Building student safety habits: Barriers and recommendations

By Mickey Sarquis

While I am not an expert in chemical health and safety, I do feel strongly that it is my responsibility, as a chemistry educator, to provide educational experiences for my students that allow them to learn in a safe environment. My goal is to provide the safety-related tools students need to live their lives and function safely in situations where they will do chemistry.

Actually, I'm the person you want to reach with the information that is being shared in this symposium. Through funded workshops, I encounter hundreds of participants annually, most of whom are practicing K–12 and college educators. Help me be better at fulfilling my responsibility of building student safety habits and you, in turn, will have reached thousands of other teachers and their students.

In his preface to *Chemical Safety for Teachers and Their Supervisors: Grades 7–12*, Henry C. Ramsey, Chair of the ACS Committee on Chemical Safety from 1998 to 2000, wrote "Chemistry and chemicals have a central place in science, and safe chemical practices are the most basic and fundamental parts of any lesson. Having acquired good chemical safety habits early, students are better prepared when they move on to more advanced courses."[1] I wholeheartedly agree, and I would add that these students are then also better prepared to enter the workplace. In fact, according to U.S. Labor Secretary Elaine L. Chao, "Safety and health training add value to all of America's workplace operations and directly impact the bottom line–fewer injuries and illnesses. Good safety and health practices also add value indirectly by increasing performance, productivity, innovation and creativity."[2] Even with such an incentive–increased profits–why are we still deficient in building student safety habits?

Unfortunately, high school teachers have indicated they are not getting the safety education training they need to be able to effectively manage a teaching lab or stockroom or to prepare their students to safely conduct experiments. For years they have called for courses on safety, laboratory management, and stockroom management. Such courses are needed to more effectively train first-year chemistry teachers so that they are able to create an improved experience for students.[3] The health and welfare of teachers and students rests on the availability of formal training, but teachers have complained that informal sources for safety training are often the only route of information.[4] In fact, less than half of physical science teachers surveyed agreed that general science courses, science methods courses, or inservice training prepared them for lab safety.[5]

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To make matters worse, some suggest that the problem is actually increasing as under-trained teachers are being called upon to implement the inquiry-based teaching called for by the national standards.[6] Let me point out that this statement is not meant as a criticism of the standards, which call for a safe working environment in Teaching Standard D.[7] Rather, it is a criticism of an educational system that has fostered complacency. Like the national standards, the ACS Committee on Professional Training states, "Safety is critical in all laboratory settings. Therefore, safety education must be an integral part of the chemistry curriculum."[8] But is it?

The problem of inadequate safety training for teachers and students is exacerbated by a lack of understanding of basic chemistry. Too many teachers, students, school administrators, and parents are unable to foresee potentially unsafe actions or situations. Many are ignorant of real risks. Others are blinded by a one-time-fix mentality, overconfidence, or dependence on luck.

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Unfortunately, the issues discussed so far are complicated even more by that fact that chemistry teachers are natural hoarders. Disposing of unused chemicals is viewed as wasteful and goes against our natural instincts to save and pinch pennies, especially in difficult economic times. In addition, many teachers inherit stockrooms suffering from past neglect. Too often,

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they are not given the time or assistance needed to take on the formidable task of cleaning up. So what do many teachers do when faced with this problem? The easiest thing . . . nothing. Teachers are very busy professionals with lots of demands on their time and talents. For better or worse, without direct support or sufficient incentive, we can easily see why many teachers choose what seems to be the easiest route.

We must attack this safety crisis by providing fundamental training to build teachers' knowledge. At a minimum, this training should include chemical reactivity, basic toxicology and chemical hygiene, potential hazards and risks, proper storage and handling, stock records and safety audits, safe physical facilities and equipment, chemical waste management, and how to select experiments for students while knowledgeably considering both educational impact and safety risks.

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In addition to this core training, we also need to improve attitudes and behaviors about safety in academic settings and the workplace. How does one bring about a significant behavioral shift? *The Psychology of Safety* outlines several steps toward creating a safety culture, including the following:

- Shift from a piecemeal approach to a systemic approach.
- Shift from fault-finding to fact-finding.
- Shift from reactivity to proactivity.
- Shift from quick fix to continuous improvement.
- Shift from a changeable priority to an immovable value.[9]

Prudent Practices in the Laboratory offers a succinct definition of a safety culture as "encompassing a group of people who voluntarily and willingly think about potential hazards and seek out and use resources that help ensure the maximum safe use of materials and procedures."[10] All chemical educators need to model proper safety and engage students in experiences that proactively and continually create a culture of safety in our classrooms. One step toward this is to insist that safety is up to everyone; it's a shared responsibility, where everyone develops correct safety habits through supportive and corrective feedback. Scott Geller offers a mnemonic device using the five letters of the word COACH to remember the basic ingredients of effective safety coaching. Care about the health and safety of fellow students and co-workers. Observe the behavior of others systematically and objectively. Analyze the reasons behind at-risk behaviors and help develop interventions to decrease them. Communicate as an active listener and a persuasive speaker. Help fellow students or co-workers work more safely.[9]

I was fortunate enough to be funded by the NSF to develop a safety resource for teachers and students of college chemistry. Thanks to the efforts of an outstanding group of contributors, the result was the *Building Student Safety Habits for the Workplace* student text and instructor guide published in 2000.[11] (Chapter 1, "The Culture of Laboratory Safety," is available for viewing online at www.terrificscience.org/bookstore/books/safety.shtml.) The guide provides several recommendations about how educators can begin to build a safety culture in academic settings. A priority is to develop safety programs modeled after industry. These programs should include continuous safety training from day one throughout the course, the establishment of a student safety committee, and regular safety meetings. Educators can add safety evaluation to student assignments, exams, lab write-ups, final exams, and through other authentic assessments methods. For example, give assignments where students must consider the risks, regulations, waste disposal, and cost of doing a given lab procedure or have them propose alternative procedures to address a given problem and discuss the safety issues associated with its solution. Educators also need to build a safety reference library and require their students to use it. Finally, don't forget to integrate safety awareness as a part of your promotional literature and advertising.

Unfortunately there are often naysayers, people who may think that efforts to increase the attention paid to safety training will lead to wasted time. Gerard F. Scannell, former Assistant Secretary of the Occupational Safety and Health Administration, has addressed this, saying "Knowledge of health and safety issues is essential and will enhance, not impede, the research and teaching of science."[12] I couldn't agree more. Without this knowledge, we could find that public fears, politics, and an increasing number of regulations paint a very restrictive future for us all.

I think you'll agree that we have a lot of work to do. To that end, I have a call to action for CHAS and CHED. We must join forces within ACS to

- Build a national plan to improve the teaching and learning of safety as a part of school and college education.
- Build a white paper on incorporating safety education into science education to take to Capitol Hill.
- Create a national safety culture by building a national model to educate all secondary and post-secondary science students in safety, including preservice teachers.
- Seek funds to provide nationwide training of all inservice science educators (K–college).
- Build a model to assess safety awareness competency for educators and students at all levels.

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No matter what your role is–student, educator, chemist, citizen–it's important to listen to these words of Jim Kaufman, Director of The Laboratory Safety Institute: "Having an understanding of inherent hazards and learning how to be safe should be an integral and important part of science education, work, and life."[13] I leave you with this final plea and challenge: Practice safe science.

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