

Introduction to School Science Safety

Student Burned After Chemistry Lab Experiment Explodes

Perth Amboy, NJ, May 24, 2017

17 People Were Injured When a Classroom Science Experiment Caused a Flash Fire

Hendersonville, TN, May 9, 2018

Science Mishap Sends Bronx Students to the Hospital

Bronx, NY November 27, 2017

5 Students, Teachers Injured in School Science Lab Fire

Fairfax, VA, October 30, 2015

A Student Burned His Eye in a University of Utah Lab

Salt Lake City, UT, July 2017

See *Chemical Management chapter, "Accidents in Schools,"* pgs 190-191.

Overview

—Thoughts of “Guns, Knives and Intruders” flash through school administrators’ minds when thinking about their school’s safety and security. An often forgotten part of school safety and security is laboratory safety, which includes namely science, technology education & engineering and STEM laboratories. Students, as well as administrators and teachers, drop things, slip, bump into equipment and make errors in judgment. It is a fact of life. Laboratory investigations and demonstrations sometimes simply go awry despite one’s best efforts. However, just because laboratory accidents happen does not mean that laboratory injury is either inevitable or unavoidable. An accident is considered unavoidable or inevitable by law (<https://law.justia.com/cases/california/supreme-court/2d/37/116.html#:~:text=%5B1%5D%20The%20terms%20inevitable%20or,force%2C%20or%20an%20irresistible%20force>). An accident cannot be foreseen or prevented by exercise of reasonable precautions. Most of the so-called lab “accidents” are “incidents” in our schools. “Accident” and “incident” will be used interchangeably in this manual even though “incident”, a distinct event or occurrence as per FindLaw Legal Dictionary, is the more correct term. When your school implements the proper training and the correct protocols and follows them with fidelity, the laboratory

experience can be both safer and more rewarding for all involved. Please note that you can only make the laboratory environment safer—you cannot make it totally safe! Accidents can still happen. Our job is to minimize the number and the severity of these accidents. If you actively follow established lab safety protocols, chances of an accident are dramatically and significantly reduced.

The purpose of the science program is to introduce and to instruct the student in the processes of science inquiry and investigation. This is known as the “doing of science.” Nationally, the emphasis on the “doing of science” has increased with the adoption of the Next Generation Science Standards, which were released in 2013, by 20 states and the District of Columbia. Laboratories and classrooms are the focal points of science instruction, which often involves potential hazards and requires following established, standard operating procedures (SOPs) to ensure the increased safety of students and teachers alike. For that reason, it is necessary that safety be an integral part of the planning, preparation and implementation of any science program on the district, building and departmental level. Moral, ethical, social, professional and legal concerns demand that you ensure that your school science laboratories are as safe as possible. It is simply not acceptable to take any unnecessary risks with the health and well-being of students and staff.

The National Science Education Standards (NSES) were released in 1995. Science inquiry is both a program and teaching standard and embedded throughout the Standards. Following the NSES, the Framework for K-12 Science Education was released on July 19, 2011. The Framework was based on the most current research on science and science learning and identified the science all K–12 students should know. In April 2013, the Next Generation Science Standards or NGSS were released. The NGSS were based on the Frameworks were developed in part to better prepare students for college and careers. Teaching science by inquiry encourages students to participate more in their own learning. It is mandatory that safety be an integral part of the experimental process in science inquiry. The NSES and NGSS underlie state standards. Science inquiry and safety are integral components of state standards. State education statutes/codes as well as State Boards of Education include science inquiry and safety as exemplified in the following goals of the North Carolina State Board of Education.

STATE SCHOOL BOARD OF EDUCATION GOALS
“Science Safety” is clearly connected to many state school boards of education goals:

High Student Performance:

- Prepare each student to master essential knowledge and skills.
- Develop a rigorous and relevant curriculum and instruction system that includes:
 - Academic standards
 - Instructional programs
 - Assessment systems
- Prepare each student for continuous learning and career readiness.

Safer and Orderly Schools:

- Create educational facilities that are adequate, safer and support high student performance.
- Create wholesome learning environments that support achieving high standards by all students.
- Establish discipline needed for the mutual respect of students, teachers and peers.

Quality Teachers, Administrators and Staff:

- Align professional preparation and professional development to support strategic priorities of teaching.
- Support a system of continuous learning for professionals to ensure high quality performance.
- Establish high educational, ethical and professional standards for all employees.

Efficient and Effective Operation

Establish control and decision making at a level closest to the learner.

OCCUPATIONAL SAFETY AND HEALTH ACT

When Congress passed the Occupational Safety and Health Act of 1970, it helped clarify and recognize many health and safety concerns. The Occupational Safety and Health Administration (OSHA) requirements were specifically tailored to help ensure the safety of employees, including all teachers—public, charter and private. However, complying with OSHA does not specifically protect the student. Administrators, staff and students are responsible for developing and following safety protocols and regulations in the science laboratory. Therefore, students must be held to the same level of OSHA safety expectations to help protect themselves and their teachers. Each must maintain a concerted effort to avoid the apathetic and laissez-faire attitudes which are a major cause of accidents in the laboratory.

WHO ARE THE STAKEHOLDERS?

- Students
- Teachers
- Principals
- Assistant Principals
- Lead Science Teachers

- School District Superintendent
- University Science Education Professors
- Science Curriculum Specialist
- Superintendent for Curriculum and Instruction
- Superintendent for Facilities
- Maintenance Staff
- Secretaries
- School Board Members
- School Board Attorney
- School Safety Compliance Officers
- Insurance Carriers
- Parents
- Custodial Staff
- School Nurses
- Local Boards of Commissioners
- School Safety Compliance Officer
- Chemical Hygiene Officer
- * University and College Science Education Professors
- * All University and College staff teaching science courses

Beyond the monetary liability faced by institutions for student injuries are the moral and ethical obligations and duty of care owed to the students by educators.



Frequently, it is viewed that “Laboratory Safety” applies only to chemistry classes. Safety in the science laboratory, field work and home schooling applies to ALL science classes in K-16 public, charter and private schools as well as colleges and universities.

Safety Issues in Schools

A short list, certainly not inclusive, includes these issues and deficiencies:

CHEMICAL MANAGEMENT

- No chemical inventories
- Failure to have Safety Data Sheets (SDSs)—written hard copy and/or electronic—for each chemical, including household chemicals
- Centralized chemical storage often lacking
- Chemicals not stored by a compatible storage system
- No Board of Education approved Chemical Hygiene Plan (CHP)
- No Hazard Communication Plan
- No appropriate SOPs for the disposal, cleanup of chemicals and biohazards
- Exposure to harmful chemicals
- No Chemical Hygiene Officer

FACILITIES

- Science teachers teaching in non-science classrooms or non-science teachers teaching in science laboratories
- No lips on chemical and glass storage shelves
- No signage for safety equipment, exits and non-exits
- Engineering controls such as eyewashes and showers absent, not working, not regularly checked, or never flushed
- Incorrectly located fire extinguishers and wool fire blankets (if present)
- Lack of GFI/GFCI protected electrical circuits
- No hot and cold water sources in science laboratories
- No separate ventilation system in most science departments and/or chemical storage areas
- New school buildings not being designed and constructed to meet OSHA 29 CFR §1910.1450 “Occupational Exposure to Hazardous Chemicals in Laboratories”
- Unsecured chemical storage areas
- Poor housekeeping

PERSONAL PROTECTIVE EQUIPMENT (PPE)

- Lack of Hazard Assessment Plan
- Lack of personal protective equipment for teachers and students
- Wrong type of eye protection for a specific laboratory investigation
- Lack of sanitation

PROFESSIONAL DEVELOPMENT

- No continuing professional development on safety for all science teachers and administrators (Check your state and local officials (i.e. Fire Marshall, DOE, OSHA, EPA, etc.) to determine your training requirements)
- Lack of current resources
- Lack of safety training in pre-service preparation

FINANCIAL

- Funds not allocated to support science safety at the school/school district level
- Funds not allocated to support the state science curriculum and National Science Education Standards/ National Science Frameworks

- Wire
- Glassware
- Hammers, saws
- Stream tables with electrical motors
- Other electrical equipment
- Cutting instruments
- Electrical blowers
- Mercury barometers
- Mercury psychrometers
- Field trips
- Radioactive materials (rocks)

Biology

- Animals
- Plants
- Microbes
- DNA
- Dissecting tools
- Biological waste disposal
- Glass
- Hazardous chemicals
- Bloodborne pathogens

Physics

- Electricity
- Hot plates, burners
- Van der Graaf generators
- Light investigation apparatus
- Springs
- Projectiles
- Weights
- Metal balls
- Glassware
- Mercury thermometers (banned in many states that have mercury laws)
- Lasers
- Radiation (ionizing and non-ionizing)

Chemistry

- Hazardous chemicals
- Glassware
- Electrical shock
- Spills
- Heating sources
- Fire
- Explosions
- Fumes, vapors, etc.



COMMON SAFETY HAZARDS

Earth Science/Environmental Science

- Chemicals
- Viewing of sun, light
- Use of heat