing hazard-appropriate PPE use during instruction.

Eye protection must meet ANSI/ISEA Z87.1 standards.

Chemical splash hazards require ANSI/ISEA Z87.1 D3 indirect vented chemical splash goggles. Emergency eyewash and drench shower systems must meet ANSI/ISEA Z358.1, and respiratory protection, when required, must align with OSHA 29 CFR 1910.134.

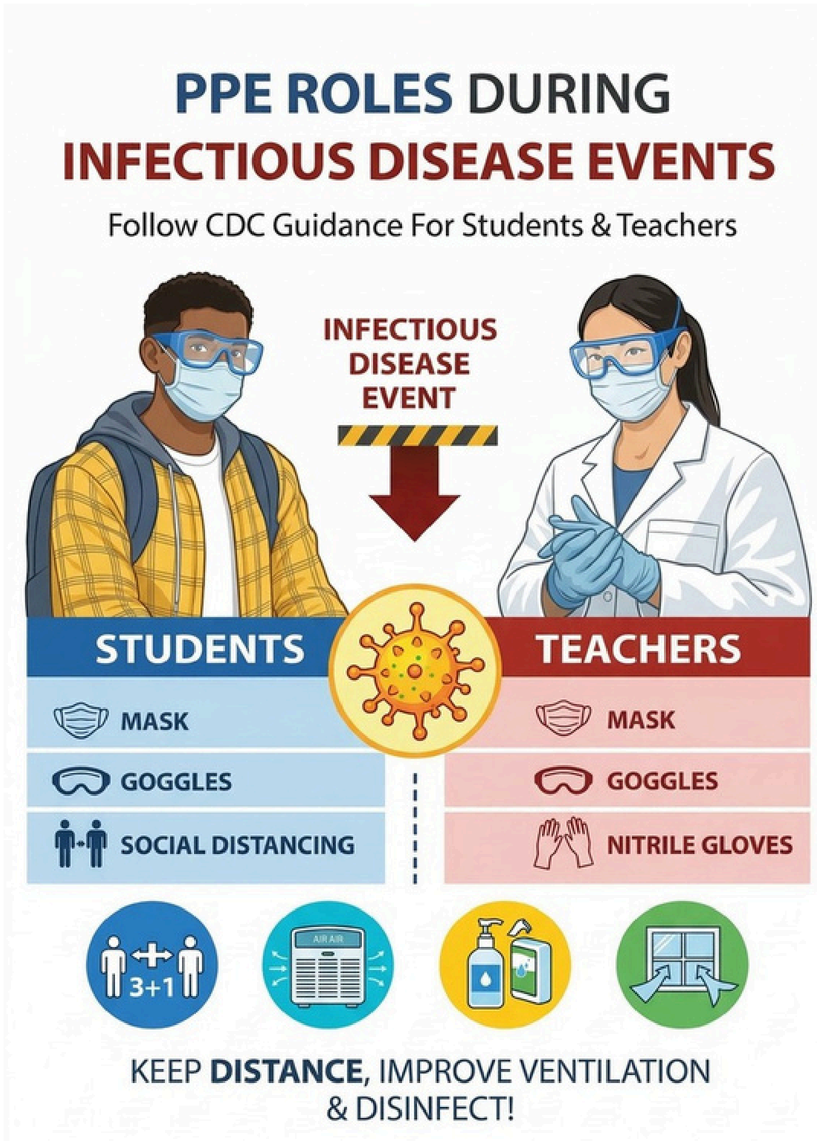
Safer STEM PPE Practices

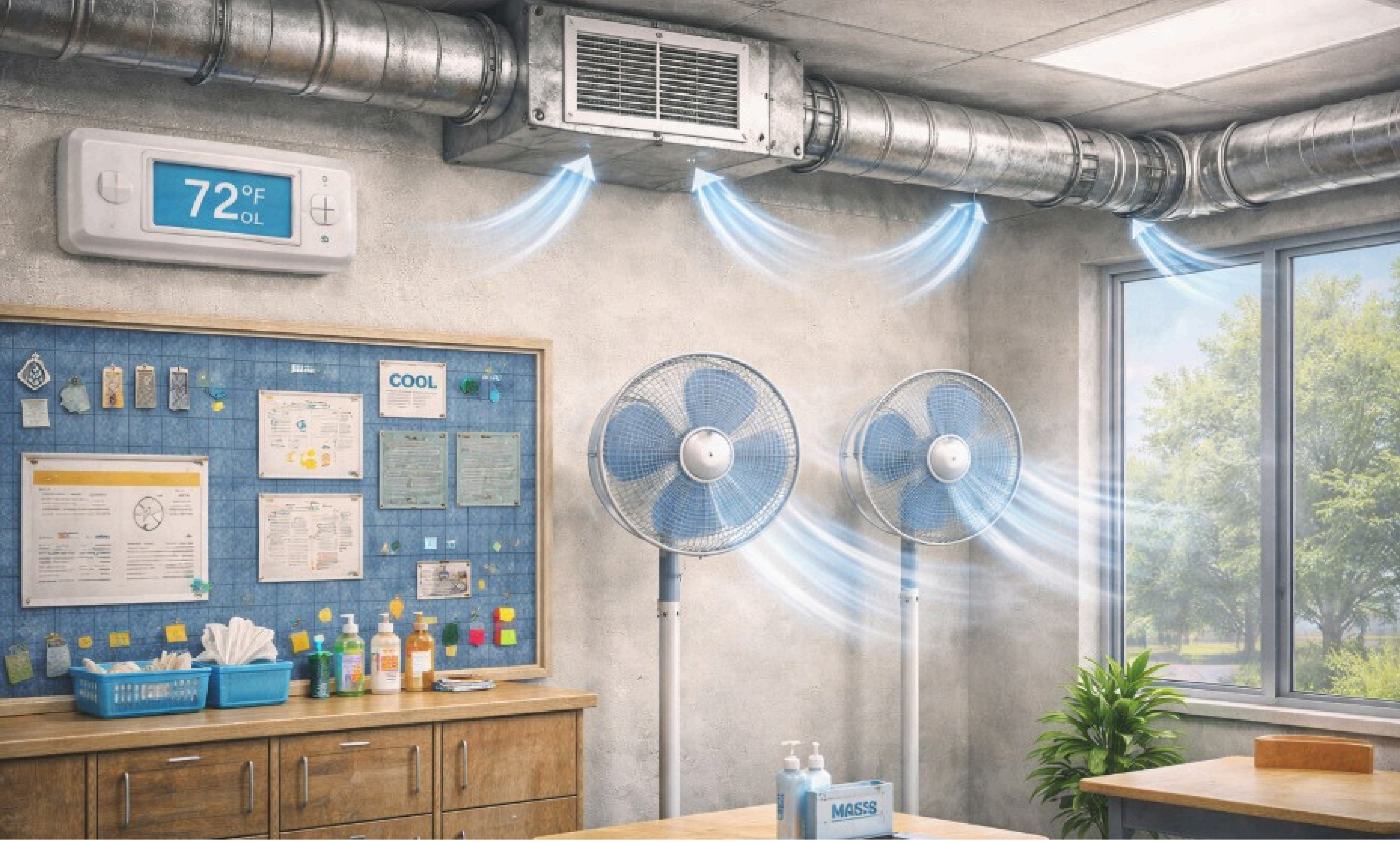
- Clean first, disinfect second for goggles
- Assign eye protection when possible
- Store PPE to prevent cross-contact and possible contamination

Pandemic PPE and laboratory PPE serve different purposes. Confusing them is like wearing a raincoat to protect against sparks. Face coverings reduce respiratory transmission; they do not replace ANSI/ISEA-compliant eye protection or splash goggles. Protection only works when it matches the hazard it is designed to address.

Figure 6

This figure clarifies the distinct roles of pandemic-related PPE and standard laboratory PPE, helping teachers reinforce correct and hazard-specific use. It supports instruction by ensuring students understand that masks, goggles, and gloves serve different protective purposes and are not interchangeable.





VII VENTILATION AND CLEANER AIR

Preparedness is not a response plan. It is a daily practice.
— James Palcik, CHO, Safer STEM

The Overlooked Control

Ventilation is a core infection-prevention strategy. Teachers should coordinate with facilities staff rather than altering systems independently.

General room ventilation must maintain adequate air exchange and must not be obstructed or disabled during STEM instruction.

Ventilation adjustments must not compromise existing laboratory exhaust systems, including chemical fume hoods or local exhaust ventilation. Infection-control airflow strategies must be evaluated in coordination with chemical hazard controls.

Ventilation practices should align with recognized standards such as ANSI/AIHA Z9.5 (Laboratory Ventilation). Where applicable, airflow should support effective air exchange without compromising local exhaust systems such as chemical fume hoods.

Effective actions include:

- Maximizing outdoor air when feasible
- Keeping vents unobstructed
- Using portable HEPA units appropriately
- Avoiding barriers that disrupt airflow

Ventilation is often invisible, which makes it easy to overlook. Yet it is one of the most powerful infection-prevention tools available.

Altering airflow without coordination can disrupt chemical controls or create new potential hazards and resulting safety risks. Effective ventilation is less about improvisation and more about collaboration with facilities professionals.

CLOSING PERSPECTIVE

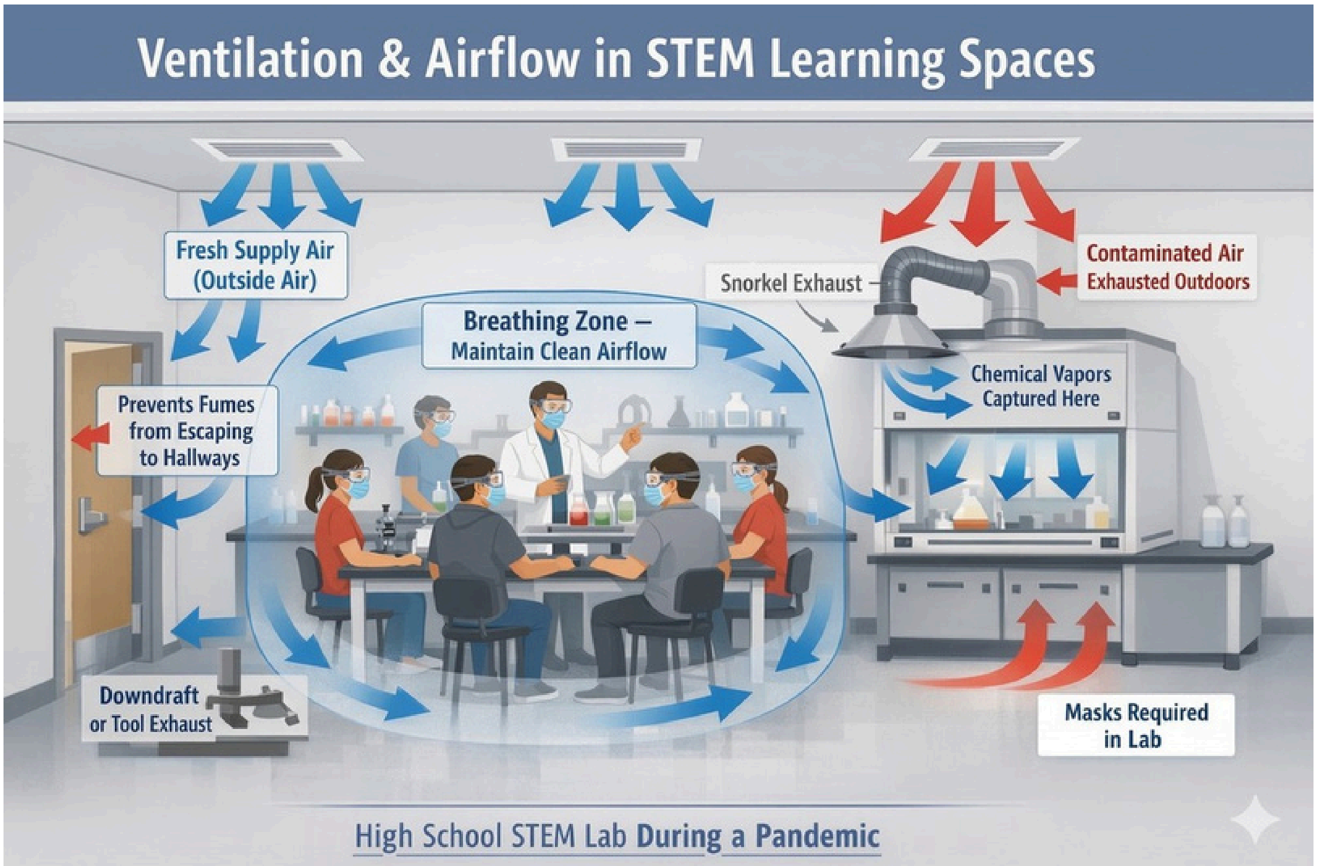
COVID Lessons That Should Become Permanent Practice

Health protection and laboratory safety are complementary. Effective pandemic protocols are those implemented correctly, consistently, and without introducing new hazards. Near-miss events, situations where potential hazards and resulting safety risks were present but no injury occurred, should be documented and reviewed to strengthen future decision-making and preparedness.

When schools institutionalize hygiene routines, evidence-based cleaning, thoughtful spacing, and ventilation coordination, they build resilience not only for future pandemics, but also for seasonal influenza, RSV, norovirus, and other emerging respiratory threats.

Figure 7

This figure helps teachers visualize how airflow moves through a lab space and how it supports both infection control and chemical safety. It can be used to guide collaboration with facilities staff and to reinforce why classroom layout and ventilation practices matter during instruction.



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ANNEX A:

During Investigation - Safety Practices for K-12 Science and STEM Instructional Spaces

During investigation activities, safer outcomes depend on a consistent, structured approach that begins before instruction and continues through cleanup. These practices are not isolated steps; they are part of a continuous workflow that reduces exposure risks, reinforces student expectations, and supports a safer learning environment.

Pre-activity setup establishes the foundation for safety. Before instruction begins, teachers must distribute appropriate personal protective equipment (PPE), including eye protection that meets ANSI/ISEA Z87.1 standards and chemical splash goggles (ANSI/ISEA Z87.1 D3) when splash hazards are present. Materials should be prepared in original or properly labeled secondary containers, with Safety Data Sheets (SDS) accessible. Clear signage and consistent enforcement, especially prohibiting food, drink, and personal items, help establish expectations before hazards are introduced. At this stage, emergency readiness must also be verified. Eyewash stations and safety showers meeting ANSI/ISEA Z358.1 must be unobstructed and operational, and hazardous activities must not proceed if critical safety equipment (e.g., fume hoods, extinguishers, emergency shut-offs) is compromised.

Material handling and inspection reduce preventable risks. Teachers should conduct a visual inspection of all work surfaces, tools, and equipment to identify residue, contamination, or damage from prior use. Damaged equipment must be removed from service, and only approved cleaning agents used. Proper labeling and containment during use prevent accidental misuse and unintended exposure. Chemical selection is equally important. Methanol (methyl alcohol) is prohibited due to its toxicity. When appropriate and permitted by district safer chemical use policies, ethanol may be substituted to reduce hazard potential.

During instruction, hygiene routines must be embedded into the workflow. Scheduled handwashing with soap and running water (preferred over hand sanitizer except when unavailable) should occur before materials are distributed and immediately after investigations. Routine glove changes between task stages are essential to limit cross-contamination across materials and surfaces. Nitrile or non-latex gloves should be used for chemical or biological work, with insulated gloves provided when handling hot or cold materials. These practices reduce transfer of contaminants and reinforce hygiene as a core part of STEM practice.

Ongoing monitoring ensures that expectations translate into practice. Active teacher observation of student behaviors is critical throughout the investigation. Teachers should provide immediate corrective instruction when safety or hygiene expectations are not followed. End-of-class hygiene checks help confirm that students leave the instructional space free of contaminants, preventing unintended exposure beyond the classroom and protecting subsequent classes.

Emergency response must be immediate and appropriate. Minor spills should be addressed promptly using procedures matched to the specific material, reducing slip, contact, and inhalation risks. Eyewash access must be readily available whenever chemicals are in use to ensure rapid response to exposures. These measures help prevent small incidents from escalating into more serious events.

Post-activity cleanup completes the safety cycle. All tools, equipment, and work surfaces must be properly decontaminated using approved cleaning agents. Contaminated materials, such as wipes and gloves, must be disposed of according to established protocols, and waste segregation (chemical, biological, and sharps) must align with district and regulatory requirements. Handwashing with soap and water is required after chemical or biological activities to remove residues from skin and prevent transfer outside the instructional space.

Taken together, these practices create a continuous system of prevention, monitoring, and response. They reduce exposure risks, limit cross-contamination, and support a safer, more controlled environment for hands-on science and STEM learning.

Bloodborne Pathogens and Sharps Safety (When Applicable) When first aid response, dissections, or sharps handling may reasonably involve exposure to blood or other potentially infectious materials, procedures must align with the OSHA Bloodborne Pathogens Standard (29 CFR 1910.1030) where applicable. Universal precautions must be followed. Sharps must be disposed of immediately in approved, puncture-resistant, closable, leak-resistant, labeled or color-coded sharps containers. Staff must follow district exposure-control procedures, and any exposure incident must be documented and managed according to policy.

ANNEX B:
Supporting Students with Additional Needs in Pandemic-Ready STEM Programs

Science and STEM instructional spaces are designed to be hands-on and inquiry-driven; however, these same qualities introduce potential safety hazards and resulting health and safety risks that must be carefully managed. During pandemic or public health emergency conditions, these risks are compounded by biological exposure concerns, changes in instructional delivery, and variability in supervision.

Students with additional needs, supported through IEPs, 504 Plans, or documented medical conditions, require individualized safety planning to ensure equitable and safer access. These obligations are grounded in federal law and reinforced through national safety guidance (U.S. Department of Education, 2020; National Research Council [NRC], 2011).

Pandemic conditions do not reduce responsibility. They increase the need for structured, student-centered safety decision-making.

Each student presents a unique safety profile. A “one-size-fits-all” approach does not work in science and STEM instructional environments, particularly when conditions shift between in-person, hybrid, and remote learning contexts.

Core Principle: Safety decisions must be both environment-specific and student-specific.

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