



THE NSTA READY-REFERENCE GUIDE TO  
**SAFER SCIENCE**  
VOL. 2

**Kenneth Russell Roy**

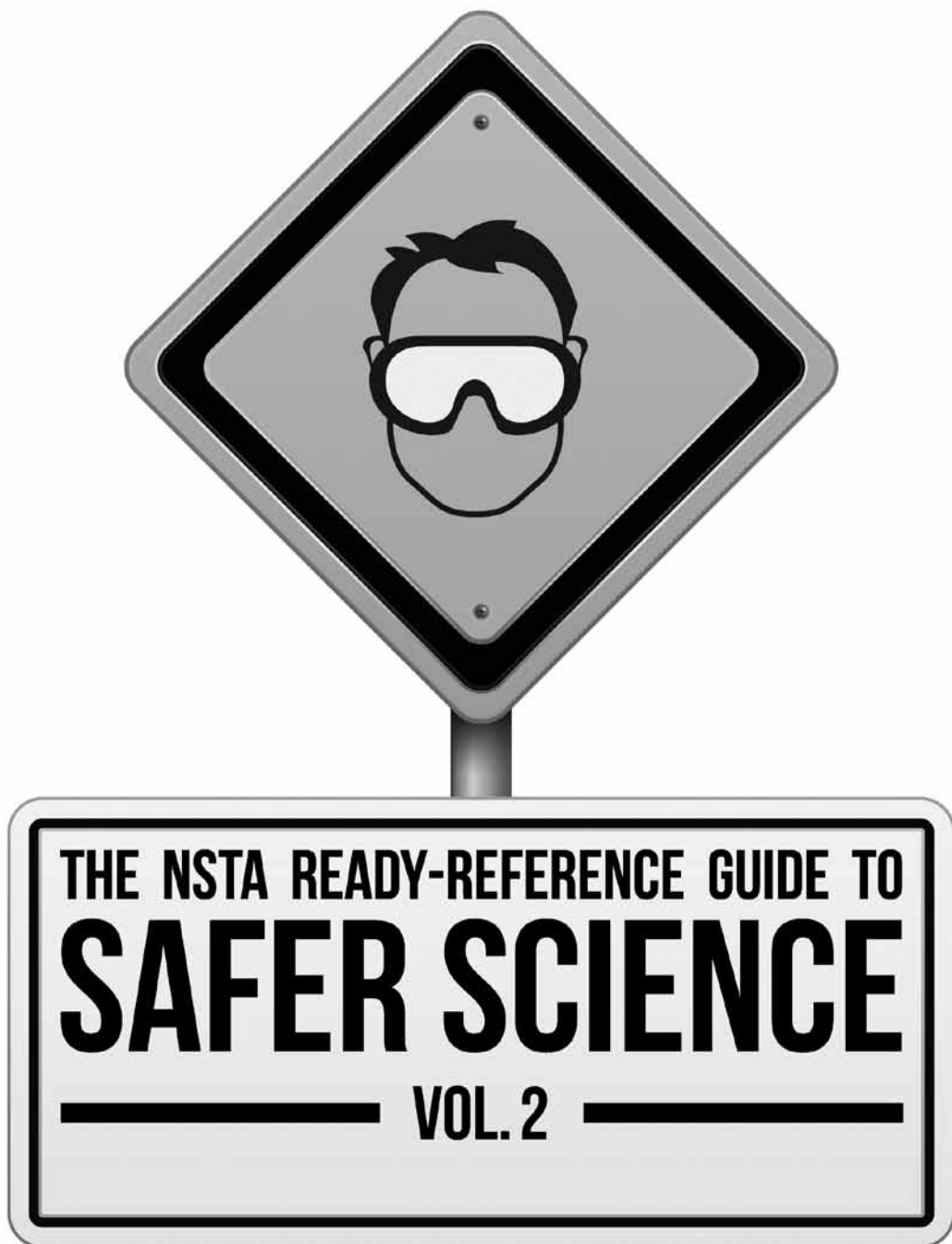
**NSTA**press  
National Science Teachers Association



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**KENNETH RUSSELL ROY**

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**Arlington, Virginia**



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# CONTENTS

(Note: All articles are from *Science Scope* except those with asterisks (\*\*). In those cases, the articles are from *The Science Teacher*.)



Preface .....	xi
Acknowledgments .....	xv
About the Author .....	xv
About This Book .....	xvi

## I. INTRODUCTION TO SAFETY IN SCIENCE

1. Making Adjustments for Mobility-Impaired Students** ....	3
2. Laboratory Safety: Welcome Aboard!** .....	6
3. Yes, You Need a Chemical Hygiene Officer .....	10
4. NSTA's Portal Into the Safety Zone .....	13
5. Good-Bye MSDS, Hello SDS! .....	16


## II. SAFETY PRACTICES AND LEGAL STANDARDS

### General Safety in Science

6. Clearing the Air on Ventilation .....	21
7. Science Storage Requirements .....	24
8. Signs of Safer Science .....	27
9. Getting Students in the Safety Zone** .....	30
10. Middle School Science Labs: A Safety Audit .....	33

### Legal Issues

11. Safety and Liability .....	35
12. Negligence: Some Things You Can't Afford to Ignore ....	37



13. Administrators Say the Darndest Things! .....	39
14. Taking Responsibility for Safety** .....	41
15. Failure of “Duty to Warn”** .....	43
16. <i>Safety in the Science Classroom:</i> An Online Resource From NSTA .....	46

### **Laboratory Construction and Renovation**

17. Blueprint for Safety .....	48
18. Permanent Safety in a Temporary Lab .....	50
19. A Science Lab by Any Other Name Would Smell as Sweet—But Would It Be as Safe? .....	52

## **III. SAFETY IN SCIENCE INSTRUCTION**

### **General Science**

20. Safety Is Always in Fashion .....	57
21. Avoiding the Burn .....	59
22. There’s No Such Thing as a Free Gift .....	61
23. Rethinking the Use of Hand Sanitizers .....	64
24. Glue Guns: Aiming for Safety .....	66
25. Extinguishing Safety? .....	68
26. Slipping on Safety .....	70
27. Safety in the Field .....	72
28. Is Greener Cleaner? .....	75

### **Chemical Science**

29. Avoid Surprise Packages .....	78
30. Flame Tests: A Burning Safety Issue .....	80
31. Combating Corrosion .....	82
32. Common Sense and Chemicals .....	84
33. Test Your Metal: Safety Knowledge .....	86
34. Beware of Students Bearing Kits .....	89
35. Chemical Sensitivity .....	91
36. Food for Thought, But Not for Eating .....	94



## **Earth and Space Science**

- 37. Hammering Home Earth Science Safety ..... 96
- 38. Modeling Clay Safety ..... 99

## **Physical Science**

- 39. Should We Pull the Plug on Wireless Computer Networks? ..... 101
- 40. Battery Safety Basics ..... 103
- 41. Black Lights: Don't Be in the Dark ..... 105

## **Biological Science**


- 42. Debugging Safely ..... 107
- 43. Sun Safety ..... 110
- 44. Digging up the Dirt on Soil Safety ..... 114
- 45. Animals in the Classroom ..... 116
- 46. Invasion of the Alien Species! ..... 118
- 47. Allergies: Nothing to Sneeze At ..... 121
- 48. Trash Talk: How to Compost Safely ..... 124

# **IV. QUESTIONS FROM TEACHERS**

## **General Questions**

- 1. Acrylic Nails ..... 129
- 2. Poison Control ..... 129
- 3. Fire Blankets ..... 129
- 4. MSDS/SDS in the Lab ..... 129
- 5. Latex in Goggles ..... 130
- 6. Housekeeping Guidelines ..... 130
- 7. Paper Towel Alternatives ..... 130
- 8. Sewer Gas ..... 130
- 9. Eating in the Lab ..... 131
- 10. Cleaning Glassware ..... 131
- 11. Parents and Safety Contracts ..... 131





12. Use of Software at Home .....	132
13. Anchoring Shelves .....	132
14. Soap vs. Wipes .....	132
15. Eyewash Stations .....	132
16. Fire Extinguisher .....	133
17. Lab Dangers .....	133
18. Science in a Math Classroom .....	133
19. Lead Paint Magnets .....	134
20. MSDS/SDS Access .....	134
21. Student-Purchased PPE .....	134
22. Plastic and Glass Containers .....	135
23. Dishwasher Use .....	135

### **Chemical Questions**

24. Chemical Indicators .....	136
25. Thermal Paper Safety .....	136
26. Diluting Acids .....	136
27. Chemical Storage .....	136
28. Heat Source Alternatives .....	137
29. Storing Nitric Acid .....	137

### **Earth and Space Science Questions**

30. Art Supplies Safety Resources .....	138
31. Stream Table Safety .....	138

### **Physical Science Questions**

32. Disposing of Batteries .....	139
33. Rocket Safety .....	139

### **Biological Questions**

34. Formaldehyde Specimens .....	140
----------------------------------	-----

35. Black Lights and Safety .....	140
36. Blood-Borne Pathogens .....	141
37. Pin Safety .....	141
38. Vermiculite .....	141
39. Dissection Eye Protection .....	142
40. Specimens in Formaldehyde .....	142

## **APPENDIXES**

### **NSTA Position Statements**

Animals: Responsible Use of Live Animals and Dissection in the Science Classroom .....	145
The Integral Role of Laboratory Investigations in Science Instruction .....	149
Liability of Science Educators for Laboratory Safety .....	154
Safety and School Science Instruction .....	160
Science Education for Middle Level Students .....	162
Learning Conditions for High School Science .....	166

<b>Internet Resources</b> .....	168
---------------------------------	-----

<b>Science Laboratory Rules and Regulations</b> .....	169
---	-----

<b>Index</b> .....	175
--------------------	-----



## PREFACE

Science education has been on a roller coaster ride since the 1950s. During the late 1950s and early 1960s, in the age of the Sputnik race, science education in the United States had a rebirth. Science education placed a focus on learning about science through the *doing* of science. A number of hands-on process- and inquiry-based programs were developed with support from the National Science Foundation (NSF) and other private groups and companies. The “alphabet soup” programs—such as SCIS (Science Curriculum Improvement Study), SAPA (Science A Process Approach), ESS (Earth Systems Science), IPS (Introductory Physical Science), and BSCS (Biological Sciences Curriculum Study)—were introduced and used in many schools throughout the United States at the K-12 levels. In the 1980s and early 1990s, these programs fell out of favor for a variety of curricular, administrative, and financial reasons. A return to the pre-1950s “textbook reading about science” approach again came into play.

Fast forward to the 1990s, when we saw the creation of the National Science Education Standards on the heels of *A Nation At Risk*, followed by No Child Left Behind legislation and the development of curriculum programs such as AAAS Project 2061; NSTA Scope, Sequence and Coordination; and State Science Frameworks. Thus began the rebirth of the “doing of science” approach in science education.

In 2012, the Next Generation Science Standards (NGSS) are being released with the goal of inspiring new generations of science and engineering professionals and scientifically literate citizens. Along with this goal comes a whole new challenge for safety in the science classroom, with an expanded emphasis on the *doing* of science for the learning of science. One potential engine embracing the NGSS is the science, technology, engineering, and mathematics (STEM) education approach, which is being adapted from comprehensive high school science curricula for STEM magnet schools. Here again is another new realm relative to safety hazards that will need to be addressed over the coming decade.

A second factor in the changes in science education during the early 1990s was the Occupational Safety and Health Administration (OSHA) unveiling and putting into effect a new federal law covering laboratory safety, known as 29 CFR 1910.1450, Occupational Exposure to Hazardous Chemicals in Laboratories, or the Laboratory Standard. This law notifies general industry employers, including school boards of education, that they must provide a safe workplace in laboratories to deal with hazardous chemicals and the use of prudent practices.

In 2012, OSHA adopted the Globally Harmonized System of Classification and Labeling of Chemicals (GHS). The main purpose of GHS is to provide consistent information (health, physical, and environmental hazards) and definitions for hazardous chemicals based on the internationally accepted GHS. Adoption of this program has safety compliance implications for science teachers in the area of the OSHA Hazard Communication Standard and the Laboratory Standard.

A third factor that has influenced the direction of science education and safety is the focus on a more diverse student population, including groups such as special needs students. A series of legislative actions, such as the Americans With Disabilities Act (ADA), required that all students have the opportunities to participate in general education, including science education. Laboratory design and construction—in addition to curriculum, instruction, and safety strategies—must attempt to address these needs.

The fourth factor in the evolution of science education is the revolution taking place in the cadre of science educators. As in the late 1960s and 1970s, many science educators are reaching retirement age and leaving the profession. As these educators retire, science education loses many years of professional experience and knowledge. Neophytes are taking these teachers' places, with limited experience in laboratory work and little to no safety preparation.

The fifth factor is the economic downturn worldwide during the past decade. Economic struggles have affected supply-intensive disciplines such as science at both the elementary and secondary levels. "Provide more by using less" has been the operative strategy. This strategy certainly has put limits on the science curriculum, instruction, and safety.

The last important factor is liability. We still live in a litigious society in which teachers are held to very high standards. Teachers and administrators need to become aware of and concerned about liability for their actions. This is especially of interest to science teachers at the middle and high school levels given the potential safety issues they face by working with students in formal laboratories and the field.

All of these factors have science teachers asking how they can improve safety in their laboratories and still carry out meaningful activities. To address some of these challenges relative to safety, the National Science Teachers Association (NSTA) introduced the safety column "Scope on Safety" in *Science Scope*, a journal for middle and junior high school science teachers. The purpose of the column was simple: provide safety information for middle-grade science teachers that will help them address safety issues when dealing with hands-on instruction in the laboratory and the field. Most of this safety information is also applicable to high school-level science laboratories, though *The*

*Science Teacher* (NSTA’s journal for high school teachers) includes the column “Safer Science” to address questions at this level.

This book is the second compendium of those articles, picking up where the first book left off in 2007. The articles are based on inquiries from science teachers nationwide. The topics focus on everyday safety issues that middle-grade science teachers and supervisors deal with when doing science. Each column is written to help science teachers become aware of legal standards and prudent practices that make for safer laboratory experiences and protect both students and teachers. Unfortunately, some architects, building contractors, school administrators, and board of education members have taken advantage of science teachers on issues such as facility design, occupancy loads, and protective equipment. This has happened because science teachers lack the expertise—in both knowledge and experience—in legal building and safety standards and prudent practices in the laboratory. Unsafe laboratory activities and facilities can get science teachers into legal challenges with professional and civil consequences.

Like the first book, this book is divided into five areas. The first section is a short introduction to the topics of hands-on science for all students, as well as the protection afforded to the science teacher through the OSHA Laboratory Standard. The second section addresses safety practices and legal standards, with a focus on current issues facing science teachers. The third section deals with safety in science instruction by providing specific information on how to best incorporate safety in various aspects of science teaching. The fourth section answers questions about everyday issues that middle-grade teachers have asked through the “Scope on Safety” column. The final section provides appendixes, including relevant NSTA position papers and internet resources.

Building safer science behaviors begins at the elementary and middle school levels. These practices serve as guidelines for future laboratory work, with many carryovers into everyday life. Safer science is critical for the teacher as an instructor and employee and for the student as a learner and citizen. Learning to teach and practice safer science is a lifelong endeavor, and I hope you will join me in this process.

*Ken Roy*



## ACKNOWLEDGMENTS

I wish to especially thank several people who have helped beyond expectations to make the journal safety columns highly effective for in-the-trenches science teachers and school administrators. Thanks to Ken Roberts, *Science Scope*'s managing editor, and Inez Fugate Liftig, the journal's field editor, for their guidance and direction in the development and operation of the column over the years. Thanks goes to David Beacom, publisher at NSTA, for his continued support and action relative to addressing safety issues in NSTA publications. Additional thanks goes to attorney Harold R. Cummings of Cummings, Lanza & Purnhagen, LLC Law Firm (South Windsor, CT), and attorney Kelly Ryan, The Ryan Law Firm (Pasadena, CA), for their professional reviews of and contributions to many safety articles. Final acknowledgment goes to my wife, Marisa; my two daughters, Lisa Marie Bride and Louise Irene Roy; and my grandson, Michael Patrick Bride, for their continued support, understanding, and patience.

## ABOUT THE AUTHOR

**D**r. **Kenneth Russell Roy** has been a science educator, K-12 administrator, and safety compliance officer for more than 44 years. In addition, he has a large number of experiences as an author and editor, with more than 200 published articles and 4 books dealing with science education and laboratory safety. He has served in numerous leadership positions for state, national, and international science education organizations. He currently serves as the director of environmental health and safety for Glastonbury Public Schools (Glastonbury, CT). Dr. Roy is also an independent safety consultant and advisor for professional organizations, school districts, magnet schools, insurance companies, textbook publishers, and other organizations dealing with safety and science education issues.

Dr. Roy earned a bachelor's degree in 1968 and a master's degree in 1974, both from Central Connecticut State University, and a doctorate in 1985 from the University of Connecticut. In addition, he received a diploma in professional education from the University of Connecticut in 1981 and has a certificate of instruction as an authorized OSHA instructor from the Keene State College OSHA (Office of Safety and Health Administration) Extension School.



Dr. Roy is a past chairperson of the NSTA Science Safety Advisory Board and also the NSTA Science Safety Compliance Consultant, serving as NSTA's liaison to the board. He is an NSTA author and safety columnist.

## ABOUT THIS BOOK

Beginning in February 2003, *Science Scope* started publishing the column “Scope on Safety” in each issue. In 2007, *The Science Teacher* began publishing the column “Safer Science” to provide safety information for high school teachers. In these columns, author Ken Roy, NSTA Science Safety Consultant and past chairperson for the NSTA Safety Advisory Board, shares the knowledge, skills, and attitudes that help guide planning for safer science instruction and laboratory facilities. Like the first book, this book includes information, anecdotes, advisories, warnings, and good leads to the newest resources and answers teachers’ questions about safety.

This book is a compilation of updated columns from both journals (though primarily from *Science Scope*), beginning where the first book left off in 2007, and it covers a wide range of safety issues in quick-reference form. You can use the index or the table of contents to locate a quick answer to your questions about practicing safer science.

Science teachers are charged with meeting “duty of care.” They must therefore make decisions based on the maturity and knowledge base of their students. This responsibility is in concert with students’ exposure to the potential hazards associated with hands-on activities in laboratories and the field. The charge is clear: to secure and foster safer learning and working environments for both students and teachers.

Science safety doesn’t just mean following a set of rules. Safer science practice requires common sense and the teacher’s intuition that helps predict what might happen when we least expect it. To foster inquiry in a safer environment, teachers must not only keep up-to-date with the latest information about products, hazards, and best practice but also consider the developmental level of their budding scientists.

As always, remember that the best piece of safety equipment in your classroom is you—the informed adult shaping and controlling the learning and working environment.



**INTRODUCTION TO  
SAFETY IN SCIENCE**





# INTRODUCTION TO SAFETY IN SCIENCE

## 1. Making Adjustments for Mobility-Impaired Students

In 1985, the year Halley's Comet last passed near Earth, the American Association for the Advancement of Science (AAAS) initiated Project 2061. *Science for All Americans*, the project's cornerstone publication, was recognized as the first step in establishing national standards in science for all students, including those with disabilities. With the help of this project and legislation such as the Americans With Disabilities Act (ADA), individuals with disabilities are assured equal opportunity and full participation in school and out. As a result, accommodations must be made to help disabled students fully participate in science classrooms and laboratories, including making the laboratory accessible to students with mobility impairments.

Given the variety of needs relative to science, lab facilities, and each student's physical abilities, no spectral standards exist for establishing science laboratories. However, several sources do exist for specific guidelines that should serve as the basis for design considerations in constructing or renovating science laboratories, which can help provide both access and safer science for students with disabilities. These include the ADA, created to eliminate discrimination against persons with disabilities; the Uniform Federal Accessibility Standards (UFAS) for facility accessibility for physically handicapped persons in schools receiving federal financial assistance; and state and local regulations.

(*Note:* See Internet Resources for a list of helpful resources.)

Students' mobility impairments need to be addressed for access to and safety in science laboratories. Typical accommodations for mobility-impaired students include workstations, sinks, fume hoods, and safety eyewashes and showers, in addition to other adaptations. The following are some of the higher-profile accommodations based primarily on ADA and UFAS expectations for mobility-impaired students and faculty members. It should be noted that the ADA and UFAS are not always in agreement, as UFAS tends to be more restrictive in some cases. Be sure to check local and state regulations as well.

### Laboratory Workstations

The traditional science laboratory workstation is equipped with electrical receptacles, gas jets, water faucets, sinks, and apparatus rod sockets. Controls for these fixtures should be easy to operate using a maximum of 2.3 kg (5 lbs.) of force and should also require only a loose grip to operate, as opposed to pinching the fingers or twisting the wrist. Single-action lever controls should be used in place of knob-type controls.

At least one workstation should be designed to accommodate students with mobility impairments. Dimensions for access to this workstation should include a maximum height of 86 cm (34 in.) from the floor to the work surface. Accommodating dimensions

## INTRODUCTION TO SAFETY IN SCIENCE

for knee space should be 69 (height) × 76 (width) × 48 cm (depth) (27 × 30 × 19 in.). Clear floor space with dimensions of 76 (width) × 122 cm (length) (30 × 48 in.) is required for a wheelchair front approach, with adequate space provided to maneuver to and from the workstation. In addition, the workstation should be in a place with no physical barriers and allow for visual access to instruction and demonstrations. Mirrors or electronic camera devices can also help provide visual access.

### Laboratory Sinks

ADA Accessibility Guidelines (ADAAG) for Buildings and Facilities specify that sink depth in the laboratory should be no more than 16.5 cm (6.5 in.) so that a wheelchair can fit under the sink. The minimum knee space required is 69 × 76 × 48 cm. The counter or rim of the sink must be mounted at a maximum height of 86 cm from the finished floor. Faucets should have easy access, lever-operated controls, or a similar alternative, such as push-type, touch-type, or electronically controlled mechanisms. Clear floor space with dimensions of 76 × 122 cm is also required for laboratory sinks. Exposed hot water and drain pipes under sinks are to be insulated or configured to protect against contact. In addition, to avoid injury, there should be no abrasive or sharp surfaces under the sinks.

### Fume Hoods

As with workstations and lab sinks, fume-hood decks should also be low-

ered to the required maximum height of 86 cm from the finished floor. Required knee space is also the same (69 × 76 × 48 cm), as is the required floor space (76 × 122 cm). Easily operable hood controls should be placed at a maximum height of 122 cm; this height is referenced by the International Building Code (IBC/ANSI A117.1) for new construction and is a requirement for state departments of education and other jurisdictions using this code. However, existing installations that have controls within 137 cm (54 in.) of the floor may remain at this height.

### Safety Eyewashes and Showers

Modifications to the standard safety-eyewash station bowl and the pull-handle shower are also required. The eyewash bowl should be lowered so that the maximum height of the water-discharge outlets is 91 cm (36 in.) above the finished floor. For new showers, the pull handle should be at a maximum height of 122 cm above the floor to accommodate a wheelchair side approach—this is a requirement for state departments of education and other jurisdictions using this code. Existing shower installations that have the pull handle within 137 cm of the floor may remain at this height. Clear floor space of 76 × 122 cm is also required for the shower. (*Note:* Flexible-hose-type showers installed in the laboratory stations are not permitted by the Occupational Safety and Health Administration [OSHA] as the sole means of providing this safety feature.)

### Additional Access Items

The sharp corners of cabinets, bookcases, and other equipment or furniture also need to be addressed. Alternative laboratory storage units, such as a storage cabinet on rollers, can be helpful in this regard. Items on storage shelving must be a maximum of 122 cm above the finished floor for easy and safe access from a wheelchair side approach—again, this is a requirement for state departments of education and other jurisdictions using this code. Adequate maneuvering space and accessible hardware (similar to controls described in the sections Laboratory Workstations, Laboratory Sinks, and Fume Hoods) are required to ease the opening of cabinet doors. Existing installations that store items within 137 cm of the floor may remain at this height.

In cases where specific equipment is required, adaptations are often available. For example, extended eyepieces for microscope viewing can be secured for students' use in wheelchairs. Another example is glassware such as beakers with handles for easier access and use.

Finally, doorway width should be a minimum of 81 cm (32 in.) for wheelchair clearance, and aisle width should be a minimum of 91 cm. For mobility clearance, a turning radius of 152 cm (60 in.) is needed.

If teachers have concerns about accommodations and safety in their

own laboratory, they should contact the building administrator in writing. Ultimately, it is up to the administration to provide alternatives, such as a portable unit, needed to meet ADA specifications.

A safer laboratory for all students involves keeping the designed laboratory landscape uncluttered. Laboratories that are messy or poorly designed foster trip-and-fall hazards and other safety incidents, which can put both students and teachers in harm's way.

### Acknowledgments

Special thanks to Architectural Design Reviewer Richard Snedeker of the Connecticut State Department of Education's Bureau of School Facilities for his professional review and contributions to this column.

### Resource

Motz, L. L., J. T. Biehle, and S. S. West. 2007. *NSTA guide to planning school science facilities*. 2nd ed. Arlington, VA: NSTA Press.

### Internet Resources

International Code Council: [www.iccsafe.org](http://www.iccsafe.org)

United States Access Board. ADA Accessibility Guidelines for Buildings and Facilities (ADAAG). [www.access-board.gov/adaag/html/adaag.htm#4.244](http://www.access-board.gov/adaag/html/adaag.htm#4.244)

United States Access Board. Uniform Federal Accessibility Standards (UFAS). [www.access-board.gov/ufas/ufas-html/ufas.htm](http://www.access-board.gov/ufas/ufas-html/ufas.htm)

## 2. Laboratory Safety: Welcome Aboard!

Why did *The Science Teacher* initiate a safety column? Walk into a typical science classroom today and you are likely to see the teacher conducting a demonstration or students doing hands-on laboratory work. This key instructional strategy has been re-embraced since the advent of the *National Science Education Standards*, state science curriculum reforms, and No Child Left Behind legislation. In the mix of these initiatives is a major retirement revolution and effects of the economic downturn. Teachers with many years of skill and knowledge in laboratory work are coming of age to leave the profession. In addition, a myriad of schools need renovations or new construction because of overcrowded conditions and outdated laboratory facilities. Some of these issues unfortunately have not been addressed due to limited funding.

Safety in the science laboratory and field work is all the more important as a result of these events and changes. The mission of this column is to address the “in the trenches” safety issues and help teachers successfully maneuver through these revolutionary and evolutionary times in science education.

### **OSHA Laboratory Standard: The Locomotive Driving Safety**

Where does a science teacher or supervisor start to ensure that laboratory work is conducted with safety in mind? Federal government legislation from 1990 is the major force in helping establish a

safe working environment in academic laboratories for teachers and students. This legislation is based on the Occupational Safety and Health Administration’s (OSHA) Occupational Exposure to Hazardous Chemicals in Laboratories, otherwise known as the Science Laboratory Standard for employees working in laboratories.

All school employees protected under Federal OSHA or similar state plans are covered by the 1986 Hazard Communication Standard or HazCom/Right to Know law (29 CFR 1910.1200). However, as of 1990, because of the dangers and uniqueness inherent in laboratory work, employers under Federal OSHA or similar state plans are required to cover laboratory workers specifically (including science teachers) with the OSHA Laboratory Standard (29 CFR 1910.1450 Subpart Z).

### **Moving on the Right Track**

The OSHA Laboratory Standard is performance based. OSHA provides the basic outline requirements, then each employer (e.g., board of education) writes a plan tailored to its independent needs. For example, plans may vary from district to district relative to differing standard operating procedures, but all plans must contain standard operating procedures.

Three important components of the standard include the development of a chemical hygiene plan (CHP), the appointment of a chemical hygiene

officer (CHO), and employee training. The written CHP must be developed to protect employees from hazards associated with chemicals in the laboratory. Although generic plans are available, each plan must be unique to address the specific needs of individual workplaces. The employer is responsible for developing and enforcing the plan. The standard also requires that the employer appoint a CHO to develop and implement the CHP. The CHO position is an appointment under the OSHA standard as opposed to a required new hiring.

### The CHP Itinerary

OSHA requires the CHP be composed of the following minimum parts:

- Standard operating procedures (SOPs): What are the standards for laboratory operation that all employees are required to follow? For example, what is the protocol for testing showers and eyewash stations in laboratories? SOPs should be rooted in standards, codes, or other professional expectations.
- Criteria to determine and implement control measures to reduce employee exposure: What type of engineering controls (e.g., eyewash stations), use of personal protective equipment (e.g., chemical-splash goggles), and hygiene practices (hand washing) are required?
- Requirement that fume hoods and other engineering controls are functioning properly and within specific measures: Is there a preventive maintenance program in place that fosters optimal performance of engineering controls?
- Provisions for employee information and training: What types of (and how much) safety training and information are provided for employees?
- Circumstances where laboratory operation requires prior approval from the employer: What is the protocol used to undertake a special laboratory activity or new procedure?
- Provisions for medical consultation and examinations: What procedure has been established to provide for medical assistance if an employee has a chemical exposure or incident?
- Designation of personnel responsible for implementation of CHP, including CHO: Who is the employer-designated CHO? This person—often a chemistry teacher, department head, or laboratory technician—must be qualified by training or experience to provide technical guidance in the development and implementation of the CHP.
- Provision for additional employee protection when working with particularly hazardous substances: What procedures are in place for employees if they



work with substances such as toxins and flammables?

### **Making the Connection for Training**

The CHP must include employee information and training relevant to laboratory work. The training must be provided at the time of initial employment and when new chemicals or hazards are introduced into the workplace. Information must include CHP contents, laboratory standards, personal exposure levels (PEL), threshold limit values (TLV), exposure signs, and the location of related reference materials. Training must minimally include methods to detect the presence of hazardous chemicals, physical and chemical health hazards in the laboratory or work area, procedures such as emergency procedures, work practices, and protective equipment.

### **Additional Items to Consider**

Remember, OSHA standards represent only the minimum expectations for safety. Also, OSHA covers employees, not students. However, to maintain a safe working environment for employees such as science teachers, the school's CHP should also include students. The rationale is that to maintain a safe working environment for teachers as employees, students must also be accountable for following SOPs in the lab.

Those working with the employer in the development of the CHP need to consider additional policies and regulations that go beyond the minimal safety expectations, such as the following:

- **Use of lab facility:** The CHP should address policies on use of laboratories by noncertified instructors and nonscience students—for example, the assignment of study halls or English classes to science laboratories.
- **Occupancy load:** Legal standards such as fire and building codes restrict occupancy loads in science laboratories. Quasi-legal and professional standards provide academic occupancy loads in science labs. This in effect limits the number of occupants allowed in a science laboratory. Be careful to distinguish between the terms *science laboratory* and *science classroom*. Those designations have different ramifications relative to code applications.
- **Security:** Science laboratories are considered secured areas, given the inherent dangers from elements such as gas, electricity, and hazardous chemicals. Policies need to be written to foster security relative to entering laboratories and storerooms. For example, only chemistry teachers are provided with a key to the chemical storeroom. Science laboratories should be locked when they are not in use.
- **Special needs:** Policies in working with students or employees who are physically challenged or have other special needs should be addressed in the CHP. A variety of options are available to

meet both the safety and educational needs of all students and employees in the laboratory.

### **All Aboard for Safety's Sake**

The OSHA Laboratory Standard is the foundation for an effective laboratory safety program. Science teachers and school administrators need to be advocates for safe science in the laboratory or field. They must help educate central office administrators, board of education members, and legislators and other government officials to promote and facilitate a safe working environment for

employees and students. Science teachers who make safety a priority for their students will not only make the lab safer for themselves but also will instill a commitment on the part of their students as future employees.

### **References**

- Occupational Safety and Health Administration (OSHA). Occupational Safety and Health Administration laboratories, other resources. [www.osha.gov/SLTC/laboratories/otherresources.html](http://www.osha.gov/SLTC/laboratories/otherresources.html)
- Occupational Safety and Health Administration (OSHA). Occupational Safety and Health Administration laboratory standard. [www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=standards&p\\_id=10106](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=10106)

### 3. Yes, You Need a Chemical Hygiene Officer

Chemical hygiene is everyone's business in middle school science labs. Middle schools with formal lab facilities (except for those in Delaware, Georgia, Massachusetts, North Dakota, and Texas) are legally required to appoint an employee to serve in the role of chemical hygiene officer (CHO). This position is absolutely critical in fostering and ensuring both chemical hygiene practices and the chemical hygiene plan (CHP).

According to OSHA (see References), the employer is required to appoint a CHO. OSHA defines the CHO as "an employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan." In those schools where the employer has not appointed a CHO, the superintendent of schools has the responsibility. Most superintendents are unaware of this fact and lack the qualifications needed for such a position.

The OSHA Laboratory Standard is necessary to ensure that all employees working in science laboratories are appropriately informed about hazardous chemicals being used, aware of the risks involved, and familiar with the standard operating procedures the employer has established to minimize employee exposure to these hazards.

#### Who Is Responsible for Chemical Hygiene In Middle School Labs?

The simple answer is that *everyone* is responsible for chemical hygiene.

- The superintendent of schools has ultimate responsibility for chemical hygiene within the institutions they supervise and must (with other administrators) provide continuing support for institutional chemical hygiene.
- The science department head, chairperson, or head teacher is responsible for chemical hygiene in his or her school.
- The CHO helps all stakeholders operate within the expectations of the CHP. The National Research Council (NRC; see References) recommends that CHOs
  - work with administrators and other employees to develop and implement appropriate chemical hygiene policies and practices;
  - monitor procurement, use, and disposal of chemicals used in the lab;
  - see that appropriate audits are maintained;
  - help project directors develop precautions and adequate facilities;

- know the current legal requirements concerning regulated substances; and
- seek ways to improve the chemical hygiene program.
- The laboratory supervisor is responsible for chemical hygiene in the laboratory. (The science teacher is considered to be the laboratory supervisor for school academic labs.) The laboratory supervisor should
  - ensure that workers know and follow the chemical hygiene rules, protective equipment is available and in working order, and appropriate training has been provided;
  - provide regular, formal chemical hygiene and housekeeping inspections, including routine inspections of emergency equipment;
  - know the current legal requirements concerning regulated substances;
  - determine the required levels of protective apparel and equipment; and
  - ensure that facilities and training for use of any material being ordered are adequate.

### **Zeroing In on the Chemical Hygiene Officer**

The specific CHO responsibilities in most school districts are an outgrowth of the sample responsibilities provided

in the OSHA Lab Standard Appendix A. The following are the basic responsibilities of a middle school CHO:

- **Chemical hygiene plan (CHP):** The CHO should work in concert with the science faculty and administration to develop the OSHA-mandated CHP and provide copies to all employees and school and central office administrators.
- **Training:** The CHO should provide appropriate training (initial and annual updates) and resources relative to the CHP.
- **Recordkeeping:** The CHO should maintain training records (three years minimum) and have an up-to-date laboratory chemical inventory with corresponding Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS).
- **Compliance inspections:** The CHO should make sure that training, accident, and other records, in addition to the CHP, are available to safety and health enforcement officers.
- **Personal protection:** The CHO should ensure the engineering controls, standard operating procedures, and personal protective equipment are provided, operating as designed, and followed as per the CHP.
- **Medical consultations:** The CHO should report any chemical exposure incidents to the administration, document cir-

## INTRODUCTION TO SAFETY IN SCIENCE

cumstances of the exposure, and work with the exposed employee on medical consultation, evaluation, and follow-up.

- Safety audit: The CHO should provide an annual laboratory safety checkup audit and submit it to the superintendent of schools.

### Final Word

Safety is a communal responsibility for all involved in the science laboratory. The CHO is critical in helping facilitate the safeguards put in place as part of the

CHP to protect both the teacher and students. Science teachers should petition their administration to make sure at least one CHO is appointed at their schools.

### References

- Occupational Safety and Health Administration (OSHA). OSHA 29 CFR 1910.1450: Occupational exposure to hazardous chemicals in laboratories. [www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=10106](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10106)
- National Research Council (NRC). National Research Council (NRC) recommendations concerning chemical hygiene in laboratories. [www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=10107](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10107)

## 4. NSTA's Portal Into the Safety Zone

In 2010, NSTA's Science Safety Advisory Board launched the Safety in the Science Classroom web portal, which contains safety resources for teachers, supervisors, and administrators. Upon entering the portal, visitors first see an interesting overview of mandated employer or board of education safety responsibilities for employees, titled OSHA Training Requirements and Guidelines for K-14 School Personnel. This document provides a definitive summary of all relevant OSHA training requirements and guidelines that most boards of education are required to provide. This resource includes training guidelines, characteristics of an acceptable trainer, and topics required. It further points out varied legal requirements at both the national and state levels.

### The Safety Resources List

The balance of the portal contains an evolving list of safety resources for both elementary and middle/secondary schools. The list includes professional societies, federal and state agencies, nonprofit and for-profit companies, and science supply houses that provide safety services and products for K-12 schools. Any for-profit company listed must make free materials or services available to K-12 schools.

### Resources for Middle and Secondary School Teachers

So what kind of resources can middle school science educators expect to find?

Here is a partial listing of some of the groups you can connect to through the portal, as well as examples of specific resources the groups have available:

- American Association of Poison Control Centers: poison prevention resources, tips, etc.
- American Chemical Society: *Safety in Academic Chemistry Labs*, recommendations for goggle cleaning, chemical storage resources
- California State Department of Education: *Science Safety Handbook for California Public Schools*
- Centers for Disease Control and Prevention: *School Chemistry Laboratory Safety Guide*
- Cole-Parmer: *Interactive Chemical Compatibility*
- Connecticut State Department of Education: *Middle School Science Safety: Prudent Practices and Regulations*
- Council of State Science Supervisors: *Science and Safety: Making the Connection—A Secondary Safety Guide*
- Environmental Protection Agency: Schools Chemical Cleanout Campaign (SC3), *Chemical Management Resource Guide for School Administrators*

## INTRODUCTION TO SAFETY IN SCIENCE

- Fermi Science Support Center: science safety issues
- Fisher Scientific: *Safety in High School and College Laboratories*
- Flinn Scientific: model chemical hygiene plan, overcrowding in science labs
- The Hartford: *An Overview of OSHA's Laboratory Standard*
- Howard Hughes Medical Institute: lab safety
- Laboratory Safety Institute: numerous safety publications
- Lab Safety Supply: *E-Z Facts*
- Local Hazardous Waste Management Program in King County (Seattle): *Rehab the Lab* (advisory list of acceptable chemicals for use in the science lab)
- Maryland State Department of Education: lab safety manual
- Massachusetts Institute of Technology: *Tips for Sustainable Solvent Practice, Generic Solvents Alternative Guide*
- National Institutes of Health: household products Material Safety Data Sheet (MSDS) database
- National Oceanic and Atmospheric Administration: chemical database with response recommendations for more than 6,000 chemicals
- National Research Council: *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals*
- National Science Education Leadership Association: professional safety practice position statements, including Occupancy Loads in School Science Laboratories and Experiments/Activities With Human Blood and Other Potentially Infectious Materials (OPIMs)
- National Science Teachers Association: books on safety, position statements such as Liability of Science Educators for Laboratory Safety
- New York State Department of Education: chemical storage guidelines
- Occupational Safety and Health Administration: 29 CFR 1910.1450 Lab Standard and 29 CFR 1910.1200 Hazard Communication Standard
- Science and Safety Consulting Services: Chemical Substitution List, Eye Protection Options poster
- University of New Hampshire: *University of New Hampshire Biological and Chemical Safety Plan*
- U.S. Department of Transportation: *Emergency Response Guidebook*
- Virginia State Department of Education: *Safety in Science Teaching manual*

- Web resources for MSDS (SDS): various online resources for MSDS (SDS)

### **Final Safety Thought**

Teachers should be aware that the list does not supersede school or school-system policy; local, state, or federal laws, regulations, or codes; or professional standards. Ultimately, it is the

science teacher's and school administrator's responsibility to use appropriate legal standards and best professional practices under "duty of care" to make the science laboratory safer.

### **Resource**

National Science Teachers Association (NSTA).  
NSTA Portal: Safety in the Science Classroom:  
[www.nsta.org/portals/safety.aspx](http://www.nsta.org/portals/safety.aspx)



## 5. Good-Bye MSDS, Hello SDS!

Science teachers who use the Material Safety Data Sheet (MSDS)—a form listing the properties of a particular substance—know that the potential hazards identified by different suppliers aren't always consistent. Unfortunately, this issue goes well beyond the secondary science laboratory—it's a global problem.

The Occupational Safety and Health Administration (OSHA) addressed this issue and other concerns with the adoption of a rule to change the Hazard Communication Standard (HCS), a national standard that addresses chemical management and employee safety. OSHA's new rule includes the adoption of the Globally Harmonized System for the Classification and Labeling of Chemicals (GHS)—a standardized system created by the United Nations to provide a worldwide standard for safety hazards—into the HCS. The goals of the GHS are to

- provide consistent information (e.g., health, physical, and environmental hazards) and definitions for hazardous chemicals,
- establish a standard format for Safety Data Sheets (SDS) and labels, and
- increase understanding by using standardized pictograms and harmonized hazard statements.

With the adoption of the GHS, the revised HCS will include the following major changes:

- Hazard classification: Chemical manufacturers will be expected

to use specific criteria to classify health and physical hazards for pure chemicals and mixtures.

- Labels: Chemical manufacturers and importers will be mandated to provide precautions and labels that include signal words, pictograms, and hazard statements for each hazard class and category.
- SDS: The SDS will have a 16-section format with specific categories and information and will replace the existing MSDS.
- Information and training: Although the GHS does not address training, the proposed HCS will require that workers be trained within two years of the publication of the final rule.

### Specific Changes

The existing HCS is performance based. It provides guidance for hazard determination but doesn't specify an approach, format, or language to convey hazards and other information on labels or MSDS. The new GHS has performance-based aspects, but the key provisions are uniformity oriented. For example, Health Hazards categories will be classified and defined via GHS protocols.

The new standard format for SDS includes these sections:

1. identification
2. hazard(s) identification
3. composition and information on ingredients

4. first-aid measures
5. firefighting measures
6. accidental release measures
7. handling and storage
8. exposure control and personal protection
9. physical and chemical properties
10. stability and reactivity
11. toxicological information
12. ecological information
13. disposal considerations
14. transport information
15. regulatory information
16. other information

OSHA will probably not enforce the sections that require information outside of its jurisdiction (i.e., #12–16).

Labeling is another improvement. Labels will include

- the product name,
- a signal word (e.g., *danger* or *warning*),

- a hazard statement (explaining the nature and degree of risk),
- pictograms and symbols,
- a precautionary statement (how the product should be handled to minimize risks),
- the name and address of the company, and
- telephone numbers.

### **In the End**

All of these changes will help science teachers better assess the risk of using hazardous chemicals in the laboratory.

Science teachers can track regulation changes and the adoption process on OSHA's website (see Internet Resource).

### **Internet Resource**

Globally Harmonized System for Hazard Communication: [www.osha.gov/dsg/hazcom/global.html](http://www.osha.gov/dsg/hazcom/global.html)

# INDEX

## A

- A Nation At Risk*, xi
- AAAS (American Association for the Advancement of Science), xi, 3
- AALAS (American Association for Laboratory Animal Science), 116
- AAPCC (American Association of Poison Control Centers), 13, 129
- Accessibility for mobility-impaired students, 3–5
- Accessibility Guidelines for Buildings and Facilities, 4
- Accommodations for mobility-impaired students, 3–5
- Acetic acid, 41, 132
- Acids, 41. *See also specific acids*
  - dilution of, 60, 136
  - eye protection for work with, 98
  - shipping of, 79
  - storage of, 137
  - testing minerals with, 97
- Acrylic nails, 46, 129, 170
- Activity kits, 89–90
- ADA (Americans With Disabilities Act), xii, 3, 4, 5, 49, 51, 122
- Administrators
  - communication about safety with, 155
  - liability of, xii
  - misguided ideas of, 39–40
  - notifying about field trips, 73
  - responsibility related to students' allergies, 122–123
  - work with chemical hygiene officers, 10, 11
- Air quality indoors, 91–92
- Alcohol-based hand sanitizers, 64–65, 132
- Allergies/allergens, 21, 22, 72, 73, 87, 92, 100, 107, 115, 116, 121–123, 130, 143, 146, 147
  - administrator/teacher responsibility related to, 122–123
  - animals, 43, 133
  - composting activities and, 124, 125
  - latex, 125, 130
  - parent/guardian responsibility related to, 121
  - peanut, 21, 22, 121, 122
  - student responsibility related to, 123
- Aluminum, 86
  - corrosion of, 83
- American Association for Laboratory Animal Science (AALAS), 116
- American Association for the Advancement of Science (AAAS), xi, 3
- American Association of Poison Control Centers (AAPCC), 13, 129
- American Chemical Society, 13
- American National Standards Institute (ANSI), 33, 133, 170
- American Scientific, 134
- Americans With Disabilities Act (ADA), xii, 3, 4, 5, 49, 51, 122
- Ammonia, 89, 91
- An Overview of OSHA's Laboratory Standard*, 14
- Animals
  - classroom care for, 116–117
  - encountered during geological fieldwork, 97
  - ordering specimens of, 119
  - releasing non-native species into local environment, 118–119
  - Responsible Use of Live Animals and Dissection in the Science Classroom, 116, 117, 118, 145–147
- ANSI (American National Standards Institute), 33, 133, 170
- Antimicrobial cleaning products, 77
- Antiseptics, 76
- Aprons, 31, 33, 41, 42, 49, 50, 58, 59, 67, 80, 81, 97, 136, 147, 170
- Architects, xiii, 24, 40, 48–49, 52
- Arsenic, 91, 114, 115
- Art supplies, 91, 138
- Asbestos, 91, 99, 114, 129, 141–142
- Assessment, 153
- Audiovisual equipment, 166
- Audits of facilities, 12, 33–34, 35, 157
- Austrian Medical Association, 101

## B

- Bacteria, 114, 124, 130, 135
  - cleaning products to kill, 75–77
  - hand sanitizers and, 64–65
- Basal cell carcinoma, 111
- Bases, 41
  - dilution of, 60
- Batteries, 103–104
  - disposal of, 139
- Behavioral expectations for students, 46, 57, 70, 72
- Benedict's solution, 84–85, 136
- Benzene, 91
- Biohazard signage, 27
- Biological science
  - allergies, 121–123
  - animals in the classroom, 116–117
  - composting safety, 124–125
  - hazards related to, 133
  - pest management, 107–109
  - questions related to, 140–142
  - releasing non-native plants and animals into local environment, 118–119
  - soils, 114–115, 141–142
  - Sun safety, 110–112

# INDEX

- Biological Sciences Curriculum Study (BSCS), xi  
Bisphenol A (BPA), 136  
Biuret solution, 136  
Black lights, 105–106, 140  
Blood-borne pathogens, 35–36, 72, 141  
BOCA (Building Officials and Code Administrators), 156  
BPA (bisphenol A), 136  
Brass, 86  
Britain's Health Protection Agency, 101  
BSCS (Biological Sciences Curriculum Study), xi  
Budget, 24, 35, 48, 51, 61, 90, 152  
Building Officials and Code Administrators (BOCA), 156  
Burn injuries, 43, 57, 133  
    acrylic nails and risk for, 46, 129, 170  
    chemical, 91  
    electrical, 60  
    from flame tests, 80–81  
    from glue guns, 66, 67  
    prevention of, 57, 59–60  
    from ultraviolet radiation, 105, 110, 111–112  
Burners  
    Bunsen, 59, 129, 137  
    butane portable micro, 137  
    propane, 51  
    safe use of, 59, 82, 137, 171
- C**  
Calcium, 86  
California State Department of Education, 13  
Carbon monoxide, 91  
*Caring for Animals: Guide to Animals in the Classroom*, 116, 117  
Cash donations, 62  
Caution signage, 27  
CDC (Centers for Disease Control and Prevention), 13, 64  
Cell phones, 101  
Centers for Disease Control and Prevention (CDC), 13, 64  
Chemical hygiene officer (CHO), 6–7, 10–12, 52, 84  
    compliance inspections by, 11  
    definition of, 10  
    legal requirement for, 10  
    recordkeeping by, 11  
    registering ventilation concerns with, 22  
    role in medical consultations, 11–12  
    role in personal protection, 11  
    safety audits by, 12  
    specific responsibilities of, 11–12  
    training provided by, 11  
    who is responsible for chemical hygiene in  
        middle schools, 10–11  
Chemical hygiene plan (CHP), 6–9, 10, 11, 30, 52, 157  
Chemical indicators, 136  
*Chemical Management Resource Guide for School Administrators*, 13  
Chemical sensitivity, 91–92  
    awareness, assessment, and actions for, 92  
    sources of hazardous chemicals, 91–92  
    symptoms of, 92  
Chemicals. *See also specific chemicals*  
    in art studio, 91, 138  
    cleaning products, 75  
    common sense and, 84–85  
    disposal of, 14, 172  
    donated, 61, 62  
    employee information and training to work with, 7, 8  
    flame-test demonstrations with, 80–81  
    food-based lab activities, 94–95  
    Globally Harmonized System of Classification and Labeling of Chemicals, xii  
    labeling of, 16, 17, 78, 79  
    Laboratory Standard for exposure to, xi, xii, xiii, 6–9, 10  
    medical assistance for exposure to, 7  
    metals, 86–88  
    MSDS/SDS for, 14, 15, 16, 28, 30, 59, 66, 78, 81, 84, 87, 89, 90, 100, 106, 129–130, 134, 136, 142, 160  
    ordering of, 78  
    outdoor exposures to, 72  
    packaging and shipping of, 78–79  
    questions related to, 136–137  
    receiving in school, 78–79  
    removal from laboratory, 170  
    returning unordered supplies of, 79  
    safe handling of, 31  
    sources of hazardous chemicals, 91–92  
    specific safety precautions involving, 171–172  
    storage areas for, 22, 25, 28, 136–137  
    suppliers of, 78–79  
    tasting of, 84, 95  
    transporting of, 31  
    use of activity kits, 89–90  
CHO. *See* Chemical hygiene officer  
CHP (chemical hygiene plan), 6–9, 10, 11, 30, 52, 157  
Chromium, 86  
Circuit breakers, 25, 60  
Citric acid, 77  
Class size guidelines, 34, 39, 155, 156–157, 160–161, 166

- Classroom activity kits, 89–90
- Cleaning
- of food containers, 135
  - of glassware, 75, 131, 172
  - of goggles, 13, 33, 48, 50, 172
  - of metal equipment/surfaces, 82, 83
  - products for, 75–77, 91
  - of rust, 83
- Clothing
- for geological fieldwork, 96–97
  - in the lab, 31, 46, 57–58, 59, 170–171
  - for Sun protection, 112
- Code for Geological Fieldwork*, 96–97
- Color-coded safety signs, 27
- Composting, 124–125
- Computer software, 166
- for donated computers, 61
  - maintenance of, 166
  - use at home, 132
- Computers, 166
- donated laptops, 61, 62
  - wireless computer networks, 101–102
- Conduct standards for students, 31, 46, 170
- Connecticut Department of Energy and Environmental Protection (CTDEEP), 118
- Connecticut State Department of Education, 13
- Consumer Product Safety Commission, 134
- Contact lenses, 58, 94, 170
- Cooking in lab, 39
- Copper, 86
- Copper sulfate, 84
- Copper(II) sulfate pentahydrate, 136
- Cornell Waste Management Institute, 124
- Corrosion
- of aluminum, 83
  - of batteries, 103
  - of lab equipment, 82–83
  - rust, 82–83
- Cosmetics in the lab, 58, 94, 105, 106, 170
- Council of State Science Supervisors, 13
- CTDEEP (Connecticut Department of Energy and Environmental Protection), 118
- Cyclamates, 105
- D**
- Danger signage, 27
- Dehumidifier for storage areas, 82–83
- Dishwashers, 135
- Disinfectants, 76, 77, 91
- Dissection
- eye protection for, 142
  - Responsible Use of Live Animals and Dissection in the Science Classroom, 116, 117, 118, 145–147
- Diverse student population, xii
- Documentation
- parent/student safety acknowledgment form, 131–132, 173
  - of safety actions, 44
- Donated supplies, 61–63
- guidelines for acceptance of, 61–62
  - inspection of, 62–63
- Doorway width, 5
- Dress
- for geological fieldwork, 96–97
  - in the lab, 31, 46, 57–58, 59, 170–171
  - for Sun protection, 112
- “Duty of care,” xvi, 15, 23, 30, 35, 37, 38, 40, 41–44, 89, 123, 131, 135, 154, 155
- E**
- Earth and space science
- geological fieldwork, 96–98
  - hazards related to, 133
  - questions related to, 138
  - use of modeling clay, 99–100
- Earth Systems Science (ESS), xi
- Eastern Federation of Mineralogical and Lapidary Societies, 97
- Eating and drinking in the lab, 27, 31, 39, 94–95, 131, 161, 170
- Electrical fires, 69
- Electrical power and equipment, 3, 25, 27, 43, 60, 62, 63, 66–67, 70, 133, 138, 166, 171
- Emergency Eye Wash and Shower Equipment standard, 132
- Emergency procedures, 31
- Emergency Response Guidebook*, 14
- Emergency telephone numbers, 27–28
- Environmental Protection Agency (EPA), 13, 76, 77, 107, 110, 119, 141, 142, 160
- ESS (Earth Systems Science), xi
- Evolution of science education, xi–xii
- Exit signs, 27, 28
- Eye damage
- from black light, 105, 106
  - protection against (See Goggles/safety glasses)
  - from the Sun, 111
- Eyewash stations, 31, 33, 134, 166
- equipment standard for, 133
  - location and access to, 133, 136
  - for mobility-impaired students, 3, 4
  - in modular labs, 51
  - requirement for, 7, 40, 48, 50, 52, 89, 132–133, 160
  - signage for, 27, 28
- EZ Facts*, 14

# INDEX

## F

- FDA (Food and Drug Administration), 64, 76, 89, 129, 147
- Federal Communications Commission, 102
- Federation of State Public Interest Research Groups (PIRG), 100
- Fermi Science Support Center, 14
- Fertilizers, 108, 114, 115
- Fieldwork, 72–74
  - geological, 96–98
  - parent consent for, 73, 97
  - Sun safety for, 110–112
- Filters for ventilation system, 22
- Fire blankets, 129
- Fire drills, 171
- Fire extinguishers, 68–69
  - classification based on types of fire sources, 69, 86
  - location and access to, 27, 28, 31, 171
  - requirement for, 48, 50, 134, 160, 166
  - when to use, 68, 69, 133
- Fire marshal, 40, 49, 53
- Fisher Scientific, 14
- Flame tests, 80–81
- Flammable materials, 8
  - fire extinguishers for, 28, 69
  - metals, 86
  - storage of, 22, 28
- Flashlights, 71, 103
- Flinn Scientific, 14, 140
- Floor markings, 28
- Food
  - cleaning containers for, 135
  - composting of, 125
  - eating and drinking in the lab, 27, 31, 39, 94–95, 131, 161, 170
  - lab activities using, 94–95
  - pests and, 108
- Food and Drug Administration (FDA), 64, 76, 89, 129, 147
- Footwear, 31, 46, 58, 59, 70, 71, 73, 96, 97, 98, 170, 171
- Formaldehyde, 91, 140, 142
- FOSS, 119
- Fume hoods, 21
  - controls for, 4
  - efficient operation of, 31
  - face velocity for, 21
  - flame tests under, 81
  - for mobility-impaired students, 4
  - OSHA requirements for, 7
- Funding, 6, 39, 48, 62, 107, 152, 164
- Fungi, 64, 76, 92, 114, 124
- Fungicides, 72

## G

- Gas cylinders, labeling of, 28
- Geological fieldwork, 96–98
  - Code for Geological Fieldwork*, 96–97
  - safety notes for, 97
  - use of hammer for, 96, 97–98
- Geologists' Association, 96
- Gerbils, care of, 116
- Germicides, 76
- GFCI (ground fault circuit interrupter), 67, 138
- Glassware, 5, 94
  - broken or damaged, 31, 62–63, 73, 135, 136, 172
  - brought from home, 135
  - cleaning of, 75, 131, 172
  - donated, 62–63
  - hot, 46, 59, 60, 171
  - slides, 141
  - tubing, 171
- Globally Harmonized System of Classification and Labeling of Chemicals (GHS), xii, 16–17
- Gloves, 31, 33, 41, 49, 50, 542, 58, 59, 60, 67, 73, 85, 97, 98, 125, 129, 131, 136, 147, 171
- Glue guns, 66–67
  - student guidelines for use of, 67
  - teacher safety preparation for use of, 66–67
- Goggles/safety glasses, 7, 31, 33, 41, 125, 131, 172
  - for black light exposure, 106
  - chemical splash, 7, 33, 41, 46, 59, 67, 80, 81, 85, 89, 98, 130, 131, 135, 136, 142, 147, 170
  - cleaning and sanitizing of, 13, 33, 48, 50, 172
  - for dissection, 142
  - latex in, 130
  - for outdoor activities, 73, 96, 97–98, 139
  - requirement for, 39, 41–42, 46, 52, 58, 59, 134, 160, 170
  - signage for, 28
  - student-purchased, 134–135
  - teacher responsibility for student use of, 67, 80, 81, 84, 87, 89, 142
- Green cleaning products, 75
- Green Purchasing Institute, 76
- Green Schools Initiative, 76
- Ground fault circuit interrupter (GFCI), 67, 138

## H

- Hairstyles in the lab, 46, 58, 59, 170
- Hammers for geological fieldwork, 96, 97–98
- Hand sanitizers, 64–65, 132
- Hand washing, 7, 58, 64–65, 73, 77, 87, 115, 171, 172
  - alternatives to paper towels for, 130
  - with soap *vs.* alcohol-based sanitizers, 132

- Hazard Communication Standard (HCS), xii, 6, 14, 16, 41, 134
- Hazardous Materials Regulations (HMR), 78  
reporting violations of, 79
- HCS (Hazard Communication Standard), xii, 6, 14, 16, 41, 134
- Health & Safety Guidance for Composting in the School Setting*, 124
- Health and Safety Act of 1970, 30
- Heat sources, 59–60, 137
- Herbicides, 72, 92, 125
- Heuser v. Community Ins. Corp. in Resources*, 37
- HMR (Hazardous Materials Regulations), 78, 79  
reporting violations of, 79
- Hot plates, 51, 59, 63, 83, 137
- Housekeeping practices, 11, 24–25, 31, 33, 71, 130  
for laboratory work areas, 8, 47, 95, 130, 132, 172  
for storage areas, 24–25, 130
- Howard Hughes Medical Institute, 14
- Hydrochloric acid, 136
- Hydrogen gas, 86, 103
- Hydrogen peroxide, 77
- I**
- IARC (International Agency for Research on Cancer), 142
- ICC (International Code Council), 36, 156
- IDEA (Individuals With Disabilities Education Act), 49, 51, 122
- Immunity statutes and negligence, 37–38
- Individuals With Disabilities Education Act (IDEA), 49, 51, 122
- Inhalation hazards, 171  
copper, 86  
from flame tests, 81  
glue gun vapors, 67  
modeling clay, 99–100  
nickel, 87
- Injuries  
from batteries, 103  
burns (See Burn injuries)  
due to negligence, 37  
due to slips, trips, and falls, 70–71  
experience and, 30  
to eyes, 57, 106, 132  
prevention of, 4, 25, 37–38, 43  
reporting of, 170  
from sharp objects/instruments, 4, 5, 31, 37, 43, 73, 86, 87, 98, 133, 141, 147  
signage to warn about, 27  
teachers' liability for, xii, 14, 35–36, 40, 41–45, 72, 154–158
- Inquiring Safely: A Guide for Middle School Teachers*, 57, 75, 94–95, 114
- Insecticides, 92, 135
- Insects, 25, 72, 73, 97, 107, 122
- Integrated Pest Management (IPM), 107–109
- Interactive Chemical Compatibility*, 13
- International Agency for Research on Cancer (IARC), 142
- International Code Council (ICC), 36, 156
- International Safety Equipment Association (ISEA), 133
- Internet resources, 168
- Introductory Physical Science (IPS), xi
- Iodine, 136, 141
- IPM (Integrated Pest Management), 107–109
- IPS (Introductory Physical Science), xi
- Iron, 82, 83, 86, 87
- ISEA (International Safety Equipment Association), 133
- Isocyanates, 91
- J**
- Jewelry, 46, 58, 170
- Journal of Environmental Health*, 64
- K**
- Kauffman Foundation, 33, 34
- kids4research.org, 117
- Kits for science activities, 89–90
- L**
- Lab Safety Supply, 14
- Labeling. *See also* Signage  
of gas cylinders, 28  
of hazardous materials, 16, 17, 28, 78, 79  
of reagent bottles, 171  
of storage areas, 25
- Laboratory  
additional policies and regulations for, 8–9  
in assessment process, 153  
class size guidelines for, 34, 39, 155, 156–157, 160–161, 166  
cleaning of, 75–77  
clothing in, 31, 46, 57–58, 59  
corrosion of equipment in, 82–83  
danger of lab activities in a regular classroom, 133–134  
definition of, 52  
donated supplies for, 61–63  
funding for, 152  
hazards in, 133  
The Integral Role of Laboratory Investigations in Science Instruction, 39, 149–153  
Liability of Science Educators for Laboratory Safety, 35–36, 154–158

## INDEX

- occupancy load for, xiii, 8, 14, 39, 49, 50, 51, 53, 68, 152, 155, 156, 160
  - OSHA Laboratory Standard, xi, xii, xiii, 6–9, 10
  - posting signage in, 27–28
  - rules and regulations for students in, 169–173
  - safety in work areas of, 8, 47, 95, 130, 132, 172
  - security of, 8
  - space requirements for, 33, 40, 50, 53, 152
  - standard operating procedures for, 7, 8
  - standards for maintaining safer environment in, 172
  - teacher support for, 151–152
  - temporary, 50–51
  - ventilation of, 21–23
  - Laboratory design and construction, xii, 48–49
    - adjustments for mobility-impaired students, 3–5
    - building and renovations phase of, 49
    - educational specifications for, 48
    - final inspection and occupancy phase of, 49
    - planning phase of, 48–49
    - safety in temporary lab during, 50–51
    - significance of laboratory designation, 52–53
  - Laboratory Safety Institute, 14
  - Laboratory sinks, 33, 172
    - for mobility-impaired students, 4
    - sewer gas from, 130–131
  - Laboratory Standard, xi, xii, xiii, 6–9, 10, 14, 21, 22, 52
    - components of, 6–7
      - chemical hygiene officer, 6–7, 10–12
      - chemical hygiene plan, 6–9, 10, 11, 30, 52, 157
      - employee information and training, 7, 8
    - itinerary of, 7–8
    - purpose of, 10
  - Laboratory workstations, 24, 130
    - for mobility-impaired students, 3–4
  - Laptop computers
    - donated, 61, 62
    - with Wi-Fi connections, 101–102
  - Latex allergy, 125, 130
  - Lead exposure, 75, 87, 91, 114, 115
    - lead paint magnets, 134
  - Learning Conditions for High School Science, 166–167
  - Legal issues, xii, xiii
    - immunity statutes, 37–38
    - laboratory designation, 52–53
    - legislative protections for students with disabilities, 3
    - negligence, 37–38, 43–44, 73, 80
  - OSHA Laboratory Standard, xi, xii, xiii, 6–9, 10
    - regarding sharing of medical information, 122
    - related to regulated substances, 11
    - safety and liability, xii, 14, 35–36, 40, 41–45, 72, 154–158
    - school policy for field trips, 72
  - Legislation
    - Americans With Disabilities Act, xii, 3, 4, 5, 49, 51, 122
    - Health and Safety Act of 1970, 30
    - Individuals With Disabilities Education Act, 49, 51, 122
    - No Child Left Behind Act, xi, 6
    - Occupational Exposure to Hazardous Chemicals in Laboratories, xi, xii, xiii, 6–9 (*See also* Laboratory Standard)
  - Liability, xii, 14, 35–36, 40, 41–45, 72, 154–158
  - Liability insurance, 37, 155, 157, 158, 160
  - Liability of Science Educators for Laboratory Safety, 35–36, 154–158
  - Lighting, 71, 147
  - Lithium, 86
  - Lugol's iodine solution, 136
- ## M
- Magnesium, 86
  - Magnets, lead paint on, 134
  - Maintenance
    - budget for, 152
    - cleaning products for, 75, 91
    - of donated supplies, 61
    - of metal equipment, 83
    - preventive, 7, 61
    - regularly scheduled, 33, 83
    - of technology, 166
  - Maryland State Department of Education, 14, 106
  - Massachusetts Institute of Technology, 14
  - Material Safety Data Sheets (MSDS), 14, 15, 16, 28, 30, 59, 66, 78, 81, 84, 87, 89, 90, 100, 106, 129–130, 136, 142, 160
    - electronic access to, 134
    - maintaining notebook of, 134
  - Medical consultation, 7, 11–12
  - Medical issues, 73, 97, 115, 121–122, 125, 141
  - Melanoma, 110–112
  - Mentoring, 163, 166
  - Metal equipment/surfaces, 82–83
    - cleaning of, 82
    - combating corrosion of, 82–83
    - protective coatings on, 82, 83
    - reducing rust on, 82–83
  - Metals for learning, 86–88. *See also* specific metals



- Methane gas, 131
- Microscopes  
   donated, 63  
   extended eyepieces for, 5
- Microwaves, 39, 60, 62, 99, 101
- Middle School Science Safety: Prudent Practices and Regulations*, 13
- Mobility-impaired students, 3–5  
   additional access items for, 5  
   fume hoods for, 4  
   laboratory sinks for, 4  
   laboratory workstations for, 3–4  
   legal protections for, 3  
   safety eyewashes and showers for, 4
- Modeling clay, 99–100
- Modular labs, 51
- Molds, 25, 75, 92, 95, 100, 122, 130, 133
- Mosquitoes, 72, 73
- MSDS. *See* Material Safety Data Sheets
- N**
- National Association of Rocketry’s Model Rocket Safety Code, 139
- National Center for Chronic Disease Prevention and Health Promotion, 112
- National Fire Protection Association (NFPA), 22, 36, 50, 52, 68, 137, 156
- National Institute for Occupational Safety and Health (NIOSH), 30, 31, 142
- National Institutes of Health, 14
- National Oceanic and Atmospheric Administration, 14
- National Research Council (NRC), 10, 14, 94
- National Science Education Leadership Association, 14
- National Science Education Standards (NSES), xi, 6, 145
- National Science Foundation (NSF), xi
- National Science Teachers Association (NSTA), xi, xii–xiii  
   class size guidelines, 34, 39, 155, 156–157, 160–161, 166  
   *Inquiring Safely: A Guide for Middle School Teachers*, 57, 75, 94–95, 114  
   The Integral Role of Laboratory Investigations in Science Instruction, 39, 149–153  
   journal columns on safety, xii–xiii, xvi, 6  
   Learning Conditions for High School Science, 166–167  
   Liability of Science Educators for Laboratory Safety, 35–36, 154–158  
   Responsible Use of Live Animals and Dissection in the Science Classroom, 116, 117, 118, 145–147
- Safety and School Science Instruction, 160–161, 162  
   safety audit based on guidelines of, 33–34  
   *Safety in the Science Classroom*, 13–15, 46–47, 70, 94, 168  
   safety publications of, 14, 41  
   Science Education for Middle Level Students, 162–164  
   Science Safety Advisory Board, 13, 46  
   Scope, Sequence, and Coordination Program, xi, 81
- Negligence, 37–38, 43–44, 73, 80  
   liability insurance for, 37, 155, 157, 158, 160  
   statute of limitations for, 73
- New York State Department of Education, 14
- Next Generation Science Standards (NGSS), xi
- NFPA (National Fire Protection Association), 22, 36, 50, 52, 68, 137, 156
- NGSS (Next Generation Science Standards), xi
- Nickel, 87
- NIOSH (National Institute for Occupational Safety and Health), 30, 31, 142
- Nitric acid, storage of, 137
- No Child Left Behind Act, xi, 6
- NRC (National Research Council), 10, 14, 94
- NSES (National Science Education Standards), xi, 6, 145, 162
- NSF (National Science Foundation), xi
- NSTA. *See* National Science Teachers Association
- O**
- Occupancy load for lab, xiii, 8, 14, 39, 49, 50, 51, 53, 68, 152, 155, 156, 160
- Occupational Exposure to Hazardous Chemicals in Laboratories, xi, xii, xiii, 6–9.  
   *See also* Laboratory Standard
- Occupational Safety and Health Administration (OSHA), xi–xii, 4, 36, 39, 40, 50, 156, 160  
   adoption of the Globally Harmonized System of Classification and Labeling of Chemicals, xii, 16–17  
   blood-borne pathogen standard, 36  
   Hazard Communication Standard, xii, 6, 14, 16, 41, 134  
   Health and Safety Act of 1970, 30  
   Laboratory Standard, xi, xii, xiii, 6–9, 10, 14, 52, 157 (*See also* Laboratory Standard)  
   position on eating in the workplace, 131  
   requirement for eyewash stations, 132  
   Right to Know Standard, 6, 157  
   Safety & Health Management Systems eTool, 168  
   safety signage recommendations, 27  
   Sanitation Standard, 95

## INDEX

- standards for fire prevention and fire extinguishers, 68
  - standards related to slips, trips, and falls, 70
  - standards related to storage and housekeeping, 24–25, 130, 137
  - Training Requirements and Guidelines for K–14 School Personnel, 13
  - on use of fire extinguisher, 133
  - OSHA. *See* Occupational Safety and Health Administration
  - Ozone layer, 110
- P**
- Paper towels, alternatives to, 130
  - Parents
    - communicating information about pest management with, 108
    - consent for field trips, 73, 97
    - informing about composting activities, 125
    - providing written safety regulations to, 161, 173
    - refusal to sign safety acknowledgment form, 131–132
    - responsibility to notify school about students' allergies, 121
  - Personal exposure level (PEL), 8
  - Personal protective equipment (PPE), xiii, 7, 8, 11, 30, 31, 33, 46, 48, 50, 52, 59, 72, 80, 106, 136, 142, 147, 154, 157, 160
    - student-purchased, 134–135
  - Pesticides, 72, 92, 107–109, 114, 115, 146
  - Pests in the classroom, 107–109
  - Petroleum naphtha, 91
  - Photochemical effects of ultraviolet radiation, 105, 106
  - Phthalates, 100
  - Physical science
    - batteries, 103–104
    - black lights, 105–106, 140
    - hazards related to, 133
    - questions related to, 139
    - wireless computer networks, 101–102
  - Pin safety, 141
  - PIRG (Federation of State Public Interest Research Groups), 100
  - Plants, 171
    - composting of, 125
    - encountered during geological fieldwork, 97
    - introducing non-native invasive species into local environment, 118–119
    - ordering specimens of, 119
  - Poison control centers, 13, 129
  - Poison exposures
    - batteries, 104
    - chemicals, 91
    - lead, 87
    - plants, 72, 73, 97
  - Policies for safety, 8, 10, 15, 26, 33, 36, 57, 61, 68, 69, 72, 112, 116, 118, 119, 129, 133, 135, 145, 155–158
  - Polymer clay, 99, 100
  - Polyvinyl chloride (PVC), 99, 100
  - Potassium, 86, 89
  - Professional development, 30, 35, 36, 151, 153, 154, 155, 164, 167. *See also* Training for safety
  - Professional judgment, 40, 41–42, 44
  - Project 2061, xi, 3
  - Prudent Practices in the Laboratory*, 14, 94
  - PVC (polyvinyl chloride), 99, 100
- R**
- Reagent bottles, 46, 171–172
  - Reagent solutions, 84, 136
  - Refrigerators, 25, 27–28, 39, 94, 135
  - Rehab the Lab*, 14, 168
  - Reporting
    - of injuries, 170
    - of violations of Hazardous Materials Regulations, 79
  - Research and Special Programs Administration (RSPA), 79
  - Right to Know Standard, 6, 157
  - Rock falls, 96
  - Rocket safety, 139
  - Rocks
    - climbing on, 96
    - hammering of, 96, 97–98
  - RSPA (Research and Special Programs Administration), 79
  - Rules and regulations for science laboratory, 169–173
  - Rust, 82–83, 86
- S**
- “Safer Science” column in *The Science Teacher*, xii–xiii, xvi, 6
  - Safety and School Science Instruction, 160–161, 162
  - Safety audit, 12, 33–34, 35, 157
  - Safety checklist for students, 31
  - Safety Data Sheets (SDS), 15, 16–17, 28, 59, 66, 81, 87, 90, 100, 106, 129–130, 136, 142
    - electronic access to, 134
    - maintaining notebook of, 134
  - Safety glasses. *See* Goggles/safety glasses
  - Safety in Academic Chemistry Labs*, 13
  - Safety in High School and College Laboratories*, 14
  - Safety in Science Teaching*, 14
  - Safety in the Science Classroom*, 13–15, 46–47, 94, 168

- Safety incidents, 30
- Safety planning, 41–42
- Safety policies, 8, 10, 15, 26, 33, 36, 57, 61, 68, 69, 72, 112, 116, 118, 119, 129, 133, 135, 145, 155–158
- Safety resources, 13–15, 168
- Sanitizers, 76, 77
- SAPA (Science A Process Approach), xi
- School Chemistry Laboratory Safety Guide*, 13, 30–32
- School Improvement in Maryland, 37–38, 44
- School nurse, 65, 66, 73, 121, 122, 125, 129, 130
- School policy, for field trips, 72
- Science, technology, engineering, and mathematics (STEM) education, xi
- Science A Process Approach (SAPA), xi
- Science and Safety: Making the Connection—A Secondary Safety Guide*, 13
- Science and Safety Consulting Services, 14
- Science Curriculum Improvement Study (SCIS), xi
- Science department chairperson, responsibility for chemical hygiene, 10
- Science education, evolution of, xi–xii
- Science Education for Middle Level Students, 162–164
- Science for All Americans*, 3
- Science Safety Handbook for California Public Schools*, 13
- Science Scope*, xii, xiii, xvi, 141
- Science teachers
- documenting safety actions of, 44
  - “duty of care,” xvi, 15, 23, 30, 35, 37, 38, 40, 41–44, 89, 123, 131, 135, 154, 155
  - liability of, xii, 14, 35–36, 40, 41–45, 72, 154–158
  - negligence of, 37–38, 43–44, 73, 80
  - new generation of, xii, 6
  - preparation for field trips, 72–74
  - professional development of, 30, 35, 36, 151, 153, 154, 155, 164, 167
  - professional judgment of, 40, 41–42, 44
  - questions from, 129–142
  - responsibility for chemical hygiene, 11
  - responsibility related to students’ allergies, 122–123
  - safety resources list for, 13–15
  - safety training for, 157, 160
  - support for, 151–152
- SCIS (Science Curriculum Improvement Study), xi
- Scope, Sequence, and Coordination (SSC) Program, xi, 81
- “Scope on Safety” column in *Science Scope*, xii, xiii, xvi
- SDS. See Safety Data Sheets
- Security, 8, 24
- Sewer gas, 130–131
- Sharp objects/instruments, 4, 5, 31, 37, 43, 73, 86, 87, 98, 133, 141, 147
- Shelving, anchoring to wall, 132
- Shoes, 31, 46, 58, 59, 70, 71, 73, 96, 97, 98, 170, 171
- Showers
- equipment standard for, 133
  - location and access to, 27, 31, 133, 171
  - for mobility-impaired students, 3, 4
  - requirement for, 33, 48, 52, 132, 134, 166
  - in temporary labs, 50, 51
  - testing of, 7
  - use for burn injuries, 59
- Signage, 27–29
- for chemical storage areas, 28
  - color-coded, 27
  - posting in middle school labs, 27–28
- Silica, 91, 99
- Silica gel desiccants, 83
- Sinks. See Laboratory sinks
- Skin cancer, 110–112
- Slips, trips, and falls (STFs), 70–71
- safer work practices for reduction of, 70–71
  - sources of, 70
- Smart paper, 136
- Sodium, 86
- Sodium chloride, 41
- Soils, 114–115, 141–142
- SOPs (standard operating procedures) for laboratories, 7, 8
- Space requirements for laboratory, 33, 40, 50, 53, 152
- Special education instruction, 39–40, 167
- Special needs students, xii
- ADA and, xii, 3, 4, 5, 49, 51, 122
  - laboratory policies related to, 8–9
  - with mobility impairments, 3–5
- Spill control station, 28
- Squamous cell carcinoma, 111
- SSC (Scope, Sequence, and Coordination) Program, xi, 81
- Standard operating procedures (SOPs) for laboratories, 7, 8
- State Science Frameworks, xi
- STEM (science, technology, engineering, and mathematics) education, xi
- Sterilizers, 75–76
- Stewart, William, 101
- STFs. See Slips, trips, and falls

# INDEX

- Storage spaces, 24–26, 152  
adequate amount of, 24  
for chemicals, 22, 25, 28, 136–137  
for flammable and combustible liquids,  
22, 25, 28  
OSHA housekeeping and storage  
standards, 24–25, 130  
problems discovered in audit of, 33–34  
restricted access to, 170  
safety hints for, 25  
use for classroom space, 39–40  
use of dehumidifier in, 82–83  
ventilation of, 22
- Stream tables, 138
- Students  
activity kits brought to school by, 89–90  
behavioral expectations for, 46, 57, 70, 72  
building attitudes about safety, 30–31  
clothing of, 31, 46, 57–58, 59, 170–171  
diversity of, xii  
injury of (*See* Injuries)  
with mobility impairments, 3–5  
safety checklist for, 31  
science laboratory rules and regulations  
for, 169–173  
with special needs, xii  
standards of conduct for, 31, 46, 170
- Sun safety, 110–112  
children and UV exposure, 111  
skin cancer and, 110–112  
tools for schools, 112
- Sunscreens, 73, 111, 112
- SunWise program, 110
- T**
- Tasting of lab materials, 84, 95
- Telephone numbers for emergencies, 27–28
- Temporary science classroom, 50–51
- Tetracycline, 105
- Textbooks, xi, 167
- The Hartford, 14
- The Integral Role of Laboratory Investigations  
in Science Instruction, 39, 149–153
- The Science Teacher*, xii–xiii, xvi, 6
- Thermal paper, 136
- Threshold limit value (TLV), 8
- Thyme oil, 77
- Ticks, 72, 73
- Tin, 87
- Tips for Sustainable Solvent Practice, Generic  
Solvents Alternative Guide*, 14
- TLV (threshold limit value), 8
- Toluene, 91
- Toxins, 8, 91, 92, 95
- Training for safety, 42, 157, 160. *See also*  
Professional development  
documentation of, 44  
for fires, 69  
in Hazard Communication Standard, 16  
for lab custodians, 52  
OSHA Training Requirements and  
Guidelines for K–14 School Personnel,  
13  
provided by chemical hygiene officer, 11  
requirements of Laboratory Standard for,  
7, 8
- Transporting chemicals, 31
- Trip-and-fall hazards, 5, 25, 58, 66, 70–71, 73,  
130
- Turpentine, 91
- U**
- UFAS (Uniform Federal Accessibility  
Standards), 3
- Ultraviolet (UV) radiation exposure  
from black lights, 105–106, 140  
from the Sun, 110–112
- Uniform Federal Accessibility Standards  
(UFAS), 3
- United Nations, 16  
Convention on the Rights of the Child,  
111
- United Scientific, 134
- University of New Hampshire Biological and  
Chemical Safety Plan*, 14
- U.S. Department of Agriculture (USDA), 107
- U.S. Department of Transportation, 14, 78, 79
- V**
- Ventilation, 21–23
- Vermiculite, 114, 115, 141
- Virginia State Department of Education, 14
- Viruses, 65, 76, 77, 114
- Volatile organic compounds (VOCs), 75, 91, 92
- W**
- Warning of safety hazards, 27, 43–44
- Waste disposal, 28, 30, 84, 142, 152, 160, 172  
batteries, 139  
chemicals, 14, 172
- Wheelchair access. *See* Mobility-impaired  
students
- Wi-Fi Alliance, 102
- Wireless computer networks (Wi-Fi), 101–102
- Workstations. *See* Laboratory workstations
- Z**
- Zinc, 83, 86, 87, 103

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## VOL. 2

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