

## VII. Laboratory Safety

As defined throughout this manual, when establishing, maintaining and operating a science laboratory the school and science teacher have a responsibility to the school and its students to provide a safe operating environment. Establishing this safe environment is regulated by governmental and association regulations. This section is designed to define these regulations as related to the science laboratory and to assist in establishing a safe and compliant laboratory. Regardless of any regulatory reference made within this section, the information presented by Ward's Science should be considered minimum safety practices and should be followed by all science teachers in the United States and Canada.

### What is a Science Laboratory?

As defined by the Occupational Safety and Health Administration (OSHA) under 29CFR 1910.1450, regulations are imposed in the use of chemicals in a science laboratory when handling or use of such chemicals in which all of the following conditions are met:

- Chemical manipulations are carried out on a "laboratory scale";

*"Laboratory scale" means work with substances in which the containers used for reactions, transfers, and other handling of substances is designed to be easily and safely manipulated by one person. "Laboratory scale" excludes those workplaces whose function is to produce commercial quantities of materials.*

- Multiple chemical procedures or chemicals are used;
- The procedures involved are not part of a production process, nor in any way simulate a production process; and
- "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

*"Protective laboratory practices and equipment" means those laboratory procedures, practices and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective, in minimizing the potential for employee exposure to hazardous chemicals.*

### General Safety Practices in the Laboratory

The following is a quick reference list of important safety practices to be aware of and instill in the laboratory. This list is not all-inclusive. Refer to the various sections of this handbook for specific details.

- Science laboratory and classroom safety starts with awareness.
- Be proactive. Know your chemicals. Read and understand the Safety Data Sheet (SDS) for all chemicals being used.
- Be alert to unsafe conditions and actions.
- Chemicals must be stored in a systematic and a neat manner. Flammables should be stored in the smallest container possible. Store flammable/combustible liquids and acids in appropriate safety cabinets and/or safety cans.
- Equipment and chemicals taken from a preparation room or storage area must be immediately returned after use.
- All storage areas, refrigerators, cabinets, etc., should be appropriately labeled.
- All chemicals must be clearly labeled.
- Use appropriate personal protective equipment (PPE).

- Teaching and storage rooms should remain uncluttered. Ensure that all bench tops and work areas remain clean and that all spills are cleaned up immediately.
- Make sure that sinks are clean and are not blocked with wastes.
- Ensure all water outlets, gas turrets on the benches, power outlets and electrical switches are in good working order.
- Don't eat, drink, or chew gum in the science laboratory and classroom.
- Know where fire extinguishers are located, as well as emergency exits, eye wash/emergency shower stations, fire alarm boxes and other safety equipment.
- When conducting experiments be mindful of your body movements and surroundings to avoid bumping into someone or have someone bumping into you.
- Always inspect equipment before using. Keep equipment in a good working order.
- Have appropriate emergency supplies on hand for spills and personal response.
- Wash hands before leaving the lab.
- Be aware of all sources of ignition, i.e., open flames, heat, electrical equipment.
- Be appropriately trained in chemical use, handling, storage, emergency response, safety and health matters.

## **Laboratory Responsibilities**

In the educational science environment with respect to the use of chemicals, certain responsibilities are inherited and undertaken to sustain safety and compliance. Regulations require certain roles be assigned and policies be established to clearly set how chemicals can be used and how students can safely be educated in the laboratory.

### **The Science Teacher**

This handbook is designed as a useful reference resource for the science teacher to learn from and establish safe procedures and practices in the laboratory. As a science teacher you have the responsibility to:

- Maintain awareness of regulations and health and safety hazards through training programs and consulting reference materials.
- Plan and conduct laboratory exercises using the least toxic alternatives.
- Use good laboratory chemical management practices and teach proper chemical management to students.
- Conduct a monthly inspection of stored chemicals for signs of leakage, improper storage, improper labeling, or any other problems.
- Conduct an annual inventory of laboratory chemicals, and include an inventory each month of all stored wastes.
- Ensure that all materials and wastes are labeled, used and disposed of as required.
- Maintain chemical spill clean-up materials in chemical storage areas.
- Understand and follow all elements of the Laboratory Chemical Hygiene Plan.

### **The Chemical Hygiene Officer**

The school shall designate a Chemical Hygiene Officer who is defined by OSHA as an employee who is designated by the employer (school), and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions to the School's Chemical Hygiene Plan. This definition is not intended to place limitations on the position, description or job classification that the designated individual shall hold within the employer's organizational structure.

The Chemical Hygiene Officer also has the responsibility to:

- Work with school administrators, teachers and faculty to develop an appropriate chemical hygiene plan.
- Monitor the procurement, use and disposal of chemicals used in the laboratory.
- Maintain all appropriate audits for chemical hygiene.
- Assist in the development of adequate precautions and facilities.
- Know the current legal requirements concerning associated regulations.
- Continuously seek ways to improve the chemical hygiene program.

## **The Students**

Before students are presented with chemical experiments and particularly before being allowed any hands-on work, they must be informed of the general safety precautions to be taken in a science laboratory. The students should know all of the safety procedures before entering the laboratory. In order to implant a safe way of thinking in the student, the science teacher should establish specific laboratory rules. These rules should be reviewed and prominently displayed. A few rules of note:

- Students must not enter any laboratory or storeroom unless a teacher is present.
- Students must not taste chemicals.
- Students must behave appropriately. No horseplay is allowed in the laboratory and classroom.
- Appropriate dress is mandatory. Depending on the chemical used, students should be given previous notice in order to plan to dress for lab. Student footwear must completely cover the feet and protect them from spilt corrosive or hot liquids.
- Students should be safely seated and not crowded.
- Students should be provided with appropriate personal protective equipment (PPE) including safety goggles for eye protection and a lab apron to protect clothes.

At the very start of the year, and for special tasks in advance of a particular experiment, the science teacher should teach the necessary skills to the student for the safe use of chemicals and associated equipment. This instruction should be accomplished by demonstration. These skills include the following at a minimum:

- Lighting and use of a Bunsen burner
- Heating of liquids or solids in test tubes
- Heating large volumes of liquids
- Handling glassware containing hot liquids
- Carrying glassware
- Handling of chemical bottles
- Diluting concentrated acids
- Inserting glass tubing in rubber stoppers

## **Chemical Hygiene Plan**

The OSHA Laboratory Standard (*29CFR1910.1450*) regulates operations in a laboratory where hazardous chemicals are used. Under this regulation the school must develop and carry out the provisions of a written Chemical Hygiene Plan (CHP). The CHP must include the necessary work practices, procedures and policies to ensure that teachers, students and faculty are protected from all potentially hazardous chemicals in use in the laboratory and classroom area.

As defined by OSHA, the Chemical Hygiene Plan is a written program developed and implemented by the employee (school) which sets forth procedures, equipment, personal protective equipment and work practices that (i) are capable of protecting employees from the health hazards presented by hazardous chemicals used in

that particular workplace (laboratory / classroom) and (ii) meets the requirements of paragraph (e) (Guidance plan) of this section.

The purpose of the Chemical Hygiene Plan is to provide guidelines for prudent practices and procedures for the laboratory use of chemicals. The Laboratory Standard specifies that the Chemical Hygiene Plan set forth procedures, equipment, personal protective equipment and work practices capable of protecting teachers, students and faculty from the health hazards presented by the hazardous chemicals used in the laboratory and classroom.

The designated Chemical Hygiene Officer and/or the science teacher are usually the one(s) responsible for developing the Chemical Hygiene Plan (CHP) for the school. Since care and supervision of the science room are primarily the responsibilities of the science teacher, the CHP will serve as a guide to safe science instruction. This Ward's Science Teacher's Comprehensive Lab Manual can be used to help science teachers develop a CHP. A model plan is defined below. An editable Ward's Science Chemical Hygiene Plan is also available upon request.

The following information must be included in a science Chemical Hygiene Plan:

**Standard Operating Procedures (SOP)- 1910.1450(e)(3)(i)**

CHP must define prudent laboratory practices to be followed when working with chemicals in a laboratory. These include general and laboratory-specific procedures for work with several categories of chemicals, emergency procedures, and laboratory waste procedures.

**Chemical Exposure Control- 1910.1450(e)(3)(ii)**

CHP must define criteria regarding when chemical exposure monitoring will be conducted to determine whether exposure limits are exceeded. It also outlines what control measures (e.g., engineering controls, personal protective equipment) will be used to assure exposure does not exceed exposure limits.

**Function of Engineering Controls- 1910.1450(e)(3)(iii)**

CHP must describe a program to ensure laboratory fume hoods and other engineering controls function properly.

**Information and Training- 1910.1450(e)(3)(iv)**

CHP must outline general and specific training required and what information must be available and communicated to faculty and students. Records must be kept of attendance at general training, exposure monitoring, medical consultation, and examinations. Such records must be transferred to an individual's physician or made available to the laboratory worker upon request.

**Criteria for Prior Approval of Laboratory Procedures- 1910.1450(e)(3)(v)**

CHP must define written approval procedures that must be obtained from the Chemical Hygiene Officer before beginning work with particularly hazardous substances, including select carcinogens, reproductive toxins, embryotoxins, materials exhibiting a high degree of acute toxicity and materials of unknown toxicity.

**Medical Consultations and Examinations- 1910.1450(e)(3)(vi)**

CHP must define how an individual who has actually or potentially been exposed to a chemical or substance will receive needed treatment

**Chemical Hygiene Officer Designation- 1910.1450(e)(3)(vii)**

CHP must define the Chemical Hygiene Officer and outline his or her role and responsibilities.

### **Particularly Hazardous Substances- 1910.1450(e)(3)(viii)**

CHP must define provisions for additional protection for work with particularly hazardous substances. These include "select carcinogens," reproductive toxins and substances which have a high degree of acute toxicity. Specific consideration shall be given to the following provisions, which shall be included where appropriate:

- Establishment of a designated area;
- Use of containment devices such as fume hoods or glove boxes;
- Procedures for safe removal of contaminated waste; and
- Decontamination procedures.

### **Means of Annual Review of Chemical Hygiene Plan - 1910.1450(e)(4)**

CHP must define how it will be reviewed and evaluated on the effectiveness of the Plan. Review and evaluation must be completed at least annually and updated as necessary.

## **Sample Chemical Hygiene Plan Outline**

The following is a starting point for the possible contents for your Chemical Hygiene Plan. Determine what items are appropriate to you and design a plan that is objectified for your school science laboratory.

- **Introduction**
  - Scope
- **Responsibilities**
  - School
  - Science Teacher
  - Chemical Hygiene Officer
  - Student
- **Chemical Exposure Control**
  - General
  - Procedures
  - Hazardous Chemicals
    - General
    - Irritants
    - Simple Asphyxiants
    - Anesthetics
    - Hepatotoxic Agents
    - Nephrotoxic Agents
    - Neurotoxic Agents
    - Hematopoietic Agents
    - Reproductive Hazards
    - Acutely Toxic Chemicals
    - Extremely Toxic Chemicals
    - Other
  - Labels
    - General
    - Special Labeling Requirements
  - Monitoring
    - Procedures

- **Handling of Chemicals**
- **Chemical Purchases**
  - Approval Process
  - Purchasing
  - Receiving
- **Function of Engineering Controls**
  - Laboratory Fume Hoods
  - Ventilation
  - Other
- **Personal Protective Equipment**
  - General
    - Eye Protection
    - Lab Coats
    - Glove Selection
    - Use of Respirators
    - Other
- **Designated Areas**
  - Laboratory
  - Classroom
  - Chemical Storage
    - General
    - Segregation
    - Chemical Storage Outside the Lab
    - Flammable and Combustible Liquid Storage
    - Chemical Stability
    - Shock Sensitive Chemicals
    - Designated Areas
    - Compressed Gases
- **Room Signs**
- **Safety Data Sheets**
- **Medical Consultation**
- **Chemical Waste Disposal Guidelines**
- **Emergencies Response**
  - Response Materials
  - Fire and Fire Related
  - Chemical Spill
  - Personal Contamination
    - Chemicals Spilled Over a Large Area of the Body
    - Chemicals in the Eyes
    - Ingestion of Hazardous Chemicals
- **Standard Operating Procedures**
  - Acutely Toxic Chemicals
  - Acutely Toxic Gases
  - Carcinogens
  - Compressed Gases
  - Corrosive Liquids
  - Flammable Liquids
  - Oxidizing Chemicals
  - Pyrophoric Chemicals
  - Reactive Liquids

- Reactive Solids
- Reproductive Hazards
- Water Sensitive Chemicals
- Other
- **Training**
  - Chemical Hygiene Officer
  - Science Teacher
  - Student
- **Recordkeeping**
  - Training Records
- **Appendices**
  - Chemical Inventory List

### **Information and Training**

The science teachers and students in the laboratory need to be trained and provided with information to become knowledgeable of the hazards present in their laboratory. This must be completed previous to using chemicals.

Training must include at least the following:

- Methods and observations that may be used to detect the presence or release of a hazardous chemical. This may include monitoring devices, as appropriate, and familiarity with the appearance and odor of the chemicals.
- The physical and health hazards of chemicals in the laboratory.
- The measures that workers can take to protect themselves from these hazards, including protective equipment, appropriate work practices, and emergency procedures

The following information should be available to all persons in the laboratory:

- Full text of the OSHA Laboratory Standard
- Location and availability of the Chemical Hygiene Plan.
- Permissible exposure limits for OSHA Regulated Substances. Refer to chemical Safety Data Sheets (SDS's).
- Signs and symptoms associated with exposure to hazardous chemicals in the laboratory. Refer to SDS's.
- The location and availability of reference materials on the hazards, safe handling, storage and disposal of hazardous chemicals in the laboratory.

Ward's Science understands that safety must be a top priority in science classrooms and laboratories. Ward's Science is available to assist schools in performing safety trainings, preparing a Chemical Hygiene Plan or updating chemical storage and inventory. Valuable resources can be found on our website, and our team of experts is available to address any questions or concerns you may have. For more information, please reach out to us at [sciencehelp@vwr](mailto:sciencehelp@vwr). (1-866-260-0501)

