

SUPPLEMENT TO

REVIEW AND RECOMMENDATIONS OF BEST PRACTICES

FOR K–12 STEM LEARNING SPACES:

TABLES OF EXAMPLE LABORATORY HAZARDS, CONTROLS, AND

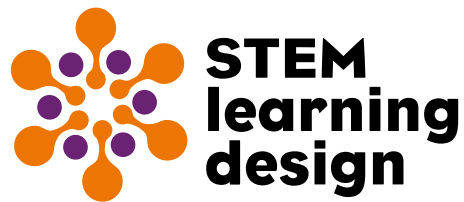
DESIGN STANDARDS

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Tables of example laboratory hazards, controls, and design standards

The first table provides an overview of common hazards and potential controls. The second table provides relevant regulations and standards for common laboratory controls.

Note that the first table assumes that the school has assessed its program for opportunities to eliminate or substitute hazards, and the remaining hazards are the minimum necessary to achieve identified learning goals. Potential controls listed are intended to provide common or representative examples of controls that could be employed; the lists and references are not exhaustive and can change.

See text of main report for explanation of acronyms.



Examples of Common Laboratory Hazards and Potential Controls

Hazard	Comments	Potential Controls			Incident Response
		Engineered	Administrative	PPE	
Exposure to hazardous chemicals	<p>Can be exposure during a lesson, if a student gets in a space they are not supposed to be (e.g., prep room), or from something like cleaning products used across the school</p> <p>Consider all sources of chemicals, including in tech/eng rooms (e.g., solvents, glues, finishes) and art rooms</p>	<ul style="list-style-type: none"> • Sinks • Provide fume hood where appropriate • Provide chemical storage room (with dedicated ventilation) • Negative pressure in STEM spaces where hazardous chemicals may be used in quantity, to prevent spread of any fumes to other areas of school 	<ul style="list-style-type: none"> • Maintain and provide SDSs • Purchase only quantities that are needed. • Store incompatible chemicals separately. • Prepare chemicals for labs in chemical storage room • Transport chemicals in closed containers using a cart with spill containment. • Use “safety shield” for demonstrations involving fire or chemical reaction. • Safety contract and training for all students • Safety procedures included in all lab instructions • Practice micro-scale chemistry • Avoid use of mercury, Lead, Arsenic, Cadmium, Benzene, air reactive and water reactive chemicals. 	<ul style="list-style-type: none"> • Splash goggles (should also be impact resistant) • Faceshield • Splash apron • Chemical-resistant, non-latex gloves • Chemical-resistant apron • (Respirator if needed) 	<ul style="list-style-type: none"> • Safety shower • Eyewash station(s) • Emergency call button in room • Fire extinguisher • Fire blanket (if required) • Visit Nurse/Health Center • Follow appropriate response and clean up procedures
Cuts and scrapes from small tool use or table-top machine use	Also from glassware, sharp tools, etc.	<ul style="list-style-type: none"> • Sinks • Machine guards • Machine enclosures (e.g., small CNC, laser cutter) 	<ul style="list-style-type: none"> • Provide safest tool for a particular task • Proper disposal procedure and container for broken glass 		<ul style="list-style-type: none"> • Emergency call button in room • Visit Nurse/Health Center

Hazard	Comments	Potential Controls			Incident Response
		Engineered	Administrative	PPE	
		<ul style="list-style-type: none"> • Electrical lockouts for selected machines • Locked tool storage 	<ul style="list-style-type: none"> • Safety contract and training for all students on use of tools • Identified safety zones around machines as appropriate (typically 3 ft) • Regularly inspect and maintain all equipment 		
Limb-threatening injuries from large machines	Typically from large floor-standing machines such as table saw, large open CNC machine, etc.	<ul style="list-style-type: none"> • Provide machine guards • Provide space for appropriate safety zones around large machines • Electrical lockouts and emergency shut off switches 	<ul style="list-style-type: none"> • Provide safest tool for a particular task • Provide emergency stops in room • Identified safety zones around machines (typically 3 ft) • Regularly inspect and maintain all equipment • Safety contract and training for all students on use of tools 	<ul style="list-style-type: none"> • Use safety glasses (impact resistant) 	<ul style="list-style-type: none"> • Emergency call button in room • Visit Nurse/Health Center
Exposure to excessive noise from machinery or certain lessons (e.g., music)	Any situation over 85 decibels is a concern. Certain large machines (e.g., table saw) and tools (e.g., shop vacuum, leaf blower) can be quite loud	<ul style="list-style-type: none"> • Consider isolation of loud machines 	<ul style="list-style-type: none"> • ‘Buy Quiet’ – purchase machines and tools designed to be quieter • Monitor decibel level • Regularly inspect and maintain all equipment • Safety contract and training for all students on use of tools 	<ul style="list-style-type: none"> • Provide and require use of ear protection 	<ul style="list-style-type: none"> • Visit Nurse/Health Center
Inhalation hazards from dust and fumes	Can be chemical sources, or from machines that	<ul style="list-style-type: none"> • Dust or fume exhaust 	<ul style="list-style-type: none"> • Provide safest equipment for a particular task 	<ul style="list-style-type: none"> • Provide respirator if necessary 	<ul style="list-style-type: none"> • Emergency call button in room



Hazard	Comments	Potential Controls			Incident Response
		Engineered	Administrative	PPE	
	produce dust or burn materials (e.g., laser cutter)	<ul style="list-style-type: none"> • Enclose cutting area of machine (CNC, laser) • Local exhaust (woodworking) • Sinks 	<ul style="list-style-type: none"> • Regularly inspect and maintain all equipment • Safety contract and training for students on use of equipment 	<ul style="list-style-type: none"> • Safety glasses for particulates (impact resistant) 	<ul style="list-style-type: none"> • Eyewash station(s) • Visit Nurse/Health Center
Injuries from falling materials	Improperly stored materials or containers can fall on somebody	<ul style="list-style-type: none"> • Dedicated material storage • Shelving secured from tipping • Weight limits posted on shelving 	<ul style="list-style-type: none"> • Only keep what you need • Stack materials securely 		
Burns from fire	From materials on hot plates, Bunsen burners, etc.	<ul style="list-style-type: none"> • Gas and electrical emergency shut off near door, keyed • Sinks • Extension cords not used as permanent wiring. • Electric power strips not used for appliances 	<ul style="list-style-type: none"> • Safety contract and training for all students on use of tools • Regularly inspect and maintain all equipment • Lab instructions include safety requirements to prevent fires or burns • Students trained on how to extinguish burning clothing (see 527 CMR 10.24.3.3) 		<ul style="list-style-type: none"> • Emergency call button in room • Fire extinguisher • Fire blanket (if required) • Visit Nurse/Health Center
Exposure to infectious diseases (e.g., ill child)	Exposure can happen through various routes including body fluids, sharing equipment, etc.	<ul style="list-style-type: none"> • Include sinks in rooms for regular hand washing and cleaning of shared equipment 	<ul style="list-style-type: none"> • Wipe desks periodically with soap and water 	<ul style="list-style-type: none"> • Provide non-latex gloves for cleaning vomit or feces 	<ul style="list-style-type: none"> • Visit Nurse/Health Center



Examples of Relevant Regulations and Standards for Common Laboratory Controls

Control	What triggers the need for it	Key guidance for its design	Key guidance for testing & maintenance	Required plan
Engineered Controls				
2 exits for every lab	OSHA 1910.33–39	See MSBA lab requirement		OSHA 1910.38 Emergency Action Plan OSHA 1910.39 Fire Protection Plan
Fume hood	NFPA 45 Fire Protection for Laboratories Using Chemicals NFPA 30 Flammable and Combustible Liquids Code	ANSI Z9.5 The American National Standard for Laboratory Ventilation NFPA 45 Scientific Equipment & Furniture Association (SEFA) 1.2-1996	Proper function required as part of OSHA 1910.1450(e)(3)(ii) ANSI 110-1995. Method of Testing Performance of Laboratory Fume Hoods	Part of OSHA 1910.1450 Chemical Hygiene Plan
Chemical storage room (vented) Including hazardous waste storage	OSHA 1910 (when quantity of flammable chemicals exceed certain amounts) NFPA 30 Flammable and Combustible Liquids Code MA 527 CMR 14.00 MA DEP 310 CMR 30	OSHA 1926.152 NFPA 30 EPA CFR 40.239–282 (particularly 260–272) IPC 248 CMR 10.13		Part of OSHA 1910.1450 Chemical Hygiene Plan
Negative room pressure	OSHA recommended, not mandated			Part of OSHA 1910.1450 Chemical Hygiene Plan
Corrosive waste neutralization system	(Not recommended or mandated for schools)	If included, must meet IPC 248 CMR 10.13		Part of OSHA 1910.1450 Chemical Hygiene Plan
Machine guards &/or enclosures	OSHA 1910.212 All machines OSHA 1910.213 Woodworking			Include in Hazard Assessment Plan



Control	What triggers the need for it	Key guidance for its design	Key guidance for testing & maintenance	Required plan
Emergency stops	OSHA general duty clause 5(a)(1) ¹			Include in Hazard Assessment Plan
Electrical lock outs	OSHA 1910.147			Include in Hazard Assessment Plan
GFCI grounded circuits	OSHA 1910.303(b)(4)	MA 527 CMR NFPA 70		
Administrative Controls				
Signage	OSHA 1910.145 OSHA 1910.1200 OSHA 1910.1450 NFPA 704	NFPA 704		Include in Hazard Assessment Plan
Proper chemical labels and SDS	OSHA 1910.1200(f)(6) OSHA 1910.1450(h) MA M.G.L. c.111F (MA Right to Know Law)	Global Harmonized System labeling system		Part of OSHA 1910.1450 Chemical Hygiene Plan
Mark and label safety zones	Not an OSHA mandate OSHA 1910.22 aisle			Include in Hazard Assessment Plan
Hazardous chemical exposure monitoring (in designated labs)	Chemicals should be selected so that toxic exposure will not occur; then air testing is NOT required by OSHA 1910.1450(d)			Part of OSHA 1910.1450 Chemical Hygiene Plan
Standard operating procedures when using hazardous chemicals	OSHA 29 CFR 1910.1450(e)(3)(i)			Part of OSHA 1910.1450 Chemical Hygiene Plan

¹ OSHA does not directly address emergency stops. The Massachusetts Department of Elementary and Secondary Education's Office for College, Career, and Technical Education uses the general duty clause for CVTE program spaces.



Control	What triggers the need for it	Key guidance for its design	Key guidance for testing & maintenance	Required plan
PPE	OSHA 1910.132–138			OSHA 1910.132–138 Hazard Assessment Plan
Goggles & face protection	OSHA 1910.133 MA M.G.L. c.71 §55C	ANSI Z87.1		Part of OSHA 1910.1450 Chemical Hygiene Plan and Hazard Assessment Plan
Ear protection	OSHA 1910.95 (if 85 decibels exceeded)			OSHA 1910.95 Hearing Protection Program (include in Hazard Assessment Plan)
Respirator	OSHA 1910.134 OSHA 1910.1450(i)			OSHA 1910.134 Respiratory Protection Plan (include in Hazard Assessment Plan) Part of OSHA 1910.1450 Chemical Hygiene Plan
Apron, coat	OSHA 1910.132			Part of OSHA 1910.1450 Chemical Hygiene Plan
Emergency Response				
Safety shower	OSHA 1910.151 MA 527 CMR 10.02(2)	ANSI Z358.1-2014 IPC 411.1 & 411.2 MA 527 CMR 10.02(2)	MA 527 CMR 10.02(2) Test every 6 months per MA 527 CMR 10.24.3.1	Part of OSHA 1910.1450 Chemical Hygiene Plan
Eyewash station(s)	OSHA 1910.151(c) MA 527 CMR 10.24	ANSI/ISEA Z358.1-2014 IPC 411.1 & 411.2 MA 527 CMR 10.02(2)	ANSI Z358.1-2014	Part of OSHA 1910.1450 Chemical Hygiene Plan
Fire extinguisher	OSHA 29 CFR 1910.157	MA 527 CMR 14.07(2) NFPA 10 Table 13.6.2	MA 527 CMR 10.24.3.3 Training required	1910.155 Fire Protection Program
Fire blanket	OSHA 29 CFR 1910.155(c) MA 527 CMR 10.23 MA 527 CMR 10.24.2	NFPA 45	MA 527 CMR 10.24.3.3 Training required	1910.155 Fire Protection Program

