Safer Handling of Alcohol in the Laboratory

A safety resource from the National Science Teachers Association

The use of alcohol is quite common in biology and chemistry laboratories. Because of its flammability and toxicity, it is imperative that teachers understand how to use it safely, especially in light of the serious injuries that have occurred due to the mishandling of alcohol.

Science teachers and administrators are required to observe legal safety standards and better professional practices in the handling of all types of alcohol to minimize the risks. Ethanol and methanol are the most common types of alcohol used in schools. The ethanol typically sold to school districts by scientific supply companies is denatured, which means methanol has been added, making it unfit for human consumption.

Before any type of chemical is used, teachers should thoroughly review the Safety Data Sheet (SDS), even if they are comfortable with the chemical's use. The SDS for ethanol and methanol identifies them as acutely toxic by oral, dermal, or inhalation means. The chemicals and their vapors are also flammable and may travel to the source of ignition and flash back. The container may explode when heated and the vapors can form an explosive mixture in the air.

Tips for the Safer Handling of Alcohol

- Conduct a hazards analysis and risk assessment of the use of alcohol and review safety action to be taken before doing any lab investigation or demonstration. Prepare a list of the significant hazards in the procedure and identify the controls necessary to minimize them. The procedure, hazards analysis, and risk assessment should be reviewed and approved by the Chemical Hygiene Officer (or designee) as indicated by the Chemical Hygiene Plan.

- Review the SDS before using alcohol and make students aware of all hazards.

- Practice the laboratory or demonstration before conducting it with students.

- Ensure that students, teachers, and any other adults in the laboratory are wearing sanitized indirectly vented chemical-splash goggles meeting ANSI/ISEA Z87.1 D3 standard, chemical-resistant aprons or lab coats, and non-latex chemical-resistant gloves.

- Ensure that personal protective equipment (PPE) noted above is worn throughout the investigation or demonstration, including setup, hands-on and take down. Only after all materials are put away at the end of the investigation or demonstration should PPE be removed and hands washed.

- Handle alcohols in a fume hood to capture and prevent any flammable and/or combustible concentrations of vapors from reaching any source of ignition.

- Know the location of the A-B-C fire extinguisher, fire blanket, fire alarm, eyewash, and shower and be able to reach them within 10 seconds. Teachers should receive annual training so that they know how to use each of these items. If district policy prohibits the use of a fire extinguisher, in the event of fire, evacuate the room, close the door, and pull the fire alarm.

- Know the location of spill clean-up materials in the event of a spill.

- Never work alone in the laboratory.

- Ensure that all sources of ignition are removed from the laboratory if alcohol will be used.

- Keep the reagent container of alcohol (stock bottle) in the chemical storeroom.

- Restrict the quantity of alcohol used in the laboratory to the quantity required for the experiment or demonstration.

- Refrain from using conventional alcohol lamps as they are unsafe.

- If a fume hood is not available during a demonstration, place an impact-resistant barrier between the experiment and students. Also ensure that students or other observers are more than 10 feet (~3 meters) away (NFPA 45). The safety shield should be made of impact-resistant plastic or tempered glass and be 24" high and extend 12" beyond the hazard in both directions. All individuals (adults and students) in the room should wear the appropriate safety goggles during the demonstration. In the absence of a permanent fume hood, a portable fume hood that is rated for alcohol use can be used.

- Tie back hair and avoid wearing loose clothing or open-toe shoes in the laboratory.

- Consider using microchemistry and a camera to show the students what is happening if a demonstration or investigation is unsafe to perform at full scale.

Understand that teachers have a "duty of care" to know what to expect of each laboratory and demonstration so that students will be protected (Read *NSTA-Duty or Standard of Care*). "Duty or Standard of Care" is an obligation, recognized by law, requiring conformance to a certain standard of conduct to protect others against unreasonable risk (Prosser et al. 1984). "The breach of a particular duty owed to a student or others may lead to liability for both the teacher and the school district that employs that teacher" (Ryan 2001).

Because the mishandling of alcohol can and has resulted in serious injuries to students and teachers, it is imperative to understand the duty of care owed by you to your students. While the duty of care remains the same for each individual—that is to protect students from unreasonable risk of harm—the behavior expected of a teacher to meet the duty of care changes with each situation. Certain behaviors are now required to meet the duty of care. For example, the duty of care requires that teachers provide safety instruction and the appropriate level of supervision during every lab activity that is done within their instructional space (e.g., classroom, laboratory, or in the field). Teachers must act reasonably (objectively measured) to prevent harm to students. Warning students once at the beginning of the school year is not enough; safety must be reinforced every time students engage in any activity with the potential to cause harm. This includes making it clear to students the PPE that must be worn to participate in a laboratory. Teachers and other adults in the room should model the correct behavior for students by also wearing the proper PPE. Failure to perform those actions required to meet the duty of care can result in students being injured, sometimes fatally.

Although the teacher's primary responsibility is to students, failure to perform the actions required by the duty of care may result in teachers and school districts being sued for negligence—a preventable waste of valuable resources. Teachers need to understand their state's education law relative to any statutes that specify a teacher's duty of care and any possible immunity that may exist. For example, in many states, teachers cannot be sued for acts that may not meet the duty of care because a governmental statute provides for immunity for those acts as defined in the statute. However, teachers should be aware that they may put their certification in jeopardy in many states if they are proven negligent. Do not assume that because you are employed by a school district that you cannot be held personally liable for a student's injuries.

Research has shown that one of the most effective means of teaching science is through inquiry and three-dimensional teaching. For students to get the most from inquiry activities, they must know and understand how to conduct experiments in the safest possible manner. Science teachers are obligated to instruct their students in the safer use of chemicals, supplies and equipment, and to make sure that all required protective equipment is available and used. By meeting these standards, science teachers and administrators can help ensure that science is conducted in the safest possible manner within our schools and laboratories.

References:

National Fire Protection Association (NFPA). 2015. *NFPA 45 Standard for Fire Protection for Laboratories Using Chemicals*. Located online at http://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards?mode=code&code=45

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Prosser, W.L., W.P. Keeton, D.B. Dobbs, R.E. Keeton & D.G. Owen, eds. 1984. *Prosser and Keeton on Torts*. Eagen, MN: West Group.

Ryan, K. 2001. *Science classroom safety and the law: A handbook for teachers*. Batavia, IL: Flinn Scientific, Inc.

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