Back to School Safety:
The Importance of Laboratory Safety in the Classroom

A Joint Safety Statement by
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and
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As we begin another school year, the U.S. Chemical Safety Board (CSB) and the American Chemical Society (ACS) remind educators and students of the importance of performing laboratory experiments and classroom demonstrations safely to prevent injuries. Chemical safety is a shared core value of the CSB and ACS, and both organizations have worked separately, as well as collaboratively, to raise awareness of the importance of laboratory safety in the classroom.

In 2015, the ACS published guidelines, *Identifying and Evaluating Hazards in Research Laboratories: Guidelines Developed by the Hazards Identification and Evaluation Task Force of the American Chemical Society's Committee on Chemical Safety*,[1] following the January 7, 2010, incident at Texas Tech University where a graduate student was severely injured after the chemical he was working with unexpectedly detonated. The ACS guidelines emphasize the importance of reporting and discussing "incidents, near misses, and close calls." The guidelines also stress the importance of striving for continuous improvement by identifying lessons learned during the course of work as well as using them to inform future hazard evaluations. The CSB attended the first ACS Safety Summit in February 2018, where participants discussed such topics as laboratory chemical safety information, laboratory safety education needs, and the importance of risk assessment in chemical safety practice and policies.

The CSB has identified numerous incidents that occurred during educational demonstrations and laboratory experiments over the last two decades. From January 2001 to July 2018, the CSB identified 261 incidents that occurred in a laboratory, experimentation, or presentation setting. Of these, 130 such incidents occurred at colleges, universities, professional schools, and junior colleges, resulting in 185 injuries and five fatalities.[2] Sixty-six incidents occurred in elementary and secondary schools, injuring a total of 170 students. The most common chemical type involved in these incidents was alcohol (i.e., methanol and ethanol), followed by nitric acid, hydrochloric acid, and sulfuric acid.

In response to three separate incidents that injured both children and adults over an eight-week period in 2014, the CSB issued a Safety Bulletin entitled, "*Key Lessons for Preventing Incidents from Flammable Chemicals in Educational Demonstrations*."[3] The CSB and ACS encourage educators and students to

[1] Available at: https://www.acs.org/content/dam/acsorg/about/governance/committees/chemicalsafety/publications/identifying-and-evaluating-hazards-in-research-laboratories.pdf.
[2] CSB Incident data are obtained from media articles and are not verified by a secondary source.
[3] To view the Safety Bulletin visit https://www.csb.gov/key-lessons-for-preventing-incidents-from-flammable-chemicals-in-educational-demonstrations/.

familiarize themselves with and adopt the CSB's four key lessons to prevent future lab demonstration incidents:

- Do not use bulk containers of flammable chemicals in educational demonstrations when small quantities are sufficient.
- Implement strict safety controls when demonstrations require handling hazardous chemicals – including written procedures, effective training, and the required use of appropriate personal protective equipment for all participants.
- Conduct a comprehensive hazard review prior to performing any educational demonstration.
- Provide a safety barrier between the demonstration and the audience.

Recent laboratory incidents continue to highlight the need to implement procedures, effectively train educators, and protect students during laboratory experiments and classroom demonstrations. On October 30, 2015, at W.T. Woodson High School in Fairfax, Virginia, a flash fire and chemical explosion occurred during a teacher's demonstration of the different composition of metals in the "rainbow demonstration."[4] The incident burned three students and the teacher and caused additional injury to three other students. Virginia Occupational Safety and Health investigated the incident and concluded that an ethanol jug used in the experiment was only one-quarter full, allowing for flammable vapors to accumulate in the headspace of the container. The vapors escaped the container during the experiment and were ignited by an open flame on the table.

Less than three years later, on May 9, 2018, 17 students and one teacher were injured at Merrol Hyde Magnet School in Hendersonville, Tennessee, when a flash fire occurred during a similar rainbow demonstration in a chemistry lab. The Hendersonville Fire Department stated that a chemical reaction occurred when the boric acid and ethyl alcohol were mixed, resulting in a flash fire.

The CSB and ACS both recognize that laboratory experiments and demonstrations in the classroom provide students with exciting educational opportunities and pique their interest in science, technology, and math. During the upcoming school year, we encourage educators and students to openly engage each other about laboratory safety and embrace and implement the important key lessons listed above when conducting laboratory experiments and classroom demonstrations, with the goal of preventing injuries in the classroom. Additional resources on chemical and laboratory safety are available at www.acs.org/safety.

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[4] The rainbow demonstration is designed to demonstrate to students that different metals will burn with different colors. Typically, a small amount of metal powder is put into a small container. Then methanol, or some other flammable liquid, is placed on top of it as an accelerant and the mixture is ignited. The CSB produced a video in 2013 called "After the Rainbow," which highlights the dangers of the rainbow demonstration. View the video here: https://www.csb.gov/videos/after-the-rainbow/.