

# Keeping it safe: Chemical safety in the high school laboratory

In an effort to (1) assess the current state of laboratory safety, (2) explore the necessity for laboratory safety training, and (3) garner feedback on laboratory training needs, a Likert survey was developed and administered. Surveys were mailed to 120 West Virginia public high schools with response of 64%. Results indicate that West Virginia high schools have science laboratories dedicated to chemistry courses but these laboratories are not adequate for current or projected student enrollment needs. These laboratories are well-equipped in terms of chemical storage facilities but may lack regularly inspected safety equipment. Although there is a general lack of formalized safety training for in-service chemistry teachers, most self-report following safety guidelines analogous to the OSHA Lab Standard. Assistance with disposal of chemical waste was the most requested form of help. Overwhelmingly, in-service teachers recommend inclusion of chemical safety training as part of the collegiate educational experience. However, neither the traditional nor non-traditional paths to science teacher certification include a focused effort in chemical laboratory safety. Current in-service teachers are receptive to enrolling in a chemical safety online course especially if continuing education credits are offered. Survey feedback is assisting to provide content for the generation of a website geared toward high school chemistry teachers, helping to forge a relationship between our institution and high school chemistry teachers, and guiding us in developing a chemical safety continuing education curriculum at both the pre-service and in-service levels.

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## INTRODUCTION

*“Lab safety is a topic that needs more attention. Fear is driving many school districts to cyber labs. This is robbing chemistry students of lab experience that restricts thought.”* (West Virginia public high school chemistry teacher, 2008; Teacher 1).<sup>1</sup> In effect, this quote summarizes our reasons for researching the status of laboratory safety and safety training of high school chemistry teachers within the state of West Virginia—teachers have an insufficient background in chemical laboratory safety to implement a quality laboratory-based instructional environment, depriving students of authentic experiences in chemistry at the high school level. A recent change of the graduation requirements in West Virginia has made this initiative even more pressing. Content specific coursework (physical science, biology, and chemistry) through the junior year of high school was recently mandated within the state. As a result, chemistry coursework (formerly an elective) will be required of all 11th grade students beginning with year 2010 9th grade students (i.e., for the 2014 graduating class).<sup>2</sup> To further improve the educational proficiency of all students, in agreement with the Federal education

initiative No Child Left Behind,<sup>3</sup> the West Virginia Board of Education’s Strategic Goal #5 states: “All students shall be educated by highly qualified personnel.”<sup>4</sup> Thus, more teachers with chemistry specific teacher certification are essential for meeting state and federally mandated educational goals of (1) content specific chemistry coursework taught by (2) highly qualified personnel. Additionally, since it is unlikely that the demand of highly qualified chemistry teachers can be met by current teacher education programs and in-service training initiatives, safety training for individuals who do not have a chemistry specific certification will be prudent to improving safe practices of teachers and students in West Virginia’s science classrooms.

Currently, a shortage of qualified chemistry teachers exists and is endemic throughout West Virginia as indicated by the U.S. Department of Education’s “Teacher Shortage Areas Nationwide Listing” for 2007–2008.<sup>5</sup> This shortfall is expected to worsen as approximately 25% of West Virginia’s 24,000 teachers are eligible to retire in 2009.<sup>6</sup> Alternative programs for teacher certification in content areas projected for critical shortage (e.g., chemistry) have been devised. One program, Project REACT (Resolve to

Educate Aspiring Chemistry Teachers), trains in-service science teachers without a chemistry specific certification to teach chemistry.<sup>7</sup> A second, the Transition to Teaching Program, allows a B.S. scientist (e.g., chemist, engineer), potentially a mid-career scientist interested in changing careers, to earn teacher certification in a high needs content area. Participants in this program complete an individualized online program concurrent with teaching in that content area.<sup>7,8</sup> However, if these programs cannot provide an adequate number of qualified chemistry teachers by 2013, the number of teachers responsible for teaching chemistry out of their content area will increase.

As a result, in addition to other content initiatives, laboratory safety training for in-service and pre-service teachers is crucial to successful implementation of West Virginia's mandated educational goals. The safety survey and results discussed herein were intended to (1) explore the current state of laboratory safety at the high school level, (2) explore the necessity for laboratory safety training, and (3) garner feedback from in-service teachers on current laboratory safety issues and concerns. The results of this survey will guide us in (a) creating a website specifically tailored to the needs of high school science teachers (including chemistry), (b) developing a pre-service teacher education course focused on safety in the science classroom, and (c) developing a continuing education course that focuses on laboratory safety in the high school setting. Dissemination of safety information via the website will be used as a first step prior to development of a full-blown safety training course. This website is expected to expand the ties between high school chemistry teachers and university faculty within the Eberly College of Arts and Sciences and the College of Human Resources and Education at our institution.

## SURVEY AND DATA COLLECTION METHOD

The safety survey instrument, entitled "High School Chemistry Teacher

Safety Survey," consisted of 40 Likert-type statements and three free response questions. Likert-type statements covered topics of laboratory availability, safety equipment, chemical storage, safety information policy, and teacher education. A five point Likert scale (a = strongly disagree, b = disagree, c = neutral (or neither agree or disagree), d = agree, and e = strongly agree) was used to assess the extent of agreement with each of the 40 Likert statements. Twenty-four (of 40) Likert statements were obtained from a high school chemistry safety survey developed by Senkbeil in 1991.<sup>9</sup> Free response questions were structured so that teachers could provide comments on (1) how our departments can help high school chemistry teachers, (2) content to be included on a website tailored to the needs of high school chemistry teachers, and (3) any other issues of relevance. The survey instrument was reviewed and granted exemption by the West Virginia University Institutional Review Board (IRB). The survey and associated materials were sent to the 120 public high schools within West Virginia. Anonymity was maintained using a dual mail-in system. Further details on the survey method used in this study can be found in [Appendix A](#).

By June 2008, a total 77 survey responses (64% rate of return) had been received. Survey responses were not limited to one geographic area or region within the state and responses were received from high schools in a minimum of 46 of West Virginia's 55 counties. Thus, survey results are

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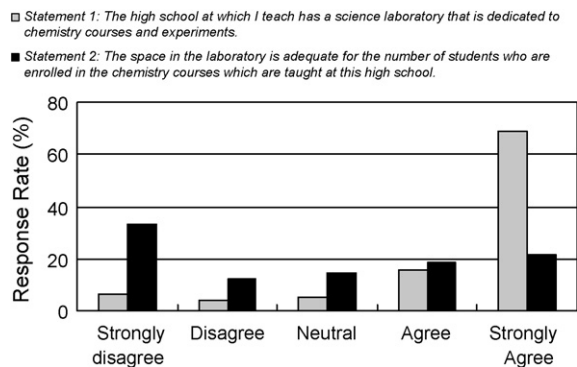
representative of 84% of West Virginia's counties.

## RESULTS AND DISCUSSION

It is important to keep in mind that the data are self reported by one member of the chemistry teaching faculty at any particular school. However, given the nature of the dissemination and the high rate of return it is believed that a representative sample of chemistry teachers across the state has been obtained. The self-reporting nature of the data may provide additional insights into the status of safety awareness of science teachers in general and chemistry teachers specifically.

## LABORATORY AVAILABILITY

As shown in [Figure 1](#), 85% of teachers surveyed were in general agreement (i.e., strongly agreed or agreed) with the statement: "The high school at which I teach has a science laboratory that is dedicated to chemistry courses



**Figure 1. High school chemistry teacher response rate (%) in terms of agreement with the statements in 1 and 2. The total number of respondents for statements 1 and 2 were  $N = 77$  and  $N = 75$ , respectively.**

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