

Safe Science: Be Protected!

A regular column on safety in school science

Storage Space: Anything but Empty!

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I STORAGE SPACE VIEWS

Many science teachers associations' standards reflect the need for adequate equipment and supply storage space, including a separate storage area for potentially dangerous materials. Although this statement is reflective of a professional standard, storage space is always an issue. In new school science laboratory construction and/or renovation projects, storage areas tend to be one of the places that architects look at as a way to reduce square footage. This strategy saves costs in effort to meet budget constraints. In some instances, there is the perception that storage is not important or needed. Yet, from a safety and environmental regulation standpoint, proper storage is a critical issue.

It is amazing that you will never hear a science teacher or supervisor say that they had planned for too much storage! In fact, it is always the opposite situation, so plan accordingly and be prepared to aggressively support it. The following information may be helpful in securing appropriate storage spaces during renovations and/or new construction projects for your science facility.

II. WHY DEDICATED SPACE FOR STORAGE?

Dedicated space is required for the storage of labware, equipment, the safe and controlled storage of both hazardous and flammable/combustible chemicals, the temporary storage of students' projects, and/or other incomplete laboratory activities, etc. These types of storage require specific types of casework. It can be in the form of open

shelving or cabinets with built-in adjustable shelving located in the laboratory or separate dedicated storage spaces or rooms. Legal requirements vary and are generally regulated for the non-hazardous or general laboratory materials. For example, the Occupational Safety and Health Administration (OSHA) regulations in the States come into play in areas such as the Housekeeping Standards and "trip/fall" and "slip/fall" hazards. The safe storage of hazardous chemicals on the other hand is governed by many local, state, and federal regulations.

III. HOW MUCH SPACE IS NEEDED?

Adequate and appropriate type of storage for chemicals, equipment, general labware, etc. is required in concert with housekeeping standards, fire codes, and other regulations. A general recommendation formula or professional guide for a preparation room and storage space is as follows:

Preparation Room/Storage Area = 0.5 square meters (5.3 sq. ft.) per student workstation.

This is a working formula which will vary depending on the focus of the science program. For a more hands-on course or program, additional space for storage would be required to meet the needs of student work.

IV. GENERAL STORAGE

As noted, general storage can be located in the laboratory and/or in a separate storeroom. In the laboratory, individual student

storage as well as teacher and general class storage is necessary. Wall and base cabinets, drawer units, tall storage units, glass front wall cabinets, microscope cases, and large open/closed areas come in all shapes and sizes, depending on need. All storage should have appropriate lighting to reduce the chance of accidents or errors.

Another key to laboratory storage is security. All cabinets and drawers should be lockable to control and guard against thefts or damage. Remember, there are legal ramifications should a student take a piece of lab equipment/supplies out of the lab and it results in an injury. As long as there is a reasonable deterrent, the licensed educator is legally on solid ground in courtroom.

Consideration should be given to the following cabinet items:

- a. Two or more adjustable shelves;
- b. Solid hardwood construction in lieu of particle board;
- c. Cabinets should be securely anchored with known weight limits;
- d. An inside usable depth of at least 15 inches (38 cm);
- e. Lock cylinders should be keyed alike for convenience;
- f. Self closing drawers/doors also promotes safety;
- g. All cabinets are required to be properly secured to walls or other suitable structural supports, to prevent movement during a seismic event or similar type of force causing motion.
- h. Step stools or stepladders should be available to reach high storage places safely.
- i. Some fire codes require that sprinkler heads have a clear distance of 18 inches (0.46 m) from the ceiling to the top of cabinets and/or shelves.
- j. The bottom of wall cabinets should be 18 to 24 inches (0.46 to 0.61 m) above the workstation counter tops.
- k. Wall cabinet doors should have glass panels in order to enhance safety by allowing the contents to be visible. Wired or polycarbonate glazing should be used for win-

dowed cabinets and/or display cases.

Storage and operation of technology equipment, such as laptop computers in drawers, is another area for planning ahead. Some technology equipment tends to be heat sensitive and therefore requires sufficient ventilation or air movement. Forced air resulting from small fans or screens in the drawer may be helpful in preventing this problem.

V. HAZARDOUS MATERIAL STORAGE

Twenty years ago, finding a chemical in the storeroom was easy if you knew your alphabet. Easy but very dangerous! A bottle of nitric acid fumes placed on a shelf near "hostile" flammables spells DANGER! Hazardous material storage depends on the nature of the hazard (flammable and combustible materials), gas cylinders, toxic materials, and highly reactive substances, the quantity and the type of operations that are used.

Special considerations for storage are a must for a safe laboratory operation. Chemicals have different needs – some like it hot, some like it cold. Some like light, some like darkness. The point is, teachers must know the chemical nature of each product used and/or stored and accommodate for that need. As a result, chemicals are found stored in general storerooms, refrigerators, and flammable liquid cabinets, to name a few. One specific note about fume hoods and storage – don't do it!

Make sure that the chemical inventories are current and updated at least semiannually as well as after receiving new products. Material Safety Data Sheets (MSDS) shall be on hand and readily accessible for all products used and/or stored. Store the minimum levels of inventory consistent with the lesson plans and dispense limited amounts as needed, being attentive to compatibilities.

In addition, regulations often require the following chemical information on all containers: name of chemical, hazard warnings, and name/address of the manufacturer or importer, as well as the date of receipt, and, the initial opening date of container

indicated on container label. However, it may be more useful to have a decision date on a container than its expiration date. When the decision date has been reached, the chemicals/products are removed from the shelf and the controller either overrides the decision date and sends the product back, with a new decision date or the product is properly disposed of.

Consider the following guidelines for chemical storage rooms:

- a. Appropriate ventilation as required by most fire codes is to be provided with 6 to 10 room air exchanges per hour on a uni-directional/non-recycling forced air system during operation of laboratory work;
- b. Store only the smallest amounts of products that can be consumed in a school year, but do not exceed the amounts permitted to be stored by safety and fire codes, as well as maximums set by any other state/local building and fire codes; amounts of flammables as mandated by safety and fire codes;
- c. Use caution in dealing with peroxides in peroxide-forming chemicals. They are accelerated in the presence of UV light and higher temperatures. Common chemicals in this group found in high school labs include diethyl ether and cyclohexane;
- d. Always isolate dissimilar reactive materials; e.g., strong acid-base groups, strong reducing agents and oxidizers;
- e. Shelf units must be firm, stable and secured to the walls to prevent sliding, collapsing or falling over;
- f. Lips or shelf-edge restraints should be placed on every shelf;
- g. Trays are needed under large volumes of bottles containing liquids to prevent spread of leaks;
- h. Floors are required to have curbs, scuppers, special drains, or other suitable means to contain spills and prevent the flow of liquids into adjacent building spaces. If a drainage system is used, it shall have sufficient capacity to carry the expected discharge of water from fire protection systems and/or hose streams, except if the containers stored do not exceed 10 gal. (38 L), then the storage area need not meet the requirements stated above;
- i. Nothing should be stored on the floor;
- j. Automatic fire suppression system i.e. – water sprinklers;
- k. Doors with self or auto close hardware;
- l. Doors to chemical storage areas must be secured with lockable hardware and the access limited to persons trained for the proper handling and operating procedures (science teachers, administrators);
- m. In spaces dealing with Class I liquids/explosive vapors, the light fixtures, switches, electrical equipment and wiring shall be classified electrically with respect to fire and electrical codes. The electrical wiring and equipment in storage rooms for Class II and Class III liquids are permitted to be suitable for general purpose use by fire and electrical Codes; One or more fire extinguishers (A-B-C type);
- n. One or more fire extinguisher (A-B-C type);
- o. Appropriate signage advising of the need for splash goggles, etc.;
- p. Electrical receptacles located on workstations should be installed 6 inches (15.2 cm) above the work surface;
- q. Wall assemblies are required to be constructed to prescribed fire resistance ratings;
- r. Class I flammable liquids can not be stored at basement level;
- s. Containers should not be stacked on top of each other;
- t. Larger storage rooms (greater than 500 sq. ft. or 51.2 sq meters) should have at least two exits;
- u. Fans that could produce a spark, both the rotating element and the casing shall be constructed of nonferrous material or of other suitable spark-resistant materials;

Depending on the hazardous materials inventory, additional type of storage may be necessary, such as flammable liquid cabinets, glass bottles, safety cans, approved plastic containers and laboratory refrigerators.

Storage cabinets for flammable and combustible materials should be mechanically ventilated in accordance with the manufacturers listed recommendations and as required by any other local requirements. These cabinets usually have vent ports, which can be connected to ducts. The vapors can then be exhausted to outside air. These cabinets can be placed in almost any location providing proper ventilation is available. Safety cans and other approved containers can be stored in these cabinets. Again, proper signage is required: e.g., Caution: Flammable Liquids.

Some chemicals decompose quickly if not kept refrigerated. Even in refrigeration, chemicals eventually form products, which can be flammable and explosive. Refrigerators, freezers, and other cooling equipment used to store or cool flammable liquids shall be designed or modified for such use. Household refrigerators may be modified to store flammable liquids. These modifications shall include that electrical equipment located within the outer shell or within the storage compartment, in or on the door, door frame shall meet the requirements for Class I, Division 1 locations, as described in fire and safety codes.

Consider the following guidelines for storing chemicals in refrigerators:

- a. Use only refrigerators designed for chemical storage;
- b. Never store food and chemicals in the same refrigerator;
- c. Only store quantities needed;
- d. Remove chemicals and dispose of properly at drop dead dates;
- e. Use proper signage on the refrigerator noting storage items; e.g., "For Edible Food And Drink Only;" "For Hazardous Chemical Storage Only."
- f. Use good housekeeping techniques when storing in refrigerator to keep the contents neat and orderly; e.g., do not overload shelves.

- g. Any unattended electrical heating equipment shall be equipped with a manual reset over-temperature shutoff switch, in addition to normal temperature controls.

VI. STORING BY SAFETY!

Appropriate storage for science laboratories is not only necessary but is also critical for the safety of all occupants in the building. Accidents can happen quickly and often where there is risk resulting from poor housekeeping and improper storage. Keeping it clean and orderly makes it safer for all. Also, remember to check your local, state or federal authorities for specific fire, safety and electrical codes. These will vary from location to location!

LIVE LONG AND PROSPER SAFELY!

RESOURCES:

Canadian Center for Occupational Health and Safety: <http://www.ccohs.ca>

Occupational Safety and Health Administration: <http://www.osha.gov>

National Fire Protection Association: <http://www.nfpa.org>

Safety in Academic Chemistry Laboratories: American Chemical Society, 1155 Sixteenth St., Washington, D.C. (<http://www.acs.org>)

The International Building Code and International Fire Code: International Code Council, Inc., 4051 West Flossmoor Rd, Country Club Hills, IL (<http://www.iccsafe.org>)

UK Health & Safety executive: <http://www.hse.gov.uk/hsehome.htm>

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