

Science/STEM Instructional Space Requirements

This paper serves as a primer for those designing and developing new or renovated science/STEM instructional spaces, including laboratories, classrooms, or both, and those who teach or schedule science/STEM courses in a school. The intent is to outline applications of the legal safety standards and better professional safety practices requirements that schools must incorporate into their science/STEM instructional spaces to provide students and staff with a safer teaching/learning environment.

Note that as new technologies emerge and codes—whether building, fire, Occupational Safety and Health Administration (OSHA), etc. —change, this position paper will need to be updated.

Size

All science/STEM laboratory areas must be designed with enough square footage to provide a safer teaching/learning environment for all students, staff, and other occupants. The National Fire Prevention Association (NFPA) defines a laboratory as “a room or space for testing, analyzing research, instruction, or similar activities that involve the use of chemicals.”¹ The International Building Code (IBC) for educational spaces’ square footage is 20 net square feet (s.f.) for general classrooms, and for shops and vocational areas, 50 net s.f.² Shops and vocational areas would include rooms with more floor area for each occupant, such as wood, metal, or auto shops and science labs. The IBC is used instead of the Building Officials and Code Administration (BOCA), which previously also set the occupancy square footage at 20 s.f. and 50 s.f., respectively.

The National Science Teaching Association (NSTA) sets a safer minimum of 60 square feet per student. In determining this number, the American Chemical Society (ACS) and the NSTA recommend a maximum of 24 students per classroom based on 60 square feet per student.³

1 NFPA-45 (National Fire Protection Association, Standard on Fire Protection for Laboratories Using Chemicals NFPA-45, 1996)

2 <https://codes.iccsafe.org/content/IBC2018/chapter-10-means-of-egress#:-:text=About%20this%20chapter%3A%20Chapter%2010,or%20evacuation%20of%20building%20occupants>

3 <https://static.nsta.org/pdfs/overcrowdingintheinstructionalspace.pdf>

Engineering Controls

When designing or preparing spaces for science/STEM lessons, science/STEM laboratories and classrooms must include the correct engineering controls with the appropriate placement. The following are the basic engineering controls necessary in a science laboratory and when required.

1. **Eyewash Station.** Anytime there is the potential for use of hazardous chemicals
2. **Safety Shower.** Anytime there is the potential for use of hazardous chemicals.
3. **UV (ultraviolet) Goggle Cabinets.** Anytime laboratory occupants will be required to use goggles or safety glasses with side shields
4. **Fume Hood.** Anytime a chemical is used that calls for confined special ventilation resulting from potential exposure to hazardous chemical fumes, vapors, etc. At a minimum, every biology and chemistry lab should have one in working order.
5. **Fire Extinguisher.** Please see local, state, OSHA, and NFPA regulations for the information specific to your locale. Generally, an “ABC”-rated fire extinguisher is required. Also, a “D”-rated fire extinguisher is required for combustible metal use.
6. **GFCI (ground fault circuit interrupter) or GFI (ground fault interrupter) outlets.** At all times
7. **Broken Glass Disposal Bin.** Anytime glass is used in the classroom or laboratory
8. **Fire Blanket.** Any science instructional space that will use hazardous chemicals or active fire sources
9. **Fuel Shutoff Valves.** Any science instructional space with gas piped into it needs a main gas shutoff valve. This is a requirement of the following codes:
 - a. The National Fuel Gas Code.⁴ The National Fuel Gas Code Sections 3.10 and 5.5.4 require manual shutoff valves to be marked and located within close proximity to the equipment they serve.
 - b. NFPA 54, Section 7.9.2.4 Shutoff Valve for Laboratories.⁵ “Each laboratory space containing two or more gas outlets...shall have a single shutoff valve through which all such gas outlets are supplied. The shutoff valve shall be located within the laboratory or adjacent to the laboratory’s egress door and identified.”

4 https://www.osha.gov/ords/imis/generalsearch.citation_detail?id=414289.015&cit_id=01001

5 <https://www.isimet.com/codes>

- c. International Fuel Gas Code, Section 409, Shutoff Valves 409.6 Shutoff Valve for Laboratories.⁶ *“Where provided with two or more fuel gas outlets...each laboratory space in educational, research, commercial, and industrial occupancies shall be provided with a single dedicated shutoff valve. The dedicated shutoff valve shall be readily accessible and located within the laboratory space served. Located adjacent to the egress door from the space and shall be identified with approved signage...”*

10. Main Water Shutoff Valve.

This is a minimum requirement list. State and local ordinances may require other engineering controls based on the laboratory activities you wish to conduct. For more information, see the NSTA document Planning School Science Facilities.⁷

Personal Protective Equipment (PPE) Storage

The Laboratory Standard, 29 CFR 1910.1450, requires the Chemical Hygiene Plan to provide the criteria for using PPE. The employer must provide and pay for the PPE for personnel when

“hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants are encountered in a manner capable of causing the injury of impairment in the function of any part of the body through absorption, inhalation, or physical contact.”⁸

Therefore, science/STEM instructional spaces must provide the appropriate storage areas so students and staff can access the PPE provided by the school district. This can include but is not limited to a goggle cabinet and storage for aprons, gloves, etc. Science/STEM instructional spaces should also allocate space for paper towels, soap, and a first aid kit.⁹

Signage

Signs stating “Goggles Must Be Worn” are required when participants must use goggles in the classroom or laboratory. Signs stating “Safety Glasses Must Be Worn” are required when occupants must use safety glasses in the classroom or laboratory.

⁶ <https://codes.iccsafe.org/s/IFGC2012P5/chapter-4-gas-piping-installations/IFGC2012-Ch04-Sec409.6>

⁷ <https://static.nsta.org/pdfs/samples/PB149E2web.pdf>

⁸ <https://www.osha.gov/sites/default/files/publications/OSHA3404laboratory-safety-guidance.pdf>

⁹ <https://www.acs.org/education/policies/middle-and-high-school-chemistry/safety.html>

Signs labeling the position of safety equipment and engineering controls must be in place. These include, but are not limited to, the following: the eyewash station, the fire extinguisher, the first aid kit, the main shutoff for gas, and the safety shower. Check your local and state regulations for more required signage.

Multiple-Use Facilities

Schools should only use science instructional spaces as Multiple-Use Spaces if the teachers using the space have the correct and up-to-date science certifications.

Educators must consider numerous safety factors when conducting a class in a science instructional space. Only an appropriately certified teacher with experience in the laboratory or classroom can be expected to keep updated on the potential safety hazards and resulting health and safety risks.

Sometimes a science/STEM instructional space includes a laboratory and a separate classroom. Unless the two areas are *entirely* separate and a barrier is in place to prevent students and staff from entering the laboratory area, prudent or reasonable educational practices dictate that if the lab area is not secured, then a trained and certified science/STEM teacher must be in the room when non-science/STEM-certified teachers are conducting class in a science/STEM classroom. In any case, non-science/STEM-certified teachers must receive appropriate safety training per the OSHA Laboratory Standard Chemical Hygiene Plan and/or the OSHA Hazard Communication Standard requirements to instruct (science or non-science course work) students in a science/STEM laboratory.

Temporary Science Instructional Spaces

When renovations are being done during the academic year, alternative science/STEM instructional spaces usually need to be found. Teachers must make sure all the appropriate engineering controls are in place in the temporary location. If they're not available or it's not possible to retro-fit the temporary science instructional space, alterations in hands-on activities and demonstrations need to be addressed. In some cases, given the possible hazard analysis and resulting risk assessment findings, no safety action interventions may be available to address the needs for a safer activity/demo. In this case, certain laboratory activities and/or demonstrations must be eliminated. Safer alternatives will need to be found, if they exist.

Conclusion

Science/STEM laboratories and classrooms must be designed and prepared with safety in mind. Without the proper space and equipment, students and staff are at a greater risk of harm than simply being without the equipment needed to keep them safer. A science/STEM instructional space should be used solely for science/STEM courses, and science/STEM instructors must be properly trained and certified.