Building for Safety in Secondary School Science Facilities: An Audit

Sandra S. West

School _____ Room No._____ Classroom Teacher_____
Department Chair_____ Content Area _____

Please place a check mark in the appropriate column. "No" answers indicate a problem.

I. Floor Space and Class Size Floor space is defined as "within the walls," excludes furniture, entry, alcoves, etc.	**YES**	**NO**
A. 24 students or fewer per class (NSTA and NSELA recommendation) for safe supervision		
B. 60 sq ft/high school student laboratory/classroom space (within the walls, do not exclude furniture), minimum (NSTA recommendation)		
C. 55 sq ft/middle school student laboratory/classroom space		
D. 45 sq ft/elementary school student laboratory/classroom space		
E. 1 lab/workstation for each student		
F. 6 sq ft/lab workstation/student (36" wide × 24" deep horizontal work surface)		
G. 1 lab/classroom for each science teacher		
H. 6 ft. linear horizontal work surface/student (includes lab/workstations, countertops, lab tables not desks)		
I. Preparation and equipment/materials storage space		
1. 10 sq ft/student, minimum, preparation/equipment (preparation, equipment and materials) storage space (240 sq ft for each 24 student lab/classroom)		
2. 1 sq ft/student, minimum, for chemical storage		
J. Additional space		
1. ADA requirements (approx. 20 sq ft) for lab/workstation		
2. Technology equipment (lab/field and instructional) 50 sq ft		
3. Multiple different courses taught in same lab/classroom		
K. Lab/classroom width 30 ft, minimum for continuous instructional wall		
L. Aisles 4 ft wide, minimum (to allow students and teachers to move and egress safely)		
M. Doorways 36" wide, minimum		
N. Separate room/space for small group or individual or long-term research projects		
II. Communication System		
A. Telephone in every room		
B. "Hotline" to office in every room (emergency telephone or intercom button)		

	YES	NO
III. Shut-Off Controls		
A. Emergency shut-off controls are labeled, accessible to teachers, preferably near the teacher's station, but not too easily accessible to students (not at door entry or hallway)		
1. Gas		
2. Electricity		
B. Master shut-off controls are labeled (if separate from emergency shutoffs) accessible to teacher, but not easily accessible to students		
C. All shut-off controls (emergency and master) clearly labeled:		
1. Gas		
2. Electricity		
3. Water (source that does not shut off eyewash or shower)		
IV. Utilities		
A. Vandal-resistant:		
1. Water faucets		
2. Gas jets		
B. Electricity:		
1. Sufficient number of electrical circuits provided in lab/classroom to meet curriculum, including computer and other technical equipment (3–20 amp minimum)		
2. No DC lines (substitute small, dry cells for students or portable DC units for teachers, protected by circuit breakers or fuses)		
3. All outlets in lab/classroom, preparation/equipment room, storage room and project room protected by ground-fault interrupters (GFI)		
4. All outlets grounded and requiring 3-pronged plugs (OSHA requirement)		
5. No outlets within 3 ft of faucets or other water sources		
6. Sufficient number of outlets provided to eliminate need for extension cords, overlapping wires, or plug-in outlet extenders (e.g., 2 duplex outlets/student lab/workstation)		
7. Laboratory refrigerators, spark-free		
C. Water faucets		
1. Capped with an aerator, not a serrated hose connection		
2. Swivel and high-arched faucets		
V. Fire Control and Security		
A. ABC dry chemical fire extinguisher, or type required by local ordinance:		
1. Present in every lab/classroom, preparation/equipment room and storage room		
2. Present in every chemical storage room unless attached to preparation/equipment storage room (may require more than one type of fire extinguisher to avoid chemical reactions)		
3. In easily visible, unobstructed locations		
4. Located near escape routes (second extinguisher may be in interior of room)		

	YES	NO
5. Correct size (5 lb, minimum, 16 lb, maximum, charge weight)		
B. Access to fire exits (via doors and ground-floor windows):		
1. 2 exits in every lab/classroom if over 1,000 square feet with main door opening outward		
2. 2 exits in every preparation/equipment storage room		
3. Fireproof doors that open outward for all chemical storage rooms		
4. All exits labeled, unobstructed, and unlocked from inside		
C. General alarm system for entire building		
D. Smoke alarm present in every preparation/equipment storage room		
E. 2 smoke alarms in preparation/equipment storage room if 200 sq ft or larger		
F. Smoke and heat alarm present in chemical storage room		
G. Automatic sprinkler system (may be required under local or state fire codes):		
1. Present in lab/classroom, preparation/equipment storage room		
2. Recommended in chemical storage room (special head may be needed to protect against oxidizers; water reactive chemicals require protected storage)		
3. No obstructions within 18" of ceiling		
H. Lockable doors for all lab/classrooms, preparation/equipment storage rooms, and science storage rooms.		
I. Chemical storage room with unique key for science teachers and administrators (not available to others such as custodians, nonscience teachers, etc.)		
J. Safe ADA accessible entrance to roof, if roof-mounted weather station is to be used		
VI. Ventilation		
A. All lab/classrooms, prep/equipment, and chemical storage rooms air vented to outside of building, not recirculated in building's ventilation system		
B. All exhaust air vented to outside of building, at sufficient distance from air intakes to prevent re-circulation		
C. Lab/classroom ventilation at a rate of 4 air changes/hr, minimum (occupied ANSI Z9.5 & ASHRAE Standard 62, or later)		
D. Preparation/equipment storage room ventilation at rate of $1ft^3$/minute/ $1ft^2$ floor space, minimum		
E. Chemical storage room ventilation:		
1. Continuous, with exhaust vented to outside of building away from intake vent		
2. 6 air changes/hr, minimum (OSHA requirement) (minimum of 1 cfm/sq ft but not less than 150 cfm NFPA 30)		
3. Climate-controlled storage so that chemicals are not exposed to excessive hot or cold temperatures or humidity		
4. Exhaust vents at floor and ceiling		
F. Exhaust fan/purge system for supplemental ventilation		
1. Present in every lab/classroom, preparation/equipment storage room, for quick removal of excessive fumes		

	YES	NO
2. Provided with manual control		
3. Exhaust vented to outside of building		
4. Equipped with fan guards, if wall-mounted		
G. Fume hood:		
1. Present in every lab/classroom where hazardous or vaporous chemicals are used		
2. Present in every preparation/equipment storage room (may be single unit available to lab/classroom and preparation/equipment storage room, mounted on common wall)		
3. 2 or more fume hoods present in AP or advanced chemistry lab/classroom		
4. Exhaust vented to outside of building on roof or outside wall		
5. Deck height 36"		
6. Provides 80 to 120 linear ft, minimum, of air movement at hood face, for working with chemicals of low to moderate toxicity (ANSI Z9.5.7)		
7. Located at least 10 ft from main exit (ANSI Z9.5.4)		
8. Not located on a main traffic aisle (ANSI Z9.5.4)		
9. Located away from heavy traffic areas, doors, windows, and intake ducts so that fume hood airflow is not disrupted.		
10. If shared by two or more fume hoods, ventilation system adequately engineered for purpose		
11. Sash level marked for 100 ft/min of air movement and with date of measurement		
12. Meets ASHRAE 110 testing standard (at least 4.0 AU 0.10)		
13. Not used as storage area		
H. Lab/classroom ventilation meets ANSI Z9.5 standard		
VII. Lighting		
A. 50 fc/sq ft, minimum, general lighting level in lab/classroom, preparation/equipment room, and chemical storage rooms		
B. 75 fc/sq ft, minimum, on counter surfaces underneath wall cabinets		
C. Battery-operated emergency light:		
1. Present in every lab/classroom, storage room, and preparation/equipment storage room that has insufficient natural light or used at night		
2. Located next to doorway in lab/classroom and preparation/equipment storeroom		
D. Directed and diffused to avoid glare		
E. Controlled lighting with separate switches for rows of lights and room-darkening capability (shades, etc.)		
VIII. Work Areas		
A. All work surfaces made of chemical-resistant materials		
B. In lab/classroom:		
1. 6 linear ft work space/student (including lab/work stations and counters, not desks)		
2. 6 linear ft counter space adjacent to a large sink 24" × 36" × 11" minimum		

	YES	NO
3. Lab/work stations that allow a minimum of 3.6 sq ft/student lab station		
4. 1 sink/4 students, sinks 18" × 15" × 8" minimum, sinks with flexible, chemical-resistant mats (such as neoprene)		
5. Hot water available		
6. Heat source available		
7. Electricity with GFI-protection provided		
8. 10 ft ceilings		
C. Preparation/equipment storage room:		
1. 4 linear ft minimum, counter space adjacent to a large sink, 24" × 36" × 11" minimum		
2. 12 linear ft, minimum, counter space, does not have to be above floor cabinets		
3. Hot water available (120° F maximum)		
4. Heat source(s) available		
5. Electricity with GFI-protection provided		
D. Clear floor space for laboratory carts, technology, human skeleton, etc.		
E. Area(s) for safety equipment in every lab/classroom and prep/equipment storeroom:		
1. Space near fire extinguisher for safety equipment such as sand container and fire blanket		
2. Space for safety equipment such as first-aid kit and poster, chemical waste container, broken glass container, and spill kit		
3. Space for hanging aprons for 24 students in lab/classroom at entry to lab area		
IX. Equipment for Personal Protection		
A. Eyewash:		
1. Provided in every lab/classroom, access within 10 seconds of all lab/workstations (ANSI Z 58.1, 1998 or newer)		
2. Unobstructed		
3. Eyewash (dual eyewash, which treats both eyes simultaneously with equal flow pressure) located near safety shower (squeeze bottle and single eye drench not sufficient)		
4. Dual eyewash in every chemistry and physical science lab/classroom and every lab/classroom and prep/equipment storeroom where hazardous chemicals are used		
5. Dual eyewash provides instant, gentle, tempered flow of aerated water for 15 minutes, and can stay in open position, leaving user's hands free		
B. Safety shower:		
1. Available in every chemistry and physical science lab/classroom, within 10 sec. Access to all lab/workstations (ANSI Z 58.1)		
2. Unobstructed shower and valve handle		
3. Fixed valve pull handle (no chains unless provided with large ring)		
4. Sufficient water pressure (20 psi, minimum, for 68 gal/minimum)		
5. Floor drain with trap present or outlet placed so that it can be tested monthly		

	YES	NO
C. Eyewashes and safety showers meet ANSI Z358.1 standard		
D. At least one eyewash and safety shower accessible to students with disabilities (see below)		
E. Safety features for equipment (such as belt guards on belt-driven machinery) provided		
X. Storage		
A. Chemicals:		
1. Storage in secure, regulated areas, with entry only for authorized personnel (no students, custodians, etc.)		
2. No storage in classroom or areas to which students have access		
3. No storage of hazardous chemicals in preparation/equipment storage room, or rooms with sensitive equipment or electrical outlets		
4. Sufficient space for safe, specialized storage:		
a. Space for storing chemicals with sufficient distance between incompatible chemicals, preferably with impermeable partitions		
b. Vented, corrosion-resistant (nonmetal or coated metal) cabinet for storing acids, corrosion-resistant shelves, and supports		
c. Separate cabinet for nitric acid, away from other acids and readily oxidized substances		
d. Dedicated, grounded, and UL=approved cabinet or safety cans for storing flammables separately		
e. Lockable cabinet for poisons		
5. Protected location for water-sensitive chemicals, especially to shield from water sprinklers		
6. All shelves equipped with lip edge or rod to prevent bottle roll-off or drip from spills onto people standing in front of the shelf		
7. Shelves made of wood with plastic supports, or other corrosion-resistant materials		
8. Shelves for chemical containers 12" deep (maximum), so containers will not be stored more than 2 containers deep		
9. Sufficient shelf space available so chemicals can be reached easily and won't be knocked over		
10. Laboratory refrigerator in preparation/equipment room, spark-free to protect against ignition of flammables		
11. Chemical-resistant countertops only		
B. Gas cylinder: (Compressed gases are not normally used in secondary school science. Numerous safeguards are necessary, including the following. See American Chemical Society 1995, pp. 14–15.)		
1. Chained to prevent from falling over (with chain securely fastened to a stud or other wall support) and becoming a missile if it develops a leak		
2. Can be clamped tightly into place after being positioned for use		
3. Stored away from heat or ignition source		
4. Safety cap on when not in use		

	YES	NO
C. Cabinets in lab/classroom, preparation/equipment and other storage rooms:		
1. Wood (not fiberboard) cabinets and drawers in lab/classroom and preparation/equipment and other storage rooms		
2. Ample for storage needs, including at least one tall cabinet		
3. Secured to floor and/or wall with sufficient attachments to keep from falling		
4. Some lockable cabinets provided, to prevent theft of equipment		
5. Solid doors (no glass fronts) in lab/classroom		
6. Flat stock drawers for storing posters		
7. Specialized storage such as a cabinet for a skeleton on wheels		
8. Drawers of different sizes and shapes in many lower cabinets		
9. Allow sufficient lab/classroom countertop space for equipment such as large distilled water containers, plant growth trays		
D. Open shelves in preparation/equipment and other storage rooms:		
1. Ample for storage needs, in a variety of depths (12", 24", and 36") and lengths for the varied and odd shaped equipment science uses such as stream trays, plant growth carts, bicycle wheels, aquariums, etc.		
2. Equipped with lip edge or rod in earthquake-prone areas		
3. Hanging shelves secured to wall or ceiling with sufficient attachments to keep from falling		
4. Hanging shelves solid enough to support a substantial amount of weight		
E. Space in preparation/equipment or other storage rooms for:		
1. Protective clothing (teacher safety goggles, aprons, etc.)		
2. Carriers for transporting chemicals, such as acids		
3. Large items and equipment, such as supply carts, safety goggles sanitizer, and microscopes		
XI. Lab/Classroom Wall Space		
A. Leave an equivalent of one side wall clear of cabinets with space for maps, etc.		
B. Use front instructional wall for storage behind a movable marker board with drawers below		
C. Apron and goggle storage at entrance to lab area		
D. Analog clock with second hand mounted in the lab area (not on front wall)		
XII. Adaptations for Students With Disabilities		
A. Permanent laboratory station or space for portable laboratory station (with gas, if used, electricity, water, sink, and sockets for rods) that meets ADA guidelines		
B. Accessible controls (e.g., levers or electronic controls) for gas, electricity, and water		
C. Adapted seating at counter, table, or desk:		
1. Counter/table/desk height 34" maximum (26–30" maximum, recommended for students under 12 years old)		

	YES	NO
2. Vertical knee clearance 27" minimum (24" minimum, recommended for students under 12 years old)		
D. Adapted sink:		
1. Counter height and sink rim 34" above floor, maximum (30" maximum recommended counter height, and 31" maximum recommended sink rim height, for students under 12 years old)		
2. Sink depth 6½" maximum		
3. Vertical knee clearance 27" minimum (24" minimum, recommended for students under 12 years old), with protection from hot water pipes		
4. Accessible controls		
E. Accessible eyewash and safety shower:		
1. Distance from wall to center of eyewash bowl 20–24"		
2. Eyewash spout 36" above floor, maximum (30" maximum, recommended for students under 12 years old)		
3. Shower pull handle 48" maximum above floor if accessible from front only		
4. Shower pull handle 54" maximum above floor if accessible from the side		
F. Adapted portable or fixed fume hood when using chemicals, with 34" deck height, maximum (see previous seating, controls, knee space requirements)		
G. Aisles 36" minimum, and doorways 32" clear width minimum, for wheelchair clearance		
H. 5'-diameter turning space for wheelchair in all rooms		
I. Wiring for electronic aids, such as field monitors for hearing-impaired students		
J. No protruding upper cabinets or sharp corners on cabinets, for the vision-impaired		

Annual Inspection using this instrument (circle one) Yes No

XIII. Overall how safe is your lab? (circle one) (low) 1 2 3 4 5 (high)

Recommendations:

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_____

Teacher Signature_____ Date_____

Administrator Signature_____ Date_____

Acronyms
ADA: Americans With Disabilities Act
ANSI: American National Standards Institute
ASHRAE: American Society of Heating, Refrigerating, and Air-Conditioning Engineers
NFPA: National Fire Protection Association
NSELA: National Science Education Leadership Association
NSTA: National Science Teachers Association
OSHA: Occupational Safety and Health Administration

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