

Evaluating Safe Science Teaching Practice in the U.S. (Phase II)

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Abstract. Science safety in is a vital issue in 2008 because: 1) it is tested on many state science content tests, 2) pre-service teachers take the Praxis test which also requires knowledge of safe science practice, 3) teachers are being trained in alternative ways that may omit safe science methods, 4) science content standards in many states emphasize doing science without specific safety guidelines, especially for middle and elementary classrooms and 5) science methods curricula have not always included planning for and conducting experiments safely. National Science Education Standards (NSES) encourage active science learning with “best practices” promoting inquiry-based and hands-on instruction at all instructional levels. Teachers who teach science are using equipment that may or may not be developmentally appropriate for their students (using open flames in K-2nd grade, for example). Accidents occur and go unreported. Based on a survey of practice in South Dakota schools, a national survey of science teaching practice K-12 is proposed.

Keywords: Science safety, hands-on science, elementary school science practice, South Dakota science teaching, teacher preparation, safety training, K-12 science,

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Prepare and prevent don't repair and repent!" ~ Author Unknown

INTRODUCTION

With support from the South Dakota Regent's 2010 Grant, Phase I of this study sampled science classroom safety knowledge and practice of a cross-section of K-12 public school science teachers in South Dakota to ascertain if presence and level of safety training and adherence to accepted safe science teaching standards. “Best practice” dictates increasing the amount of student-centered hands-on science instruction which also increases the possibility of accident, especially in the classrooms of uninformed or untrained teachers. [1]

An extensive search of the literature spanning the spectrum of recommendations from experts, government agencies and practitioners yielded a set of common core questions to be posed and terms to be carefully defined so that safety concepts and processes could be understood by all stakeholders.

What the Literature Reveals

In some cases science is being taught in safe environments where teachers are well-informed and trained in safe use of equipment and materials. And, in other situations, the opposite is true. Science teachers are certified through many routes, many are cross-over teachers from other disciplines (as the South Dakota Science Survey and other studies have shown). [1, 2] Safety instruction provided to teachers, no matter how they have been educated and certified may not be consistent, explicit or in depth. [2]

The Council of State Science Supervisors provides a comprehensive and practical guide for teachers and students appropriate for teachers in K-5 classroom situations. The National Science Teachers Association and its *Science Teacher journal* provide safety resources, videos and articles pertinent to classroom teachers K-12. The American Chemical Society, Carolina Biological Supply and Flinn Scientific, among other companies, provide checklists, science safety signs and advice to teachers on chemical and fire safety issues as well

as classroom and lab arrangements, class size recommendations and safety cautions. The list of resources is nearly exhaustive. [3]

This information, however, is not likely to get into the hands of teachers without explicit instruction and modeling of situations. Interactive-engagement, active, inquiry-based instructions are not just for students, anymore.

Core Questions

1. Do U.S. teachers use correct (and safe) practices (as outlined in the National Science Teachers Association Guidelines and elsewhere) when teaching science?
2. What is the state of safety training for K-12 science teachers in South Dakota as well as nationally?
3. What are the key safety issues that face the classroom teacher and for which they MUST be trained? And, how do these vary by grade level?
4. How will K-12 teachers, when trained explicitly in safe science teaching practices, demonstrate learning of knowledge and skills of appropriate safety practices?
5. Will U.S. K-12 teachers, when trained explicitly in safe science teaching practices, apply those practices when teaching science in their classrooms?

THE SOUTH DAKOTA SAFETY SURVEY FIELD TEST

Results from the preliminary round of the South Dakota Survey showed that teachers are not typically and specifically trained in safe classroom science methods. One teacher responding to the South Dakota Safety Survey stated, “I have handled some safety equipment...but I haven’t been trained on specific procedures.”

The results of teacher knowledge of the use of typical safety equipment found in K-12 classroom sand labs are shown in Figure 1.

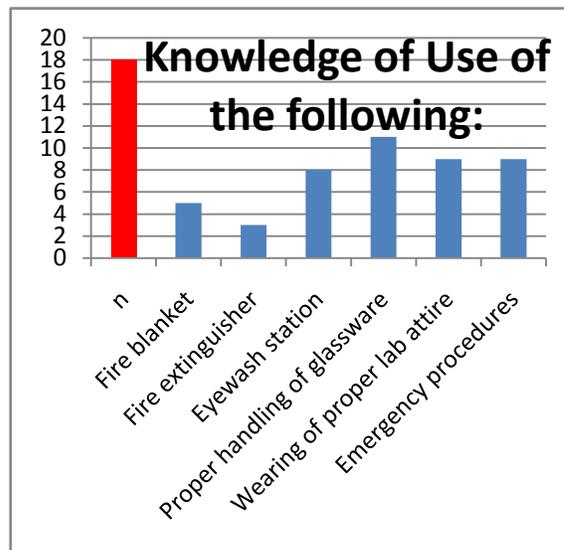


FIGURE 1. Teacher’s responses to use of safety equipment.

The field test survey participants were South Dakota public school teachers from across the state. The survey was offered online and disseminated at the end of April 2008. The participant profiles, including grade level taught, location whether rural or urban, the average number of years taught and certification status were surveyed in the field test are seen in Table 1.

TABLE 1. Profiles of Teacher-participants on the Field test of the South Dakota Science Survey (n=18)

Grade Level Taught	# sampled	# Rural (R) / Urban (U)	Mean Yrs Teaching Science	Certified In Sci. (Y/N/NR*)?
9-12	n = 7	4R, 3U	10	2, 3, 2
6-8	n = 7	5R, 2U	13	4, 2, 1
K-5	n = 4	3R, 1U	12	2, 1, 1

*NR = No response

It was recognized, as a result of a field test of the South Dakota science survey that science teachers do not have consistent training in many aspects of safety or even realized that they needed information on specific safety issues, until asked as shown by the data for question 17 in Figure 2.

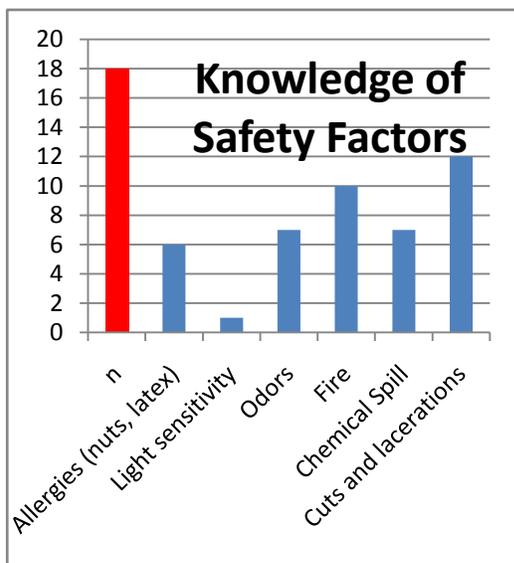


FIGURE 2. Teacher knowledge of specific safety situations.

Not one-size-fits-all for safe classrooms, appropriate equipment and activities for a 6th grade science class may not be appropriate for either a 1st or 10th grade classroom. [4]

Focus Group Comments

A focus group, held at a June 2, 2008 workshop in science safety also yielded some surprising responses as is shown in Table 2.

TABLE 2. Comments by Focus Group Participants n= 3

Question	Participant Comment
1. What is the most important Issue about science safety that teachers should know?	1. Getting the (science safety) information out to other teachers. 2. Disposal of old or unused chemicals. 3. Provide more information to school districts
2. What was the most useful information that you received on safety, today?	1. The web site information on safety and articles. 2. Sharing how to take proper precautions to cover ourselves in case of a problem

Focus group participants also echoed their enthusiastic agreement that they needed more information about methods to keep themselves and students safe. They also emphatically stated that they had not received information on safety procedures nor were aware how to get that information freely. [5]

NEXT STEPS

In order to begin gathering information, listen to the advice of science experts, not only in the sciences, science organizations, government and safety agencies. It is also important to listen to the school practitioners who deal with safety situations on a daily basis and hard data from a well-drawn study for determining what the most important safety needs in schools that are yet to be met and taught [6, 9]

Recommended Action Items

The Core concepts and recommendations synthesized from the literature search were synthesized into a set of five key action items:

- 1) Set clear and actionable safety standards appropriately for each grade level that are separately delineated from state and national science standards.
- 2) Identify the core correct, safe, and age-appropriate procedures to be followed.
- 3) Assess science teaching practice through a set of consistent and well-developed instruments that get at the reality of how and if science is actually taught safely in public schools.
- 4) Train K-12 teachers to perform, direct, and evaluate safe and effective science.
- 5) Classify exemplify which types of science experiments should be: a) safe to perform for student, b) only performed by teachers and c) those which should NEVER be performed in the classroom. [7, 8]

Once these steps have been outlined subsequent analysis of the survey should be followed by recommendations for Safe Science Practice and disseminated widely to all classroom science practitioners. Safe science procedures should be taught explicitly and completely for all pre- and in-service teachers and their students as is demonstrated in Figure 3. [4]



FIGURE 3. Instruction in safe science procedures should be explicit and modeled for students

Actual national baseline data about classroom safety, once obtained, will go a long way toward constructing a common set of guidelines based on need in a practical way for teachers to use. [10] A national study is warranted and enthusiastically invited. This paper is a call to action for those interested to bring a coherent and unified effort to bear on the problem of classroom safety.

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