THE 2003 STATUS OF SCIENCE SAFETY IN TENNESSEE SECONDARY SCHOOLS

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ABSTRACT—This study sought to answer the following two questions: 1) What is the status of safety in Tennessee secondary school science programs, and 2) Can pragmatic tools be developed to address the identified needs? Between January and November 2003 state agency representatives worked with science safety researchers to assess the status of science safety in Tennessee secondary schools and then to create a customized training program and CD-ROM designed to address identified safety concerns. Information focused on state laws, codes and professional standards applicable to science teaching in Tennessee.

In recent years there has been a great deal of inquiry surrounding safety conditions in science settings throughout the United States. In the fall of 1999 and spring of 2000, a yearlong science safety project was completed in Wisconsin (Gerlovich et al, 2001). As part of that effort, teachers completed a pre-training survey of their facilities, equipment, and understanding of their legal and professional obligations towards safety. The results were disturbing and confirmed earlier studies by Gerlovich (1997) indicating that few teachers were sufficiently aware of their legal and professional responsibilities for safety. The study also supported safety conclusions that emerged from an Iowa study (Gerlovich et al, 1998) that indicated poor facilities and equipment combined with inadequate understanding of legal and professional obligations were associated with increased numbers of accidents and lawsuits. These findings were verified in later statewide research in North Carolina (Stallings et al, 2001), Iowa (Gerlovich et al, 2002), Alabama (Gerlovich et al, 2003), and South Carolina (Sinclair et al, 2003). In addition, a 2002 preliminary national study conducted electronically through the National Science Teachers Association, corroborated these results.

On the basis of these data, L. Jordan, State Science Consultant for the Tennessee Department of Education, contacted J. A. Gerlovich, Professor of Science Education/Safety at Drake University, with the objective to examine the status of science safety in Tennessee schools and then to provide tools to address the safety needs. This report presents a summary of this project.

MATERIALS AND METHODS

In January 2003 a statewide science safety advisory committee was created, including: Tennessee State offices of the Fire Marshal, Tennessee Occupational Safety and Health Administration (TOSHA), Tennessee Department of Health, Tennessee Department of Environment and Conservation (TDEC) and exemplary teacher educators. J. A. Gerlovich and his safety team met with this advisory group to introduce survey tools, workshop agenda models, and science safety CD-ROM models from other states that might form the basis for a Tennessee model.

In February 2003 each committee member assessed safety measures or guidelines required by their respective state agency and shared this information with the committee. The committee prioritized the safety issues, and questionnaires were developed reflecting this information. The ultimate purpose of the questionnaire was to have invited science teachers assess the safety status of Tennessee elementary and secondary school science facilities, equipment, procedures, and teacher understanding of legal and ethical obligations prior to attending a training workshop. Based on this information, a draft edition of a science safety CD-ROM was developed and refined by the committee for professional development with teachers.

By early spring 2003, the CD content and formatting was confirmed, and Tennessee photos were added to the opening of each directory within the final version of the *Tennessee Edition—Total Science Safety System CD* (JaKel Inc., 2003). The CD served as the basis for professional development and for safety audit purposes in all Tennessee school science programs. An initial training program was held for presenters. Throughout the summer, trainers conducted full day workshops for secondary level teachers from each of the three Tennessee geographic regions. The workshops were designed to enable the attending science educators to effectively use the *Tennessee Edition—The Total Science Safety System CD* to: a) establish district science safety policies, b) perform science safety audits that enable the identification and correction of safety hazards, c) comply with Tennessee laws, and codes and professional standards, d) make peers, administrators, and students aware of science safety issues, and e) manage chemicals, cradle to grave (purchase to disposal), via accepted safety procedures.

One important part of the project was collecting information about teacher facilities, equipment, and teacher understanding of laws, codes, and standards. This information represents a vital step toward the goal of moving Tennessee science educators forward, focusing on their own facilities, equipment, and understanding their safety responsibilities.

RESULTS

Approximately 170 teachers participated in the summer training programs. Due to administrative problems (surveys not passed to teachers by administrators, surveys not returned), some survey response forms were not returned. However, the 73 surveys that were properly completed and returned provided a valuable first step towards understanding the status of science safety in Tennessee secondary schools. It is anticipated that additional information will be secured through future workshops.

Facilities—The findings relative to facilities provided from the pre-training questionnaires are summarized in Table 1. Ninety-five percent of the schools represented were from the public sector. This might be an area that should be probed further for unique concerns of private schools. Slightly more than 53% of the respondents represented high schools.

Laboratory age can impose serious limitations in light of newly implemented safety codes. Fifty-three percent of the responding teachers had laboratories that were less than ten years of age, while 37% of the laboratories were constructed more than 20 years ago.

Laboratory total square footage can be critical to the safety of teachers and students. It is generally recommended, within the science teaching profession, that class enrollment should be limited to 24 students. In addition, individual laboratories should include a minimum of 900–1000 square feet. The National Science Teachers Association (NSTA) recommends 45 square feet/student in science laboratories (1080 square feet), and a class size not to exceed 24 students (Biehl et al, 1999). The survey indicated that nearly 51% of the laboratories represented had less than 750 square feet, and only 20% had more than 1000 square feet.

Combination laboratory/classroom settings present special safety concerns to teachers and students. Eighty percent of the responding teachers indicated that the laboratory/classroom total square footage settings contained less than 1000 square feet. The NSTA recommends 60 square feet per student (1440 sq. ft. total for 24 students) in such settings (Biehl et al, 1999).

Fume hoods are essential pieces of safety equipment for many laboratory investigations. However, it is critical that they be tested regularly. The Occupational Safety and Health Administration (OSHA) recommends fume hood testing every 90 days. However, the Tennessee survey revealed that nearly 69% of the fume hoods included in the survey had never been tested. Science educators may wish to investigate some of the newer fume hood technologies to help address this issue. Ductless fume hoods generally meet all applicable hood standards and typically monitor themselves for performance.

Room ventilation can be viewed as an extension of the fume hood component and also as a lead in to the laboratory exits component. It is typically recommended that room air in science laboratories be turned over 4–12 times/h depending on the types of activities being performed. It was noted that nearly 88% of the Tennessee respondents were unaware of this requirement.

The National Fire Protection Association (NFPA, 1991) codes 45 and 10, adopted in many communities, spell out the exit requirements for laboratory facilities. NFPA 45 requires that laboratories have two exits, not greater than 50 feet distance from any point in the laboratory, if the laboratories: 1) contain explosion hazards that could block an exit, 2) are Class A laboratories (hazardous materials that present significant fire hazards), 3) are larger than 500 ft^2, 4) are Class B laboratories (moderate fire hazard), 5) are Class C laboratories (low fire hazard) and exceed 1000 ft^2 in work area, 6) have a laboratory fume hood located near a primary laboratory exit, 7) contain a compressed gas cylinder larger than lecture bottles containing a flammable or cryogenic gas with a NFPA Health Rating of 3 or 4.

Approximately 59% of responding teachers' laboratories had two or more exits with outward opening doors. Most applicable federal and state agencies, as well as professional science/education organizations require or strongly suggest two exits, with outward opening doors for science laboratories. Thus, the large number (41%) of laboratories that do not have exits with outward opening doors is a critical problem that needs immediate attention.

Equipment—Participant responses to questions regarding science safety equipment items are summarized in Table 2. Ground fault interrupters (GFI) or ground fault circuit interrupters (GFCI) are examples of simple, yet very strategic items (Kaufman, 1995). While nearly 56% of the responding teachers' laboratories had GFI/GFCI's, approximately 44% either lack this equipment or the teachers do not know what they are. The lack of this equipment may be due in part to the age of the buildings. GFI/GICI's are essential to protect teachers and students from electrocution through unintentional grounding via water pipes, etc.

Fire extinguishers are essential equipment items for science laboratory settings. Slightly more than 88% of the responding teacher's laboratories had at least one appropriate fire extinguisher. All science laboratories need at least one ABC tri-class fire extinguisher, and teachers must receive training in their proper use.

According to OSHA, eyewash stations are required safety equipment for science laboratories because they are vital to laboratory safety. Teachers must assure that eyewash stations are readily available whenever working with chemicals or materials that could damage eyes. Seventy-five percent of responding teachers indicated that they had this equipment.

When asked if they had Tennessee Code Approved Goggles, 62% of the responding science teachers reported they had the essential equipment. The fact that 37% either did not have the equipment or were unaware if they did is very disconcerting, considering the widespread need for this protection for almost all science activities.

Procedures—Participant responses to procedural concerns are outlined in Table 3. It is often assumed that teachers have received Safety Training for all of the essential duties that they are asked to perform. The data suggest this assumption is incorrect. Over 45% of the responding teachers have not received science Safety Training in the past five years. This statistic is of concern given the recent proliferation of codes and standards and our society's propensity to sue for personal injuries to themselves or their children.

Wearing contact lenses is increasingly common among adolescents. When contact lenses are worn in science laboratories, the "potential" for injury can increase. Teachers should know which students are wearing contacts and be prepared to address their emergency medical needs relative to the science activities being performed.

When asked "under what conditions do you allow students in your science laboratories to wear Contact Lenses", seven percent responded that they allow the wearing of contact lenses with non-vented cover goggles, which is the recommended practice. Thirty nine percent of the responding teachers indicated that they never allow contact lenses to be worn in laboratories. This seems to be extreme given all of the contemporary options. Fifty four percent of the respondents allow contact lenses with safety goggles.

Seventy-one percent of responding teachers indicated that they required student Safety Contracts. Teachers should consider

TABLE 1. Summary of responses to the pre-training questionnaires, with emphasis on the following areas: School type, Building level, Laboratory age (years), Laboratory area, Laboratory/Classroom area, Fume hood testing, Room ventilation, and Laboratory exits.

	Response	Count	Percent
School type	Public	69	94.52
	Private	4	5.48
	Total	73	100
Buiding	Middle	26	35.62
	High	39	53.42
	Combination	8	10.96
	Total	73	100
Laboratory age (years)	0–10	35	53.03
	11–20	7	10.61
	21–30	13	19.7
	30 +	11	16.67
	Total	66	100
Laboratory area (feet²)	500–749	28	50.91
	750–999	16	29.09
	1000–1450	5	9.09
	> 1450	6	10.91
	Total	55	100
Laboratory/Classroom (feet²)	500–749	25	50
	750–999	15	30
	1000–1450	4	8
	> 1450	6	12
	Total	50	100
Fume hood testing	Never	35	68.23
	< 1year	13	25.49
	> 2 years	3	5.88
	Total	51	100
Room ventilation (air-turnovers/h)	1–3	1	1.79
	4–6	3	5.36
	> 10	3	5.36
	Don't know	49	87.50
	Total	56	100
Laboratory exits (number)	1	10	14.93
	2	30	44.78
	> 2	9	13.43
	N/A	18	26.87
	Total	67	100

these and their implications as regular parts of their lesson plans and student laboratory/inquiry reports.

The nature of the chemicals incorporated into science lessons is a significant issue for teachers, administrators, and insurance companies. Management of these resources raises numerous questions. When asked about their preferred Chemical Storage System, responses were varied. Sixty two percent preferred the chemical families system, while 16% of the teachers were unsure of what system was used in their own storage areas.

Student Safety Tests can be powerful teacher tools for assessing student perceptions of their safety needs. Sixty four percent of the responding teachers indicated that they incorporated safety assessments.

Teacher Understanding of Laws, Codes, and Professional Standards—A synopsis of teacher responses relative to applicable laws, codes, and professional standards is provided in Table 4. Only 13% of responding teachers were aware that the NSTA has established minimal Floor Space Requirements per student for science laboratories. In addition, 47% of the teachers responded that they were unaware there were minimum floor space requirements.

With respect to minimal enrollment requirements for special needs students, 82% of the responding teachers were unaware that the National Science Education Leadership Association (NSELA) had such a recommendation to protect special needs students in science settings.

Twenty-five percent of the responding secondary level teachers were aware that NSTA had recommendations of 1 teacher to 10 students while on field trips. This low percentage is of concern given the frequency with which field trips occur at this level of students' education.

Teachers were asked where one might find specific Eye Pro-

TABLE 2. Summary of responses relative to available laboratory equipment.

	Response	Count	Percent
GFI/GFCI[a] protected outlets	Yes	38	55.88
	No	13	19.12
	Don't know	17	25.00
	Total	68	100
Number of fire extinguishers	0	8	11.94
	1	51	76.12
	2 or more	8	11.94
	Total	67	100
Functional eyewashes	0	17	25.00
	1	47	69.12
	2 or more	4	5.88
	Total	68	100
Tennessee code approved safety goggles	Yes	45	62.50
	No	12	16.67
	Don't know	15	20.83
	Total	72	100
Fume hood type	None–not needed	18	27.69
	Exhaust	35	53.85
	Ductless	3	4.62
	None–needed	9	13.85
	Total	65	100
Fume Hood Testing	Never	21	31.34
	< 1 Year	11	16.42
	Don't know	11	16.42
	N/A (no hood)	24	35.82
	Total	67	100

[a] GFI = ground fault interrupters; GFCI = ground fault circuit interrupters.

TABLE 3. Summary of results relative to teacher training and safety procedures.

	Response	Count	Percent
Teacher safety training	< 2 Years	19	29.69
	< 5 Years	16	25.00
	> 5 Years	29	45.31
	Total	64	100
Student wearing of contact lenses	Never	23	38.98
	W/safety	32	54.24
	W/nonvented goggles	4	6.78
	W/faceshield	0	0.00
	Total	59	100
Incorporation of safety contracts	Yes	49	71.01
	No	20	28.99
	Total	69	100
Chemical storage system	Alphabetic	4	5.88
	Chemical families	42	61.76
	Other	11	16.18
	Don't know	11	16.18
	Total	68	100
Required student safety tests	Yes	44	63.77
	No	25	36.23
	Total	69	100

TABLE 4. Summary of responses relative to teacher understanding of applicable laws, codes, and standards.

	Response	Count	Percent
Floor space requirements	NSTA[a]	9	13.24
	OSHA[b]	24	35.29
	Tennessee education code	3	4.41
	Don't Know	32	47.06
	Total	68	100
Enrollment	EPA[c]	1	1.47
	ANSI[d]	7	10.29
	NSELA[e]	4	5.88
	Don't know	56	82.35
	Total	68	100
Field trip	NSTA	16	24.62
	OSHA	3	4.62
	NSELA	5	7.69
	Don't know	41	63.08
	Total	65	100
Eye protection	Tennessee OSHA	21	30.88
	TN Ed Code	15	22.06
	TN Fire Codes	2	2.94
	Don't Know	30	44.12
	Total	68	100
Sharps	Tennessee OSHA	18	26.47
	Tennessee education code	4	5.88
	Tennessee fire codes	2	2.94
	Don't know	44	64.71
	Total	68	100
Negligence	Instruct, supervise, maintain	39	58.21
	Practice, maintain, report	9	13.43
	Teach, test, verify	2	2.99
	Don't know	17	25.37
	Total	67	100

[a] NSTA is National Science Teachers Association.
[b] OSHA is Occupational Safety and Health Administration.
[c] EPA is Environmental Protection Agency.
[d] ANSI is American National Standards Institute.
[e] NSELA is National Science Education Leadership Association.

tection equipment legislation applicable to Tennessee science students. Only 22% could identify the source of this requirement. This finding brings into question whether state legislation is being enforced in its general intent and its details to best protect all students.

The next question asked what organization addressed the use of sharps in Tennessee. Sharps are instruments used by medical personnel and science teachers to assist in puncturing the skin and a blood vessel to draw blood. Twenty six percent of the responding teachers knew that Tennessee OSHA addressed this issue in detail.

The last question addressed the issue of Teacher Negligence in student injury cases. Fifty eight percent of the respondents understood the three duties that they must satisfy to avoid negligence allegations. With proper instruction, adequate supervision, and proper maintenance of the teaching/learning setting it is very unlikely for a student to be injured or if so, for a teacher to be judged to be negligent.

Workshop Evaluations—Participant responses concerning the value of the science safety workshops are summarized in Table 5. At the close of each training session, evaluations were conducted concerning the responding science educators' perceptions of the value of the workshop and the *Tennessee Edition—Total Science Safety System CD* in meeting their safety needs. Fifty-two secondary science teacher workshop participants returned the workshop evaluation forms.

Generally, secondary science educators expressed positive attitudes towards the workshops. They were most satisfied with the knowledge of the presenters and applications made to their science classrooms and laboratories. They were most reserved in their judgment of the ease of use of the CD. Most felt that additional time was needed to become familiar with all of the details of the comprehensive safety tool. Respondents agreed that the training program prepared them to address applicable federal and Tennessee science safety laws, codes and standards. One of the most significant findings was the respondents' recommendation that all science educators and administrators receive similar professional development training.

TABLE 5. Summary of training evaluations.

Question	Respondent score/possible score[a] (avg. of 52 responses)
1. Presenters were knowledgeable about science safety and applications to science classrooms and labs	4.3/5.0
2. The Tennessee Edition—Total Science Safety System CD is well-done and easy to use	3.7/5.0
3. This training program has prepared me to address all applicable federal and Tennessee science safety laws, codes, and professional standards	4.0/5.0
4. I would recommend the training programs to all Tennessee science educators and concerned administrators	4.1/5.0

[a] Evaluations were based on the following scoring system: 1 = strongly disagree, 2 = disagree, 3 = uncertain, 4 = agree, and 5 = strongly agree.

DISCUSSION

Facilities—Brennan (1970) found class enrollment and laboratory space have a significant relationship to laboratory accidents; the higher the classroom enrollment and the smaller the laboratory space, the higher the frequency of accidents. Eliminating overcrowding is the one change that will most quickly and strategically affect safety in science laboratories.

Overcrowding in laboratories and combination laboratory/classrooms is a serious problem in the majority of Tennessee schools represented in this project. Teachers must ensure that the administrators are aware of these issues and that all attempts have been made to protect themselves and students in these substandard settings.

In Bush vs. Oscoda Area Schools (1981), a teacher and principal were held to have potential liability even though the school district was protected by the doctrine of sovereign immunity. In this case, a student was burned when methanol caught fire during a science experiment, which was being conducted in a mathematics classroom. The classroom was being used due to a shortage of space in the science laboratories. The room was not properly equipped with storage, ventilation, fire extinguisher, or fire blanket. The student was returning her extinguished alcohol burner to the counter in the back of the room when she noticed a burner that was still lit. When she attempted to extinguish it, the burner exploded, causing serious burns. The fire was eventually extinguished using the fire extinguisher located at the other end of the room. Negligence was cited for the failure to supervise, failure to instruct as to dangers, and failure to provide safety equipment and space. Although the school district was immune from suit, the principal and teacher were found negligent for allowing a science activity to occur in a room not designed for that purpose and lacking in essential safety equipment.

In Science Classroom Safety and the Law (2001), Ryan reviewed the implications of this case for principals and teachers: "School administrators take note of this case because it has important implications in overcrowded facilities. This case stands for the proposition that principals can be held liable for injury if they schedule classes improperly or hold them in inappropriate facilities . . . Thus, for teachers working in poor facilities and overcrowded conditions, it is imperative that the school district be placed on "actual notice" of the existence of conditions constituting a threat to the safety of students and teachers."

Equipment—The most notable safety equipment concerns discovered in this study focused on the lack of approved eyewash stations in 25% of the responding teachers' laboratories, the lack of knowledge concerning approved eye protective equipment, and the lack of regular fume hood testing.

The NSTA Guide to Facilities (Biehl et al., 1999) provides extensive information concerning essential equipment for general students and for meeting Americans with Disabilities Act (ADA) requirements. The American National Standards Institute (ANSI, 1993) Z358.1 code describes the essential safety role of this equipment. The OSHA (1990) standard, 29 CFR 1910.151(c), parallels the requirements of ANSI Z358, requiring emergency eye/face wash stations and drench showers. In addition, according to Rules of the Tennessee State Board of Education, Chapter 0520-1-4, 01 School Facilities:

1) Each school shall comply with rules, regulations, and codes of the city, county, and state regarding planning of new buildings, alterations, and safety. Copies of state regulations may be obtained from the office of the State Architect.
2) Each school shall observe all fire safety regulations and procedures promulgated by the Tennessee Fire Marshal's Office.
   a) Each school shall have at least one fire safety inspection annually. The fire safety inspections will be based on the fire safety inspection checklist developed by the Tennessee Fire Marshal's Office.
3) Each school shall have classrooms, laboratories, and libraries that are sufficient in number, adequate in space, and so constructed and arranged as to be conducive to carrying on the assigned activities.

With respect to eye protective equipment, all Tennessee science teachers are responsible for understanding, and modeling the following state legislation. The Tennessee Code should be enforced with students who are participating in any science activity that presents potential eye hazards. Tennessee Code/Title 49 Education/Chapter 50 Miscellaneous/Part 5 Laboratory Safety/49-50-501. Eye Protection for students and teachers (1967) 59-50-501. Eye Protection for Students and Teachers states that:

a) All students, teachers and others in attendance at the following courses or laboratories in schools, colleges or universities, and exposed to the risks incident to working with the materials, equipment and/or performing the acts described in subdivision (a) (1), shall wear eye protective devices of industrial quality.

1) Vocational or industrial arts courses or laboratories using or concerned with:
   A) Hot molten metals;
   B) Milling, sawing, turning, shaping, cutting, grinding or stamping of any solid materials;
   C) Heat treatment, tempering or kiln firing of any metal or other materials;
   D) Gas or electric arc welding;
   E) Repair or servicing of any vehicle; or
   F) Caustic or explosive materials; and
2) Chemical or combined chemical-physical laboratories using caustic or explosive chemicals or hot liquids or solids.

b) Eye protective devices shall be considered of "industrial quality" when they meet the standards of the American Standards Association Safety Code for Head, Eye, and Respiratory Protection promulgated by the American Standards Association, Inc. or other standards generally recognized by industry.

With regard to fume hood testing, the American Conference of Governmental Hygienists (ACGIH) stated in 1982 that the optimum face velocity for general safe hood operation was 60–100 fpm, with 60 fpm as a working minimum. For most operations the 60 fpm speed is sufficient for secondary school science laboratories. For additional information, teachers may wish to visit the ACHIH website in the Literature Cited section of this report. Alternatively, some teachers may wish to investigate the incorporation of the new ductless fume hoods that are self-monitoring, self-contained, and, in many cases, better options for school laboratories.

Teacher Procedures—The greatest concern in this section deals with wearing contact lenses in science laboratories. The most succinct position on this issue was rendered in 1994 when the OSHA published its Personal Protective Equipment (PPE) for General Industry Standard (29 CFR 1910; Final Rule). Part of the preamble stated:

> OSHA believes that contact lenses do not pose additional hazards to the wearer and has determined that additional regulation addressing the use of contact lenses is unnecessary. The Agency wants to make it clear, however, that contact lenses are not eye protective devices. If eye hazards are present, appropriate eye-protection must be worn instead of, or in conjunction with, contact lenses.

At the 2000 American Chemical Society national meeting in Dallas, Texas, the Committee on Chemical Health and Safety reinforced this position when it issued the following statement (Segal, 2002):

> In many workplaces where hazardous chemicals are used or handled, the wearing of contact lenses is prohibited or discouraged. A good number of these prohibitions are traceable to earlier statements in this book (Safety in Academic Laboratories, 6th Ed., ACS Committee on Chemical Safety: Washington, DC, 1995) that were based on rumors and perceived risks. A careful study of the literature by knowledgeable consultants has refuted these risks. Recent studies and experience have suggested that, in fact, contact lenses do not increase the risks but can actually minimize injury in many situations. Because of the ever-increasing use of contact lenses and the benefits they provide, the American Chemical Society Committee on Chemical Safety, having studied and reviewed the issue, is of the consensus that contact lenses can be worn in most work environments provided the same approved eye protection is worn as required of other workers in the area. Clearly, the type of eye protection needed depends upon the circumstances. It should be stressed that contact lenses, by themselves, do not provide adequate protection in any environment in which the chance of an accidental splash with the Personal Protective Equipment exists (29 CFR 1910.132 and 133), and ANSI Z87.1a-1991 should always be worn in such situations.

From this legislation and professional standards, it appears that students and teachers may safely wear contact lenses in science laboratories as long as they wear the proper ANSI approved safety equipment over them.

Teacher Understanding of Laws, Codes, and Professional Standards—The most significant message gleaned from this section is the importance of practicing the three teacher duties in avoiding accidents and resulting negligence allegations. Most responding teachers were aware that they must instruct properly, supervise adequately, and maintain the teaching/learning environment in order to protect themselves and their students from foreseeable injuries.

Teachers are not expected to be superhuman in anticipating hazards. Rather, they simply need to be "reasonable and prudent" in their judgment. They need only have the foresight of a person with their level of training, years of experience and professionalism. They must also keep themselves informed of the expected standards for safety within the science teaching profession. For example, high school chemistry teachers would be expected to: 1) develop lesson plans and student laboratory reports that contain appropriate safety cautions, rehearsals, etc, 2) check the environment to assure that it is not overcrowded and that at least two emergency exits are accessible to all students and easy to reach, and 3) check all safety equipment items and verify that they are accessible to all students, that the equipment functions properly, and that students know where the items are located and how and when to use them.

If, despite all precautions, an accident were to happen, the courts and parents would generally be forced to explore other options for the cause. Some states have adopted what is called contributory negligence, in which a plaintiff cannot recover for damages if their negligence in some way contributed to their injury. The younger the student, the more difficult it is to prove contributory negligence. In other words, teachers must be more selective about student activities.

Workshop Evaluations—Generally, respondents felt that the presenters were knowledgeable of safety issues. They also felt that the training would be valuable to their peers and their administrators. They were slightly less confident with the ease of use of the *Tennessee Edition—Total Science Safety System CD.* This appeared to be related to the complexity of the CD associated with its comprehensive coverage.

The 2003 Tennessee science safety project attempted to gauge the status of safety in secondary schools throughout the state. Survey results focused on the status of facilities, equipment, teacher procedures, and the effectiveness of the training programs. Although the results indicated some areas of concern, there also were some very positive findings. In the area of facilities and equipment, a number of buildings were new, included two laboratory exits to facilitate quick exit, had GFI/GFCI protected electrical outlets, and adequate numbers of fire extinguishers, eyewash units, and safety goggles for students. With respect to teacher procedures, most teachers required safety contracts with their students, properly stored their chemicals, and administered safety tests to students. Most teachers also indicated that the safety training and tools would be valuable to them in helping create safe science settings.

Summary—Because the teachers participating in this science safety program selected themselves, represented all school size classes, and came from all geographic locations within the state of Tennessee, it was assumed that they were generally reflective of science teachers from across the state. The objective of this project was to assess the status of safety in Tennessee school science programs and provide tools for addressing them. There were some significant safety concerns identified relative to facilities, primarily focusing on inadequate size to accommodate the laws and standards for student enrollments and the lack of regular testing of equipment. Teachers from the participating schools do not consistently observe most standard safety procedures. In addition, most participating science teachers are not aware of applicable science safety laws, codes, and standards. It does appear as if the training, and the CD-ROM developed based on these findings, did prepare participants to address applicable federal and Tennessee science safety laws, codes, and professional standards.

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