



Chemical Hygiene Plan

Department of Public Safety - Environmental, Health and Safety
Standard Operating Procedure (SOP) #20
Revised 03 March 2025

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Table of Contents

1.0 INTRODUCTION.....	2
1.1 Policy.....	2
1.2 Purpose.....	2
1.3 Scope.....	2
2.0 DIVISION OF RESPONSIBILITIES.....	2
2.1 Department Heads.....	2
2.2 Chemical Hygiene Officer.....	3
2.3 Faculty and Staff.....	3
2.4 Students and Student Workers.....	3
2.5 Public Safety - Environmental Health and Safety (EHS) Division.....	4
3.0 GENERAL PROCEDURES FOR WORKING IN A LABORATORY.....	4
3.1 General Safety Principles.....	4
3.2 Health and Hygiene.....	5
3.3 Housekeeping.....	6
3.4 Work Conducted Outside Normal Hours / Working Alone.....	6
3.5 Chemical Segregation.....	7
3.6 General Chemical Storage.....	8
3.7 Flammable Liquids Storage.....	8
3.8 Compressed Gases Storage.....	9
3.9 Corrosive Materials Storage.....	9
3.10 Oxidizers and Organic Peroxide Storage.....	10
3.11 Acutely Toxic Materials Storage.....	10
3.12 Transporting Hazardous Substances.....	10
3.12.1 Handling and Transfer of Flammable Liquids.....	11
3.13 Glassware and Sharps.....	11
3.14 Unattended Operations.....	11
3.15 Systems Under Pressure.....	12
3.16 Children and Pets in Laboratories.....	12
4.0 HAZARDOUS CHEMICAL CLASSIFICATION SYSTEMS.....	12
4.1 Safety Data Sheets.....	12
4.2 Chemical Labeling.....	13
4.2.1 Globally Harmonized System (GHS) Labeling.....	13
4.2.2 National Fire Protection Association Rating System Labeling.....	15
5.0 CLASSES OF HAZARDOUS CHEMICALS.....	16
5.1 Physical Hazards.....	16
5.2 Health Hazards.....	17

5.3 Particularly Hazardous Substances.....	17
6.0 LABORATORY SAFETY CONTROLS.....	18
6.1 Engineering Controls.....	19
6.1.1 Chemical Fume Hoods and Ventilation.....	19
6.1.2 Laminar Flow Hoods and Biological Safety Cabinets.....	21
6.1.3 Rockwell Integrated Sciences Center.....	21
6.2 Administrative Controls.....	22
6.2.1 Standard Operating Procedures.....	23
6.3 Safety Controls.....	23
6.3.1 Fire Extinguishers.....	23
6.3.2 Safety Showers and Eyewash Stations.....	24
7.0 HAZARD ASSESSMENTS AND PERSONAL PROTECTIVE EQUIPMENT.....	24
7.1 Hazard Assessments.....	24
7.2 Personal Protective Equipment.....	25
7.2.1 Eye and Face Protection.....	25
7.2.2 Hand Protection.....	27
7.2.3 Protective Apparel.....	28
7.2.4 Respirators.....	28
8.0 PRIOR APPROVAL REQUIREMENTS.....	28
9.0 TRAINING AND INFORMATION.....	30
10.0 MEDICAL CONSULTATION AND EXAMINATION.....	31
11.0 HAZARDOUS MATERIAL DISPOSAL.....	31
11.1 Chemical Waste.....	32
11.2 Infectious/Biohazardous Waste.....	32
11.3 Radioactive Waste.....	33
12.0 EMERGENCY PROCEDURES, ACCIDENTS, AND CHEMICAL SPILLS.....	33
12.1 Emergency Procedures.....	33
12.2 Accident Reports.....	35
12.3 Chemical Spills.....	35
12.4 Handling Leaking Gas Cylinders.....	36
12.5 Control of Fires.....	37

Appendix A – Classes of Hazardous Materials

Appendix B – Emergency Response and Laboratory Shutdown Procedures

1.0 INTRODUCTION

1.1 Policy

It is the policy of Lafayette College (as represented by the Office of the President) to provide a safe and healthy workplace in compliance with all applicable environmental, health, and safety laws and regulations. This Chemical Hygiene Plan (CHP) has been prepared in accordance with the Occupational Safety and Health Administration (OSHA) regulation entitled “Occupational Exposure to Hazardous Chemicals in Laboratories” (29 CFR 1910.1450), commonly known as the Laboratory Standard.

1.2 Purpose

The risks associated with laboratory work are significantly reduced or eliminated when proper precautions and practices are observed. Lafayette College has developed this Chemical Hygiene Plan to manage and mitigate these risks and to aid faculty, staff, and students in maintaining a safe environment in which to teach and conduct research.

1.3 Scope

This Chemical Hygiene Plan applies to all Lafayette College laboratories and academic work spaces where hazardous substances are used. Each laboratory or work space using hazardous materials is required to have a copy of the CHP readily available for all laboratory personnel. Each laboratory worker must be familiar with the contents of the CHP and the procedures for obtaining additional safety information needed to perform their duties safely.

Individual College departments may adopt this CHP or write their own chemical hygiene plan as long as the requirements of the OSHA Laboratory Standard are met. It is assumed that if a department has not developed their own chemical hygiene plan, then they have adopted the Lafayette College Chemical Hygiene Plan.

2.0 DIVISION OF RESPONSIBILITIES

2.1 Department Heads

Department Heads are responsible for providing a safe and healthy work environment and for maintaining safety programs in their departments. The Department Head has the final responsibility for the safety and health of employees, visitors, students, and other personnel conducting work in their department. To satisfy this responsibility, the Department Head will:

- Appoint a Chemical Hygiene Officer (CHO) within their department.
 - if none is appointed, the CHO position is defaulted to that Building’s Manager or Technician.

- Promote a strong safety culture within their department.
- Provide support necessary to implement the Chemical Hygiene Plan.
- Ensure department compliance with applicable codes and regulations.

2.2 Chemical Hygiene Officer

Chemical Hygiene Officers (CHOs) work with faculty and staff within their department to develop and implement appropriate chemical hygiene policies and practices. The CHO assists the Department Head with implementation of the CHP. To satisfy this responsibility the CHO will:

- Review the storage, use, and disposal of laboratory chemicals.
- Conduct monthly inspections of laboratories, prep rooms, and chemical storage areas.
 - EHS will conduct the annual inspection of the laboratories with the CHO present.
- Assist in developing and maintaining adequate facilities.
- Ensure that faculty, staff, and students are properly trained.
- Assist in the annual review and revision of the CHP.

2.3 Faculty and Staff

It is the responsibility of faculty and staff working and teaching in laboratories to follow the procedures outlined in the CHP and all standard operating procedures developed under the plan. Faculty and staff that supervise students must ensure that students working in the laboratory have received laboratory safety and hazardous waste management training and are following all policies and procedures outlined in the CHP. To satisfy these responsibilities, faculty and staff will:

- Ensure that laboratory personnel comply with the CHP and do not operate equipment or handle hazardous chemicals without proper training and authorization.
- Always wear personal protective equipment (PPE) that is compatible to the degree of hazard of the chemical.
- Confirm that emergency equipment and necessary PPE is available.
- Follow all pertinent safety rules when working in the laboratory to set an example for students.
- Report all hazardous conditions to their supervisor and to EHS.
- Monitor the laboratory and chemical fume hoods to ensure that they are maintained and function properly. Contact Facilities Operation or EHS to report any issues.
- Report any job-related injury or illness to their supervisor and EHS ([procedures for reporting work-related injuries](#)).
- Notify the CHO of any experiment-specific deviations from the posted general laboratory hazard assessment's PPE requirements.

2.4 Students and Student Workers

Students participating in a laboratory course or research involving work with chemicals must attend a laboratory safety and hazardous waste management training session annually. Additionally, students and student workers are responsible for the following:

- Maintain awareness of the hazards and safe handling procedures of all chemicals being used.
- Follow all pertinent safety rules when working in the laboratory
- Report all hazardous conditions, including problems with chemical fume hoods or other engineering controls to their supervisor.
- Report any lab-related injury or illness to their supervisor and EHS ([procedures for reporting work-related injuries](#)).
- Follow all lab-specific operating procedures, including use of personal protective equipment.

2.5 Public Safety - Environmental Health and Safety (EHS) Division

EHS's primary role is to manage regulatory compliance with all federal, state, and College policies involving environmental, health and safety issues. EHS acts in an advisory capacity to individual departments to help provide a safe and healthful workplace and provides a number of services such as chemical and biological waste disposal pickups, safety training, and consultation.

EHS evaluates and implements safety policies, such as this CHP, and reviews new and existing equipment and operating practices to minimize hazards to the College community and visitors. EHS reviews accident investigations and suggests remedial measures and procedures. EHS conveys appropriate information to Department Heads and Chemical Hygiene Officers and recommends implementation of new guidelines and regulations from governmental agencies relevant to the work carried out at the College.

3.0 GENERAL PROCEDURES FOR WORKING IN A LABORATORY

The College has developed general procedures for working in laboratories that experience has shown to be useful for avoiding accidents and reducing injuries. Where hazards are not fully addressed by this general guidance, Department Heads and/or CHOs must develop written procedures for work with certain lab-specific substances or equipment.

3.1 General Safety Principles

Carefully read the label before using a chemical. Safety Data Sheets also provide special handling information. Be aware of potential hazards in the laboratory and of the appropriate safety precautions. Know the location and proper use of emergency equipment, the procedures for responding to emergencies, and the proper methods for storage, transport, and disposal of chemicals.

Every lab worker shall observe the following rules.

- **Preparation.** Know the safety rules and procedures that apply to the work that is being done. Determine the potential hazards (e.g. physical, chemical, biological) and appropriate safety precautions prior to beginning any new operation. This determination may require consulting research and chemical safety references and safety data sheets, and may involve discussions with the CHO and/or EHS.
- **Minimize exposure to chemicals.** All skin contact with chemicals in the laboratory should be avoided. Use laboratory hoods and other ventilation devices to prevent exposure to airborne substances whenever possible (note that the use of hoods is required for work with many hazardous substances).
- **Clearly and correctly label all chemical containers.** Post warning signs when unusual hazards, such as radiation, laser operations, flammable materials, biological hazards, or other special problems exist.
- **Do not underestimate risks.** Familiarization with a particular laboratory operation may result in overlooking or underrating its hazards. This attitude can lead to a false sense of security, which frequently results in carelessness. Assume that any mixture of chemicals will be more toxic than its most toxic component. All new compounds and substances of unknown toxicity should be treated as toxic substances.
- **Be alert to unsafe conditions and actions.** Notify your supervisor of any unsafe condition or action so that corrections can be made as soon as possible. Use machines and equipment only for their designed and intended purpose.
- **Be prepared for accidents.** Before beginning an experiment, know what specific action you will take in the event of the accidental release of any hazardous substance. Know the location of all safety equipment including fire extinguishers, eye washes, safety showers, and spill control materials. Be familiar with the location of the nearest fire alarm and telephone and know what telephone numbers to call in the event of an emergency. Know the location of the circuit breakers and gas shutoffs for your laboratory.

3.2 Health and Hygiene

All laboratory workers shall observe the following health and hygiene practices.

- All personnel, including visitors, must wear eye protection at all times while in laboratories.
- Use protective apparel, including gloves, face shields, and lab coats as needed. Long pants and long-sleeved shirts are recommended. Clothing such as shorts, miniskirts and/or dresses are not acceptable lab attire.
- In some cases, laboratory supervisors may identify situations where the use of lab coats or more protective apparel is mandatory in addition to long pants and long-sleeved shirts.
- Do not wear sandals or open-toed shoes when working in laboratories.
- Confine long hair, jewelry, and loose clothing.
- Never use mouth suction to pipet chemicals or to start a siphon.

- Never taste laboratory chemicals.
- Wash hands immediately after working with hazardous chemicals and before leaving the laboratory, even if gloves are worn.
- Eating, drinking, smoking, gum-chewing, and applying cosmetics in laboratories is prohibited.
- Do not store food, beverages, or eating utensils in areas where hazardous chemicals are used or stored.
- **Do not use cell phones while working with chemicals in laboratories.**

Avoid inhalation of hazardous substances by taking the following precautions.

- Procedures involving volatile toxic substances and those operations involving solid or liquid toxic substances that may result in the generation of aerosols should be conducted in a laboratory hood or other containment device whenever possible.
- OSHA Permissible Exposure Limits (PELs) and American Conference of Governmental Industrial Hygienists Threshold Limit Values (TLVs) should be observed when working with hazardous substances for which PELs and TLVs have been established. Contact EHS to evaluate PELs and TLVs, if needed.
- Never smell compounds of unknown toxicity.

3.3 Housekeeping

There is a definite relationship between safety and orderliness in the laboratory. The following housekeeping rules should be adhered to in all laboratories:

- Work areas (including floors) shall be kept clean and aisles must be free from obstructions. Do not allow trash to accumulate.
- Access to emergency equipment, exits, and control panels shall be kept clear at all times.
- All chemical containers (including waste containers) shall be properly labeled.
- Spilled chemicals shall be cleaned up and disposed of properly.
- Hazardous chemicals should not be stored on the floor and bottles one-gallon (or four liters) and larger must be stored below eye level (e.g. in cabinets).
- Chemical storage refrigerators should be defrosted periodically and should not be overcrowded.
- Hazardous waste containers shall be removed from the laboratory when full and stored in the designated hazardous waste room.

3.4 Work Conducted Outside Normal Hours / Working Alone

Researchers should avoid conducting work with hazardous chemicals when they are alone in the laboratory. When working alone, arrange with Public Safety or workers in other laboratories to check on you periodically. Some experiments are too hazardous to be conducted alone under any circumstances;

it is the responsibility of researchers to consult with their supervisor to identify such particularly hazardous operations.

Laboratory operations involving hazardous substances are sometimes carried out continuously or overnight. It is the responsibility of the researcher to design these experiments with provisions to prevent the release of hazardous substances in the event of interruptions in utility services such as electricity, cooling water, and inert gas. Laboratory lights should be left on and appropriate signs should be posted identifying the nature of the experiment and the hazardous substances in use. In some cases, researchers should plan for periodic inspection of the operation. Information should be left indicating how to contact the researcher in the event of an emergency. Additional guidance for Unattended Operations is provided in Section 3.14.

3.5 Chemical Segregation

Chemicals must be stored according to chemical compatibility. Information on chemical compatibility can be found in Safety Data Sheets, Section 7 – Handling and Storage and Section 10 – Stability and Reactivity.

The following chemical compatibility chart illustrates how proper segregation can be achieved. Hazard classes marked by an **X** are incompatible and need to be segregated from each other.

Chemical Compatibility Chart

	Acid Inorganic	Acid Organic	Acid Oxidizer	Base Inorganic	Base Organic	Oxidizer	Toxic Inorganic	Toxic Organic	Reactive	Organic Solvent
Acid Inorganic				X	X		X	X	X	
Acid Organic			X	X	X	X	X	X	X	
Acid Oxidizer		X		X	X		X	X	X	X
Base Inorganic	X	X	X						X	
Base Organic	X	X	X			X			X	
Oxidizer		X			X			X	X	X
Toxic Inorganic	X	X	X						X	

Toxic Organic	X	X	X			X			X	
Reactive	X	X	X	X	X	X	X	X		X
Organic Solvent			X			X			X	

“X” denotes incompatible materials

[CAMEO Chemicals](#), an online resource for identifying chemical incompatibility, was developed jointly by the Environmental Protection Agency (EPA) and National Oceanic and Atmospheric Administration (NOAA). This software allows the user to build an inventory and check for incompatibility, as well as providing hazardous chemical datasheets.

3.6 General Chemical Storage

The decision to use a hazardous chemical is a commitment to handle and use the chemical properly from initial receipt to disposal.

- Information on proper handling, storage and disposal of hazardous chemicals and access to related Safety Data Sheets should be made available to all laboratory employees and students prior to use of the chemical.
- All chemical containers shall be properly labeled. When appropriate, special hazards should be indicated on the label. For certain classes of compounds (e.g. ethers), the date the container was opened should be written on the label.
- Wherever feasible, appropriate storage trays or secondary containment shall be used to minimize spills in the event of a break or leak.
- Chemicals shall not be stored on desks, bench tops, or in fume hoods.
- Large containers (1-gallon/4-liters or larger) should be stored below eye level on low shelves. Never store hazardous chemicals on the floor.
- Chemicals shall only be stored in refrigerators designed and constructed for such a purpose.
- Departments should maintain an inventory list of hazardous chemicals present in their laboratories.
- Chemicals shall be periodically inspected and unwanted materials shall be disposed according to the [Hazardous Waste Management Plan](#).
- To avoid the accumulation of excess chemicals, always purchase the minimum quantities of commercial chemicals necessary for your research.

3.7 Flammable Liquids Storage

Flammable and combustible liquids are liquids that can burn. Flammable liquids have a flashpoint below 100°F, and combustible liquids have flashpoints at or above 100°F but below 200°F. The following guidelines for storing flammable and combustible liquids must be followed in all laboratories.

- Flammable and combustible liquids should be stored in flammable storage cabinets whenever possible.
- Flammable and combustible liquids can only be stored in refrigerators or freezers that are designed for that purpose.
- Flammable and combustible liquids must be stored in well-ventilated areas free from ignition sources.
- No more than 10 gallons of flammable and/or combustible liquids are permitted to be stored outside of a flammable storage cabinet.
- If no flammable storage cabinet is available, small quantities may be stored in a cabinet under a chemical fume hood or bench, or on a shelf below eye level.
- While drum storage is not appropriate for laboratories, chemical stockrooms may purchase bulk containers of flammable and/or combustible liquids used in high volumes.
- Larger quantities of flammable liquids must be handled in areas free of ignition sources (e.g., spark-emitting motors and equipment) using non-sparking tools. Please keep in mind that vapors are heavier than air and can travel to a distant source of ignition.
- Never store containers of flammable liquids or other hazardous chemicals directly on the floor.

3.8 Compressed Gases Storage

Compressed gases are gases that are contained in a vessel at a pressure not less than 280 kPa at 20°C or as a refrigerated liquid. Compressed gases expose laboratory personnel to both chemical and physical hazards. It is essential that these containers are monitored for leaks and have proper labeling. By monitoring compressed gas inventories and disposing of or returning gases for which there is no immediate need, the lab can substantially reduce risk.

- Compressed gas cylinders must be stored in a secure, well-ventilated location and in an upright position.
- Cylinders that are not in use must be secured with a strap or chain and have the safety cap on.
- Cylinders that are in use (regulator is attached) must be individually secured by a chain or strap.
- Gas cylinders shall be transported using cylinder carts designed specifically for this purpose.
- Flammable compressed gases shall be stored away from heat, oxygen, and ignition sources.
- Departments who may transport compressed gases via elevators should take reasonable precautions in doing so.

3.9 Corrosive Materials Storage

The best method for storing corrosive materials is inside of a corrosive storage cabinet or lab cabinet where acids and bases are segregated at all times. Acids must also be segregated from chemicals where a toxic gas would be generated upon contact with an acid. Organic acids must be stored away from oxidizing acids. Segregation can be achieved by either physical distance or by using secondary containment. Corrosives shall never be stored above eye level.

3.10 Oxidizers and Organic Peroxide Storage

Oxidizing materials are not necessarily combustible but yield oxygen that can cause or contribute to the combustion of other materials.

- Oxidizers and organic peroxides must be stored in a cool, dry location, and away from combustible materials and organic solvents and acids.
- If possible, store all strong oxidizing agents in a chemical cabinet dedicated only for oxidizers.
- The amount of oxidizers and organic peroxides stored in the lab should be kept to a minimum.
- All materials must be clearly labeled with the date they were opened and expiration date, if applicable.

3.11 Acutely Toxic Materials Storage

Acutely toxic materials are defined as substances that may be fatal or cause damage to target organs as the result of a single exposure or exposures of short duration. The following guidelines for storing acutely toxic materials must be followed in all laboratories:

- Suitable storage locations for acutely toxic materials include desiccators, glove boxes, flammable storage cabinets that do not contain incompatible chemicals (primarily strong acids), or non-domestic refrigerators or freezers.
- Acutely toxic materials should be stored in secondary containment at all times as a best management practice.
- If possible, store all acutely toxic materials in a cabinet dedicated only for acutely toxic materials.
- Signs should be posted to indicate their presence and unique hazards.
- The amount of acutely toxic material stored in the lab should be kept at a minimum. Any expired or unnecessary materials must be properly disposed of as hazardous waste.
- All acutely toxic materials should be clearly labeled with the original manufacturer's label, which should have the chemical name, hazard labels, and pictograms. The label should not be defaced in any way.
- Please note, acutely toxic materials may also be subject to special requirements if the material qualifies as a Particularly Hazardous Substance (refer to Section 5.3).

3.12 Transporting Hazardous Substances

Chemicals must be transported between stockrooms and laboratories in break-resistant or approved secondary containers. Approved secondary containers are defined as commercially available bottle carriers made of rubber, metal, or plastic, with a carrying handle, and which are large enough to hold the contents of the chemical container in the event of breakage. When transporting cylinders of compressed gases, always strap the cylinder in a suitable hand truck and protect the valve with a cover cap.

3.12.1 Handling and Transfer of Flammable Liquids

The procedures for handling and transfer of flammable liquids are dependent upon the flashpoint of the product and the size of the container.

1. Determine the flashpoint of the liquid.
 - If the liquid you plan to transfer has a flashpoint less than 100°F, continue to Step 2.
 - If the flashpoint is greater than 100°F and you are not heating the liquid above the flashpoint during transfer, the product can be transferred without grounding and bonding.
2. Consider the source container size.
 - If the product is transferred from a 1-gallon (4 liter) container or smaller, the product can be transferred without grounding and bonding.
 - If the product will be transferred from containers larger than 1 gallon (4 liters), grounding and bonding is required.
 - Please note, containers made of glass, less than 5 gallons in capacity, can usually be transferred without any special precautions.

3.13 Glassware and Sharps

- Damaged or broken glassware shall be discarded in designated, marked containers.
- Adequate hand protection shall be worn when inserting glass tubing into rubber stoppers or corks, or when placing rubber tubing on glass connections.
- Glass apparatuses under vacuum shall be handled with extreme care to prevent implosion.
- Glassware or bottles used in laboratory operations shall not be used for food or beverages.
- Collect all used needles and syringes in designated sharps containers.

3.14 Unattended Operations

Certain circumstances may require leaving a laboratory operation unattended. Follow these procedures in the design of any experiment that must be left unattended.

- Develop a protocol for potential interruptions in electric, water, gas or other services and provide containment for toxic substances (if needed), as part of the protocol.

- Fail-safe provisions must be implemented for equipment such as hot plates, heating mantles, and water condensers to be left unattended.
- Appropriate signage must be posted in the vicinity of the experiment (e.g., on the laboratory door), if hazardous conditions are present.

3.15 Systems Under Pressure

Reactions under pressure shall be carried out in an apparatus that is designed to withstand the full pressure of the system and all pressurized apparatuses shall have appropriate relief devices.

3.16 Children and Pets in Laboratories

Pets are not permitted in laboratories where hazardous substances are stored or are in use. Children are only permitted in department laboratories while under the direct supervision of their parent(s) or other adult(s).

4.0 HAZARDOUS CHEMICAL CLASSIFICATION SYSTEMS

Chemical classification systems are designed to communicate hazards. The most widely used classification systems are the OSHA Globally Harmonized System for Classifying and Labeling Chemicals (implemented under the OSHA Hazard Communication Standard) and the National Fire Protection Association (NFPA) system of classifying the severity of hazards.

The Globally Harmonized System (GHS) is a world-wide system adopted by OSHA for standardizing and harmonizing the classification and labeling of chemicals. The objectives of the GHS are to:

- Define health, physical, and environmental hazards of chemicals;
- Create classification processes that use available data on chemicals for comparison with the defined hazard criteria (numerical hazard classification is based on a 1 – 5 scale, 1 being the most hazardous and 5 being the least hazardous); and
- Communicate hazard information, as well as protective measures, on labels and Safety Data Sheet (SDS).

4.1 Safety Data Sheets

Safety Data Sheets (SDS) provide comprehensive information that is imperative for the safe handling of hazardous chemicals. Laboratory personnel should use SDS as a resource to obtain information about hazards and safety precautions.

A master file of SDSs is maintained in the EHS Office (901 Bushkill Drive) and any member of the College can refer to this file and, if desired, obtain copies of any SDS. In addition, most SDSs can be found through a Google search or from the manufacturer's website. SDSs are a good starting point for safety

and handling information and they can be supplemented by literature searches and use of safety databases (i.e. National Toxicology Program, EPA Integrated Risk Information System).

Laboratories and other academic areas must keep copies of current SDSs for any commercial products used in the lab. Additionally, upon ordering and/or receipt of chemical shipments, a copy of the most recent SDS must be forwarded to the EHS office to be added to the master file.

Federal law requires that chemical manufacturers use a standard format when developing SDSs. The SDS will contain 16 headings which are shown below.

1.	Identification of the substance and manufacturer	9.	Physical and chemical properties
2.	Hazards identification	10.	Stability and reactivity
3.	Composition and information on ingredients	11.	Toxicological information
4.	First aid measures	12.	Ecological information
5.	Firefighting measures	13.	Disposal considerations
6.	Accidental release measures	14.	Transport information
7.	Handling and storage	15.	Regulatory information
8.	Exposure controls/personal protection	16.	Other information from manufacturer

4.2 Chemical Labeling

Container labels are an essential form of hazard communication in the lab and are required by OSHA. They provide information to you, your co-workers, and even regulatory inspectors or emergency response personnel. It is essential that all containers in the lab have, at a minimum, a legible label to identify the contents – even if it is water or a benign material.

Hazardous chemical containers must have one the following:

- The original manufacturer label with the date received written on it; or
- A printed label identifying the contents, concentration, primary hazards, owner and date prepared.




4.2.1 Globally Harmonized System (GHS) Labeling

Chemical manufacturers are required to use the GHS standardized label. These labels must contain the following elements:

- Symbols (hazard pictograms) are used to convey health, physical, and environmental hazard information, assigned to a GHS hazard class and category;
- Signal words such as “Danger” (for more severe hazards) or “Warning” (for less severe hazards), are used to emphasize hazards and indicate severity;
- Hazard statements (e.g. “Danger! Extremely Flammable Liquid and Vapor”) are standard phrases assigned to a hazard class and category that describe the nature of the hazard; and
- Precautionary statements are recommended measures that should be taken to minimize or prevent adverse effects resulting from exposure to the hazardous chemical.

The GHS also standardized the hazard pictograms that are to be used on all hazard labels and SDSs. There are 9 pictograms that represent several defined hazards, and include the symbols that are intended to convey specific information about each hazard. Each GHS hazard pictogram is shown below.

		
Carcinogen, Respiratory Sensitizer, Reproductive Toxicity, Target Organ Toxicity, Mutagenicity	Flammable, Pyrophoric, Self-Heating, Emits Flammable Gas, Organic Peroxide	Irritant, Dermal Sensitizer, Acute Toxicity (Harmful), Narcotic Effects
		
Gases Under Pressure	Corrosive	Explosive, Organic Peroxide, Self-Reactive

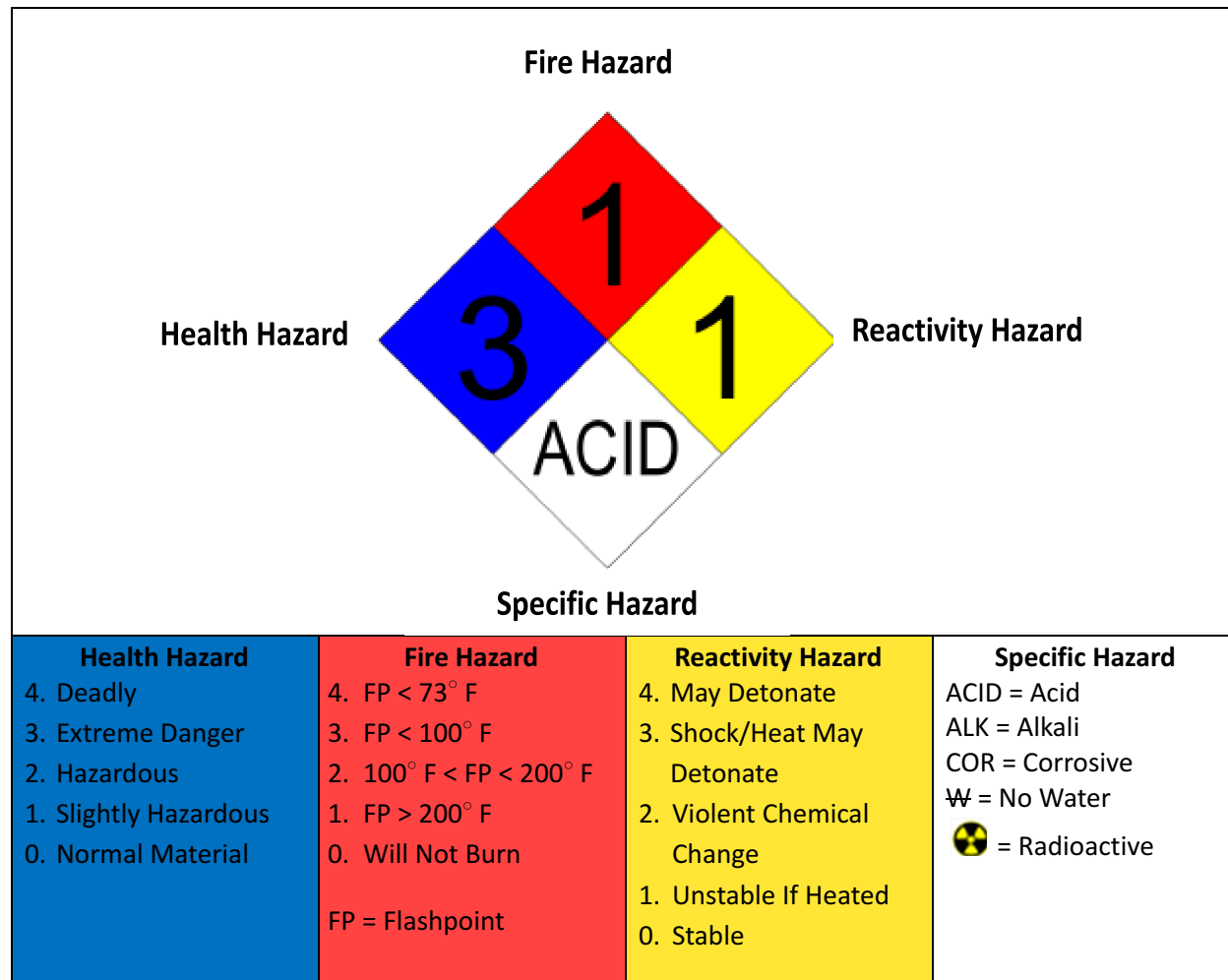
		
Oxidizer	Environmental Toxicity	Acute Toxicity (Severe)

GHS labeling requirements are only applicable to chemical manufacturers, distributors, and shippers of chemicals. GHS labeling requirements are not required for chemicals being stored in a laboratory. However, since most chemicals stored in the laboratory have been purchased from a chemical manufacturer, the GHS labeling and pictogram requirements are relevant and must be understood by laboratory employees.

4.2.2 National Fire Protection Association Rating System Labeling

The NFPA system uses a diamond-shaped diagram of symbols and numbers to indicate the degree of hazard associated with a particular chemical. This system was created to easily and quickly communicate hazards to first responders in the event of an emergency situation. These diamond-shaped symbols are placed on chemical containers to identify the degree of hazard associated with the specific chemical or chemical mixture.

The NFPA system is a common way to identify chemical hazards and should be understood by laboratory employees. **The NFPA 704 numerical rating system is based on a 0 – 4 system; 0 meaning no hazard and 4 meaning the most hazardous (note: this in contrast to the GHS system of 1 – 5 where 1 is the most hazardous and 5 is the least hazardous).** The NFPA hazard rating system that identifies both the hazard categories and hazard rating system is shown below.



5.0 CLASSES OF HAZARDOUS CHEMICALS

Hazard classes provide information to help determine how a chemical can be safely managed. It is essential that all laboratory workers are familiar with the major classes of hazardous chemicals, understand the types of hazards common to each class, and recognize the routes of exposure. The most important single generalization regarding hazardous chemicals in research is treating all compounds as potentially harmful, especially new and unfamiliar materials, and working with them under conditions to minimize exposure. Under OSHA’s Hazard Communication Standard (HCS), any chemical that presents a physical hazard or a health hazard is considered a hazardous chemical. It is the responsibility of all employees to be familiar with the physical and health hazards of all chemicals involved in their work.

5.1 Physical Hazards

A physical hazard means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive. Refer to Appendix A for detailed information on each physical hazard.

5.2 Health Hazards

A health hazard means a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals that are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents that act on the hematopoietic system, and agents that damage the lungs, skin, eyes, or mucous membranes. Refer to Appendix A for detailed information on each health hazard.

5.3 Particularly Hazardous Substances

Particularly hazardous substances (PHSs) are defined in OSHA's Laboratory Standard as select carcinogens, reproductive toxins, and substances which have a high degree of acute toxicity. Working with PHSs requires prior approval by both the Chemical Hygiene Officer and Environmental, Health and Safety. The procedure for acquiring prior approval can be found in Section 8.

OSHA's Laboratory Standard requires that all work with particularly hazardous substances adhere to the following:

1. Establish a designated area for work with PHSs;
2. Use containment devices such as fume hoods or glove boxes;
3. Establish procedures for safe removal of contaminated waste; and
4. Establish decontamination procedures.

A designated area is defined as a laboratory, an area of a laboratory, or a device such as a laboratory hood, which is posted with warning signs that ensure that all employees working the area are informed of the hazardous substances in use. Every department is required to maintain a list of particularly hazardous substances in use in their laboratories. Particularly hazardous substances are divided into three primary categories:

1. Carcinogens;
2. Reproductive Toxins; and
3. High Acute Toxicity Substances.

Detailed information on, and for working with particularly hazardous substances, can be found in Appendix A.

The many different types of physical and health hazards identified in OSHA's Hazard Communication Standard are listed below.

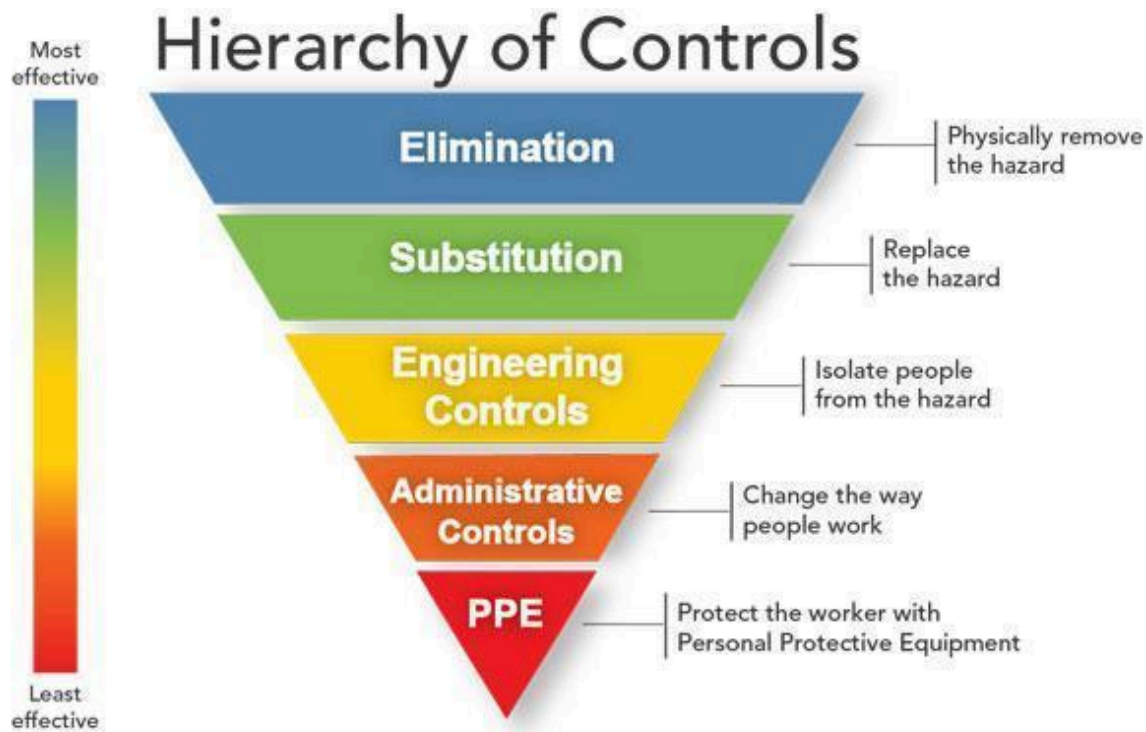
Hazard Communication Standard Hazard Categories		
<i>Physical Hazards</i>		
<i>Fire Hazards</i>	<i>Reactive Hazards</i>	<i>Explosion Hazards</i>
Combustible Liquid	Organic Peroxide	Compressed Gas
Flammable Liquid	Unstable or Reactive	Explosive
Flammable Aerosol	Water-reactive	
Flammable Gas		
Oxidizer		
Pyrophoric		
<i>Health Hazards</i>		
<i>Systemic Effects</i>	<i>Target Organ Effects</i>	
Carcinogen*	Hepatotoxin	
Toxic Agent	Nephrotoxin	
Highly Toxic Agent*	Neurotoxin	
Corrosive	Blood/Hematopoietic Toxin	
Irritant	Respiratory Toxin	
Sensitizer	Reproductive Toxin*	

*May also be classified as a Particularly Hazardous Substance

6.0 LABORATORY SAFETY CONTROLS

Controlling exposures to occupational hazards is the fundamental method of protecting workers. Traditionally, a hierarchy of controls, as shown below, has been used as a means of determining how to implement feasible and effective hazard control solutions. The hierarchy of controls prioritizes intervention strategies based on the premise that the best way to control a hazard is to systematically remove it from the workplace, rather than relying on employees to reduce their exposure.

The best way to control a hazard is to eliminate it from the workplace or substitute a less hazardous technique, process, or material. If elimination or substitution are not viable options, engineering controls, administrative controls, and PPE must be used to provide the necessary protection. Laboratory workers are responsible for using engineering controls, following administrative procedures, and wearing PPE properly.



6.1 Engineering Controls

Engineering controls are designed to remove the hazard at the source, before it comes in contact with the worker. Well-designed engineering controls can be highly effective in protecting workers and will typically be independent of worker interactions to provide this high level of protection. Examples of laboratory engineering controls include:

- Glove boxes that isolate the operator from the process; and
- Forced ventilation systems such as chemical fume hoods and biological safety cabinets.

6.1.1 Chemical Fume Hoods and Ventilation

General ventilation provides only modest protection against inhalation hazards, and therefore cannot be used for protection against toxins. Local exhaust ventilation is the primary method used to control inhalation exposures to hazardous substances.

The laboratory hood is the most common local exhaust method used on campus. Other types of local exhaust include vented enclosures for large pieces of equipment or chemical storage, and snorkel types of exhaust for capturing contaminants near the point of release. Local exhaust systems consist of some type of hood, ductwork, and fan located on the roof. Some systems are equipped with air cleaning devices (HEPA filters or carbon absorbers). In most cases individual fans service each hood.

It is advisable to use a laboratory hood when working with all hazardous substances. In addition, a laboratory hood or other suitable containment device must be used for all work with particularly hazardous substances. A properly operating and correctly used laboratory hood can control the vapors released from volatile liquids as well as dust and mists.

The following general rules should be followed when using laboratory hoods:

- Always keep hazardous chemicals at least six inches behind the plane of the sash.
- Never put your head inside an operating laboratory hood to check an experiment. The plane of the sash is the barrier between contaminated and uncontaminated air.
- Work with the hood sash in the lowest possible position. The sash will then act as a physical barrier in the event of an accident in the hood. Effective hood containment is provided when on low fan mode. Keep the sash closed when not conducting work in the hood.
- Do not clutter your hood with bottles or equipment. Keep it clean and clear. Only materials actively in use should be in the hood. This will provide optimal containment and reduce the risk of extraneous chemicals being involved in any fire or explosions that may occur in the hood.
- Do not make any modifications to hoods or ductwork without first calling EHS X-5330. Any changes to the local exhaust system must be approved by EHS and Facilities Operations.
- Do not use a laboratory hood for large pieces of equipment unless the hood is dedicated to this use (large obstructions can change the airflow patterns and render the hood unsafe for other uses). It is generally more effective to install a specifically designed enclosure for large equipment so that the laboratory hood can be used for its intended purpose.
- Clean the grill along the bottom slot of the hood regularly so it does not become clogged with papers and dirt.
- Promptly report any suspected hood malfunctions to EHS (X-5330).

EHS inspects and tests all laboratory hoods on campus bi-annually. The bi-annual checks include a visual inspection of the hood and the testing consists of measuring the face velocity of the hood. If the laboratory hood requires a sash height lower than 18" in order to meet the minimum face velocity, it will be posted visually with a label indicating the maximum height that the sash may be located.

If a hood fails inspection, EHS will submit a work order to Facilities Operations to have it repaired. Facilities Operations will notify EHS when the repairs have been made, and the fume hood is then re-inspected. If a hood functions poorly due to incorrect use (e.g. cluttered hoods) then EHS will notify the Department CHO.

If there is any question about a laboratory hood's operation, EHS should be called immediately. When a new laboratory hood is installed, it is the responsibility of the laboratory supervisor to ensure that no hazardous substances are used in the hood until it is surveyed and labeled by EHS. If any changes are

made to the laboratory hood system, EHS should be notified so that a new hood inspection can be conducted.

6.1.2 Laminar Flow Hoods and Biological Safety Cabinets

A laminar flow hood (LFH) is a device that is designed to maintain a clean environment inside the cabinet. LFHs offer no protection to the user from microorganisms or other pathogens and are sometimes referred to as “clean benches.” If an LFH is designed to contain pathogens within the unit, so as to minimize the chance of exposure from these agents to the user, then it is referred to as a biological safety cabinet (BSC). Because these devices exhaust air directly into the room, they do not offer any protection from hazardous or toxic chemical vapors or gases. Working with toxic substances may require more specialized local ventilation such as the use of a glove box or other closed system.

Work practices for LFHs and BSCs:

- Do not use flammable or toxic chemicals in these types of hoods.
- A clean bench is to be used only with non-hazardous materials.
- The CHO shall determine whether a LFH, BSC or chemical fume hood is appropriate for the operation to be performed.

6.1.3 Rockwell Integrated Sciences Center

Chemical Fume Hoods

There are twelve (12) total fume hoods in Rockwell. In order to operate the fume hoods, an access card, which is provided with each individual hood, must be present during use. If the card is removed, the fume hood will shut down. Each access card is specific to a certain fume hood – meaning you cannot swap cards from one unit to another.

Ten (10) fume hoods are filtered ductless hoods. These hoods clean and recirculate air in the lab through the use of filters on top of the hood. All chemicals used in the hoods have been approved for use by the manufacturer. A list of approved chemicals is maintained by EHS. Any new chemicals must be evaluated and approved by the manufacturer before use.

The filtered ductless fume hoods contain a filtration column consisting of a pre-filter, a HEPA filter, a Neutrodine filter, a fan module with a sensor, and a second Neutrodine filter. The pre-filter and HEPA filter remove large and then finer particulate matter. The Neutrodine filter is a comprehensive molecular filter that has been tested with over 500 chemicals and allows simultaneous handling of solvents, acids, bases, ammonia and formaldehyde. The fan module contains a sensor that will detect any chemicals that “breakthrough” the first Neutrodine filter, with an alarm to indicate to users that the filter needs to be changed. The second Neutrodine filter is located above the fan and captures any of the chemical “breakthrough” before air is discharged from the unit.

The filtered fume hoods are not approved for the following chemical groups and processes:

- Organophosphorus Compounds (primarily used in pest control)
- Mercury
- Hydrogen Cyanide
- Radioisotopes
- Perchloric Acid
- Highly exothermic reactions

Two (2) mechanically ducted fume hoods are located in the chemical stockroom 106 and Biology research lab 114.

Aircuity System

The Aircuity system monitors indoor environmental parameters and adjusts air supply and exhaust delivery based on indoor contaminant levels and thermal load. The automated system samples and analyzes pockets of air which are routed to a centralized suite of sensors. The system provides input to the building's ventilation system to optimize indoor air quality and energy efficiency.

The system monitors for total volatile organic compounds, carbon dioxide, particulate matter, and carbon monoxide. The analysis of these parameters determines the appropriate air change rates. The normal air change rate for an occupied laboratory is 4 air changes per hour. If a sensor detects a contaminant, the system will alarm and the air change rate will be increased automatically to 6 air changes per hour.

The system also includes occupancy sensors which allow for air change rate reductions when a lab is unoccupied. If the air is clean and the room is unoccupied and has no thermal load the air change rate will be reduced to 2 air changes per hour.

If the Aircuity sensors detect contaminants or temperatures above the set point, the ventilation will increase even if unoccupied. The system will go to a full air flow immediately after a person is detected. Upon entry after a long period of inactivity, the lab may feel stuffy. It may take as long as 15 minutes to exchange the air in the room. The Aircuity system does not affect fume hood ventilation so air will be drawn into the filtered fume hoods at all times.

6.2 Administrative Controls

Administrative controls are procedural measures that can be implemented to reduce or eliminate hazards. Administrative controls include the following:

- Ensuring lab workers are provided with suitable documented training for working safely with hazardous materials;
- Planning of experiments that includes the development of written standard operating procedures and hazard assessments (discussed in the next section);

- Discussing safety on a regular basis (e.g., during faculty or lab meetings) and creating an atmosphere where people feel comfortable talking about safety;
- Restricting access to areas where hazardous materials are used;
- Using safety signs or placards to identify hazardous areas;
- Labeling all chemical containers;
- Substitution of toxic materials with less toxic materials;
- Good housekeeping and good personal hygiene (e.g., hand washing); and
- Prohibiting eating and drinking where chemicals are used and stored.

6.2.1 Standard Operating Procedures

The OSHA Lab Standard requires that standard operating procedures (SOPs) be developed for all hazardous tasks that are performed in the laboratory. This CHP represents best practices and provides a broad overview of the information necessary for the safe operation of laboratories. Departments engaged in work not sufficiently covered by this CHP must customize this document with written (or referenced) lab-specific procedures. SOPs must be prepared by laboratory personnel who are most knowledgeable and familiar with the experimental process. An individual SOP is not required for every hazardous task or chemical used; SOPs can be written in a comprehensive manner that address lab-specific operations and hazards.

6.3 Safety Controls

6.3.1 Fire Extinguishers

Personnel are not required to extinguish fires that occur in their work areas. However, under certain circumstances suitably trained personnel may attempt to extinguish fires. Most **laboratories are provided with a Dry Chemical fire extinguisher; however, some laboratories contain a Carbon Dioxide extinguisher.** In some buildings, fire extinguishers are mounted in the hallway within close proximity to laboratories.

All fire extinguishers should be mounted on a wall or be standing vertically on the floor in an area free of clutter. Research personnel should be familiar with the location, use, and classification of the extinguisher in their laboratory. Fire extinguishers are one element of a fire response plan, but the primary element is safe escape.

In buildings staffed by Lafayette custodians, fire extinguishers are checked monthly by the custodian, and are inspected and tagged annually by EHS. In buildings staffed by CSI custodians, EHS performs bi-annual inspection of the fire extinguishers.

Any time a fire extinguisher is used, no matter for how brief a period, it should be reported to Public Safety. The used extinguisher will be replaced with a full extinguisher. For recharging, replacement,

inspection, or information regarding the type of extinguisher best suited for your laboratory, call EHS (X-5330).

6.3.2 Safety Showers and Eyewash Stations

All hazardous material exposures resulting in eye, face, or body contamination are cause to use the emergency eyewash stations and safety showers located in the laboratories and/or hallways. There are several types of eyewashes and safety showers on campus, including combination units, and it is essential that all laboratory users know the location and proper use of this equipment. In addition, access to safety showers and eyewashes must not be obstructed.

It is the responsibility of the CHO or his/her designee to inspect and flush eyewash units in their laboratories once each week. Facilities Operations conducts water flush/flow testing and maintenance of safety showers on an annual basis. Improper function of eyewashes or safety showers should be reported to EHS or Facilities Operations immediately. Public Safety EHS will inspect all eyewash stations monthly, and a tag will be placed on each one to designate the inspection was completed by the department monthly.

If eyes and/or face are contaminated, immediately flush the eyes in the eyewash station for at least 15 minutes. The eyelids should be held open and eyeballs should be rolled around to fully irrigate the eye. If the body is contaminated, remove clothes at and below the affected area, and remain in the safety shower for at least 15 minutes.

7.0 HAZARD ASSESSMENTS AND PERSONAL PROTECTIVE EQUIPMENT

7.1 Hazard Assessments

Laboratory personnel must conduct their work under conditions that minimize the risks from both known and unknown hazardous substances. Because few laboratory chemicals are without hazards, general precautions for handling all laboratory chemicals have been developed and are included in Section 3.0. However, prior to beginning any laboratory-specific work, the hazards and risks associated with an experiment or activity must be determined and the necessary safety precautions implemented.

Each laboratory should develop lab-specific policies and procedures for the highest risk materials and activities used in their lab. Consideration should be given to past accidents, process conditions, chemicals used in large volumes, and particularly hazardous chemicals. Hazard assessments should:

- Identify chemicals to be used, amounts required, and circumstances of use in the experiment. Consider any special employee or laboratory conditions that could create or increase a hazard. Consult sources of safety and health information and experienced scientists to ensure that those conducting the risk assessment have sufficient expertise.

- Evaluate the hazards posed by the chemicals and the experimental conditions. The evaluation should cover toxic, physical, reactive, flammable, explosive, radiation, and biological hazards, as well as any other potential hazards posed by the chemicals.
- For a variety of physical and chemical reasons, reaction scale-ups pose special risks, which merit additional prior review and precautions.
- Select appropriate controls to minimize risk, including use of engineering controls, administrative controls, and personal protective equipment to protect workers from hazards. The controls must ensure that OSHA's Permissible Exposure Limits (PELs) are not exceeded. Prepare for contingencies and be aware of the institutional procedures in the event of emergencies and accidents.

A basic hazard assessment should answer these five questions:

1. What are the hazards?
2. What is the worst thing that could happen?
3. What can be done to prevent this from happening?
4. What can be done to protect from these hazards?
5. What should be done if something goes wrong?

Experiment-specific laboratory hazard assessments are conducted as necessary by faculty and laboratory instructors or, by request, in collaboration with EHS. Experiment-specific laboratory hazard assessments provide a mechanism for faculty and staff to increase or decrease the general laboratory PPE requirements based on experiment specific protocols and associated safety considerations. Experiment specific laboratory hazard assessments are to be documented and clearly communicated to all lab workers.

7.2 Personal Protective Equipment

Personal protective equipment (PPE) must be readily available in laboratories and, based on laboratory hazard assessments, are to be used by all faculty, students, and staff. Laboratories are also to provide appropriate PPE for all visitors. Hazards presented by certain chemicals require the use of specific equipment and personal apparel for protection. Standard operating procedures for work with specific hazardous substances often include special requirements for the use of protective equipment.

7.2.1 Eye and Face Protection

All personnel, including visitors, must wear eye protection at all times while in department laboratories. Eye protection is required whether or not one is actually performing a "chemical operation", and visitors should not be permitted to enter a lab unless they wear appropriate eye protection. Groups that handle chemicals should provide a supply of safety glasses at the entrance of each laboratory for the use of staff and visitors.

All protective eyewear in the laboratory must meet the ANSI Z87.1-2003 standard. Work involving laser outputs must also meet the ANSI Z136.1-2007 standard. Various types of non-protective and protective eyewear are described below. Refer to chemical compatibility charts, SDS, and protective equipment manufacturer resources to aid in the selection of the proper eye and face protection level based on the chemicals being handled and the experiment being performed. Consultation with EHS or your CHO can also be helpful in selecting appropriate gloves for given applications.

- **Contact lenses** offer no protection against eye injury and cannot be substituted for safety glasses and goggles. Do not wear contact lenses when carrying out operations where a chemical splash to the eyes is possible since contact lenses can interfere with first aid and eye-flushing procedures. If an individual must wear contact lenses for medical reasons, then tight-fitting goggles should be worn over the contact lenses.
- **Prescription glasses** do not provide adequate protection against injury, and must not be substituted for safety glasses or splash goggles. Faculty and staff who wear contacts or prescription eyeglasses may consider obtaining a pair of prescription safety glasses. Alternately, safety glasses (for impact hazards) or safety goggles (for splash hazards) designed to go over prescription glasses shall be worn.
- **Safety glasses with side shields** provide the minimum protection acceptable for regular use. Safety glasses must meet the ANSI standard Z87, which specifies a minimum lens thickness (3 mm), certain impact resistance requirements, etc. Safety glasses provide eye and face protection from moderate impact and particle hazards associated with grinding, sawing, scaling, broken glass, and minor chemical splashes. Although these safety glasses can provide satisfactory protection against injury from flying particles, they do not fit tightly against the face and offer little protection against larger splashes or sprays of chemicals.
- **Splash Goggles** provide adequate eye protection from hazards including potential chemical splash, use of concentrated corrosive material, and bulk chemical transfer. Goggles are available with clear or tinted lenses, fog proofing, and vented or non-vented frames. Splash goggles should be worn when carrying out operations in which there is reasonable danger from splashing chemicals, flying particles, etc. For example, goggles are preferred over regular safety glasses when working with glassware under reduced or elevated pressures (e.g. sealed tube reactions), when handling potentially explosive compounds (particularly during distillations), and when employing glass apparatus in high-temperature operations. In some instances "safety shields" should be set up around experiments for additional protection.
- **Welder Goggles** provide protection from flying sparks, metal splatter, slag chips and harmful radiant energy. Lenses are impact resistant and are available in graduated lens shades depending on the nature of the work. Minimum protective shade numbers based on the type of welding can be found in the OSHA 29 CFR 1910.133 Eye and Face Protection standard.
- **Face Shields** provide additional protection to the eyes and face when used in combination with safety glasses or splash goggles. Face shields consist of adjustable headgear and a face

shield with either tinted or clear lenses, or a mesh wire screen. Face shields should be worn when conducting laboratory operations when the entire face needs protection from flying particles, metal sparks, liquid cryogenics, or chemical/biological splashes. Face shields are not a substitute for appropriate eyewear and should always be used in conjunction with a primary form of eye protection such as safety glasses or goggles.

- **Welding Shields** are similar in design to face shields but offer additional protection from radiant light burns, flying sparks, metal splatter, and slag chips encountered during welding, brazing, soldering, resistance welding, bare or shielded electric arc welding, and oxyacetylene welding and cutting operations. Equipment fitted with appropriate filter lenses are to be used to protect against light radiation. Tinted and shaded lenses are not filter lenses unless they are marked or clearly identified as such.
- **Laser Eye Protection** is dependent on spectral frequency and the specific wavelength of the laser source. No single type of safety glasses is available for protection from all laser outputs. Contact EHS for additional guidance on laser PPE selection.

7.2.2 Hand Protection

Gloves are to be used when handling hazardous chemicals in laboratories. Typically, the requirements of the general laboratory safety procedures found in Section 3.0 shall be followed. However, deviations may be made based on experiment-specific laboratory hazard assessments. EHS can provide guidance on appropriate hand protection in instructional and research settings.

There is no single glove material that protects against all chemicals. It is important that the appropriate glove be used when handling chemicals. Gloves should be carefully selected for their degradation and permeation characteristics to provide proper protection. Refer to chemical compatibility charts, SDS, and protective equipment manufacturer resources to aid in the selection of the proper glove protection level based on the chemicals being handled. Consultation with EHS or your CHO can also be helpful in selecting appropriate gloves for given applications.

The following are general procedures applicable to glove selection and use:

- Gloves should always be inspected before use and replaced immediately if they are contaminated or torn.
- Gloves are to be removed before handling phones, doorknobs, computers, etc.
- Gloves are to be removed before leaving the laboratory, except in situations where actively transporting chemical/biological material between labs. Persons transporting chemicals should have another person open/close doors for them, or employ the “one glove” rule, where one hand is un-gloved and used to touch door handles, elevator buttons, etc.
- Glove protection is not required during the transport of chemicals in a cart, bottle carrier, or clean secondary container.
- In situations involving extremely hazardous chemicals, double gloves in combination with sleeve protectors and other chemically resistant PPE are recommended. The thin latex, vinyl,

or nitrile gloves, popular for their dexterity, are not appropriate for highly toxic chemicals or solvents.

7.2.3 Protective Apparel

The specific hazardous substances being used in an experiment determine the choice of protective apparel. However, certain general guidelines should be observed at all times in the laboratory:

- Skin contact with any chemical must always be avoided.
- Sandals or open toed shoes are not permitted and long hair and loose clothing should be confined when present in the laboratory.
- Depending on the type and quantity of hazardous chemicals being used and the manner in which they are used, additional protection such as lab coats may be necessary.

7.2.4 Respirators

It is the College's goal to control respiratory hazards at their point of generation by using engineering controls and good work practices. The use of respirators as the primary means of protecting employees from airborne hazards is considered acceptable only in very specific situations. These situations include short-term experiments where engineering controls are not feasible, and situations in which the use of respiratory protection is an added or supplemental control. The following guidelines must be followed when using respirators:

- OSHA's Standard on Respiratory Protection (29 CFR 1910.134) which requires a medical evaluation, training, and fit testing.
- Respirator use must be approved by EHS and must follow the College's [Respiratory Protection Program](#). Appointments for medical evaluations can be arranged by calling EHS at X-5330.
- The type of respirator to be used will be selected in consultation with EHS.
- Personnel must participate in a Respirator Training Program prior to using a respiratory device. All users must undergo fit testing (conducted by EHS) when a respirator is first issued and subsequently as required by OSHA regulations.
- EHS will maintain records of respirator users.

Some Lafayette employees and/or student workers may elect to use filtering facepiece respirators (e.g., N95 or N99 disposable dust masks) on a voluntary basis, during activities that involve exposure to low-level, non-hazardous nuisance dust or other similar particulates. A job hazard assessment must be conducted by EHS and approval from EHS is required prior to wearing a filtering facepiece respirator.

8.0 PRIOR APPROVAL REQUIREMENTS

The use of particularly hazardous substances, as defined in Section 5.3 of this CHP, requires the prior approval of the Department Chemical Hygiene Officer. Additional details regarding the hazards of PHS, as well as the OSHA Laboratory Standard requirements for work with PHS, can be found in Appendix A.

Researchers intending to work with Particularly Hazardous Substances (PHS) must prepare a Standard Operating Procedure (SOP), which must be reviewed and approved by the Chemical Hygiene Officer and Environmental, Health and Safety. The plan should contain the following sections:

1. Laboratory Information – Describe the laboratory and user of the chemical (include building name, room number, department, type of research, names of staff involved in research project).
2. Chemical Information – Outline the chemical identification information. This information can be found on the SDS provided by the chemical manufacturer. List all chemical synonyms.
3. Hazard Information – Describe the hazards associated with the chemical. This information is found on the SDS. Include the chemical hazard class (e.g., flammable, corrosive, poison, etc.), storage requirements, PHS designation, and health hazards (e.g., acute/chronic exposure effects, carcinogenic, reproductive toxicity, etc.).
4. Engineering Controls – Describe the engineering controls required while handling the chemical (e.g., fume hood, biosafety cabinet, eyewash, safety shower, etc.).
5. Personal Protective Equipment (PPE) – Describe the PPE required for use of the chemical. PPE recommendations can be found on the SDS; however, specific PPE requirements should be determined by the specific hazards associated with the experimental protocol and chemical characteristics.
6. Special Handling Procedures – Any special handling/storage instructions can be found on the SDS. In addition to the basic information on the SDS, further handling/storage instructions may need to be added depending on how the chemical is being used.
7. Emergency Procedures – Provide a detailed contingency plan for responding to emergency situations involving the chemical (e.g., fires, chemical exposures, etc.). Consult the SDS and refer to Appendix B for guidance on establishing emergency response plans.
8. Decontamination/Spill and Clean-up Procedures – Describe procedures for cleaning up affected areas, including what type of PPE is appropriate to wear during clean-up/spill/decontamination, as well as what materials will be used (e.g., tongs, absorbent material, etc.)

9. Waste Disposal Guidelines – Waste disposal procedures listed in the SOP should reflect the proper waste disposal procedures outlined in Lafayette College’s [Hazardous Waste Management Plan](#).
10. Experimental Protocol – Outline the experimental protocol, including: tasks to be performed, duration of experiment, concentration of chemical used, dose administered (if applicable), number of animals used (if applicable). Include a statement that all personnel who use the chemical will be trained on the SOP, and document the training.
11. Certification and Approval – Certify that all information within the SOP has been researched and is current. Reference the SDS and any other sources used to prepare the SOP. This section is signed by the preparer, then counter-signed by the Chemical Hygiene Officer and a representative from Environmental, Health and Safety.

All personnel working with the associated PHS must receive training and information related to the potential risks and proper laboratory practices associated with this procedure. Trained personnel must sign-in to the training to certify they have been informed of the chemical hazards and trained on safe work practices and procedures.

9.0 TRAINING AND INFORMATION

Laboratory safety education and training is an ongoing process that must be integrated into every laboratory course. Lab workers must have access to information to ensure they are knowledgeable of the hazards present in their work area. Training and information must be provided at the time of the employee’s initial assignment to a work area and prior to assignment involving new exposure situations.

The hazards present in the laboratories vary widely from group to group, and consequently, it is the responsibility of each department’s CHO to provide faculty, staff, student workers, and students in their areas with proper information and training on hazardous chemicals, biological, and/or radiological hazards specific to the work area.

At the request of the Department Head or CHO, EHS can provide basic laboratory safety training to new faculty, staff, and/or student workers, covering the general topics of laboratory safety, including safe handling and disposal of hazardous materials. This training can be accessed through Moodle with the link;

[Bloodborne Pathogens](#)

[Hazcom](#)

[Laboratory Safety](#)

[Personal Protective Equipment](#)

[Spill Prevention, Control](#)

The CHO and/or laboratory supervisor are responsible for providing specific health and safety information to staff, student workers, and students on the unique hazards found in their laboratories on an on-going basis. Records of laboratory training attendance should be maintained by each department.

10.0 MEDICAL CONSULTATION AND EXAMINATION

Lafayette College must provide all employees who work with hazardous chemicals an opportunity to receive medical attention, including any follow-up examinations that the examining physician determines to be necessary, whenever an employee develops signs and symptoms associated with a hazardous chemical to which the employee may have been exposed. Lab workers requiring advice on the health effects of chemicals involved in their work should contact EHS (X-5330) for further assistance.

Any individual who believes they may have been exposed to a hazardous substance should notify their supervisor immediately and contact EHS. If an employee encounters a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure, the affected employee must be provided an opportunity for a medical consultation by a licensed physician. All accidents involving exposure to hazardous substances that require medical attention must be reported immediately to the Department Chemical Hygiene Officer and EHS.

Special programs of ongoing medical surveillance are available for researchers planning extended work with certain hazardous substances. Enrollment in these programs can be arranged by calling EHS at X-5330. There are no charges for these services.

It is the responsibility of the academic department to identify workers in their group who will be engaged in research that may involve hazardous exposures requiring medical surveillance. Faculty, staff, or student workers may be enrolled in medical surveillance programs by calling EHS at X-5330.

11.0 HAZARDOUS MATERIAL DISPOSAL

Consideration of the means of disposal of chemical, biological, and radioactive wastes should be part of the planning of all experiments before they are carried out. The best strategy for managing laboratory waste aims to maximize safety and minimize environmental impact, and considers these objectives during experiment planning. No activity should begin unless a plan for the disposal of nonhazardous and hazardous waste has been formulated.

Whenever practical, order the minimum amount of material possible in order to avoid the accumulation of large stocks of excess chemicals which will not be needed in future research.

EHS manages the disposal of all hazardous materials generated at Lafayette College in accordance with state and federal regulations. For assistance on the storage and disposal of hazardous materials from laboratory operations, contact EHS or the Hazardous Waste Coordinator. Also, further information regarding the disposal of specific waste categories can be found in the College's [Hazardous Waste Management Plan](#).

11.1 Chemical Waste

Hazardous chemical waste is defined as waste that has certain hazardous characteristics, or waste that is specifically listed as such by the EPA. Some wastes are not regulated but could still cause significant harm to people or the environment if disposed of improperly. Unless EHS or the Hazardous Waste Coordinator has been consulted regarding disposal, all wastes will be collected and handled as if they are hazardous.

All mixed waste containers must have a hazardous waste accumulation tag (available from EHS) affixed at the time waste is first placed into the container. The tag must have the following information:

- The generator contact information and chemical constituents;
- The waste accumulation start date;
- Record waste contents as accumulated (use 2 tags if necessary);
- Chemical percentages (can be completed when the container is filled).

Individual containers with the original manufacturer label that have been designated as waste do not need to be labeled with a hazardous waste tag; however, an inventory of such items should be sent to the CHO and EHS prior to moving the items to the waste storage area. If individual chemical containers are stored within a box or bin, the box or bin must be labeled as “Hazardous Waste” and an inventory of items in the box or bin should be attached.

11.2 Infectious/Biohazardous Waste

Infectious or biohazardous wastes are not considered hazardous and are not regulated by the federal EPA. The Pennsylvania DEP has developed standards for the management of infectious wastes. Infectious/ biohazardous waste is defined as waste that is composed or contaminated with biological materials. Examples of these wastes include cell cultures, animal tissues, any item containing infectious agents or recombinant DNA; or human tissues, bloods, or fluids.

Infectious and bio hazardous waste, including sharps, should be segregated from all other waste types. Specially labeled red or orange biohazard bags and puncture resistant sharps containers must be used for the collection of all infectious waste. Infectious/biohazardous waste that has been mixed with chemical waste must be managed as a hazardous chemical waste. The hazardous waste tag must include a list of biological components in addition to the chemical components.

Liquid infectious/biohazardous waste is to be decontaminated (bacterial cultures, blood, animal fluids, etc.) by autoclaving, if appropriate. Decontaminated culture media, containing no chemicals or drugs, may be discarded into a sink drain.

Solid Infectious/biohazardous waste (such as contaminated paper, plastic pipettes, and tips) should be placed in clear autoclave bags and autoclaved. After autoclaving, the waste bags can be collected with non-hazardous solid wastes in the trash.

Animal carcasses (non-infectious tissues and associated non-sharps solid waste) are collected in red biohazard bags and sealed. Biohazard bags should be placed in a freezer until the day of pick up.

Needles, razors, and other sharps are collected in red puncture-proof sharps containers. Items must never be removed from these bins once they have been placed inside. Once a container is full, contact EHS for disposal.

Further information regarding the disposal of medical/infectious waste categories can be found in the College's [Infectious Waste Plan](#).

11.3 Radioactive Waste

Radioactive wastes have strict regulatory requirements and the means of disposal depends on the material being used. Radioactive waste management at the laboratory level will be determined prior to purchase and during experimental planning stages. EHS and the Radiation Safety Officer (RSO) must be notified prior to the production of any radioactive waste.

12.0 EMERGENCY PROCEDURES, ACCIDENTS, AND CHEMICAL SPILLS

12.1 Emergency Procedures

The College's Incident Action Plan describes procedures to be followed in the event of an emergency, fire, explosion, or unplanned release of hazardous materials or hazardous waste which could pose a threat to human health and/or the environment. It provides for prompt, orderly, and controlled evacuation from the campus under emergency conditions.

In the event of an emergency in the laboratory, the following procedures should be initiated:

- **Building Evacuation:** Pull the fire alarm and verbally alert others. Without endangering yourself, help the injured leave the area.
 1. All building evacuations will occur when an alarm sounds and/or upon notification by Public Safety, or other College or Municipal officials.

2. When the building evacuation alarm is activated during an emergency leave by the nearest marked exit and alert others to do the same.
 3. Assist the physically challenged in exiting the building.
 4. Once outside proceed to a clear area that is at least 500 feet away from the affected building. Keep streets, fire lanes, hydrant areas and walkways clear for emergency vehicles and personnel. Assemble at your predetermined assembly area for a head count.
 5. Do not return to an evacuated building unless told to do so by a College or Municipal official.
- **Confine:** Close doors and fume hood sashes as you leave the area.
 - **Report:** From a safe place, call Public Safety (X-4444, or 610-330-4444 from a cellphone). Give your name, location and the phone number you are dialing from. Describe the incident, especially what chemicals were involved.
 - **Secure:** Prevent personnel and students from re-entering the affected area until Public Safety and/or Easton Fire Department take over the scene.

Some additional considerations include:

- **If a coworker has ingested a toxic substance**, have the individual drink large amounts of water until they can be escorted/transported to Bailey Health Center (never give anything by mouth to an unconscious person). Attempt to learn exactly what substances were ingested and inform the medical staff as soon as possible.
- **If a coworker is bleeding severely**, elevate the wound above the level of the heart and ask the injured employee to apply firm pressure directly over the wound with a clean cloth, handkerchief, or their hand. Obtain immediate medical assistance by contacting Public Safety (X-4444).
- **For cases of eye injuries** which involve minor foreign objects, chemical exposure or irritation, and related injuries (barring very serious eye injuries requiring emergency care), please have all employees seek initial care at the Bailey Health Center. In most cases, appropriate and immediate medical care can be provided at the health center. If more comprehensive care is needed the employee will be triaged and sent to the appropriate medical facility.
- **Do not touch** a person in contact with a live electrical circuit-disconnect the power first.

Appendix B contains information for researchers on laboratory emergency planning and shutdown procedures.

Your most important role in an emergency situation is to share information and resources with your colleagues and friends. Work together, listen for, and follow official instructions, get the information you need to be safe, and stay safe.

In addition, you should:

- Register for [Lafayette Leopard Emergency Alert Service](#).
- Familiarize yourselves with emergency procedures.
- Be prepared to assess situations quickly but thoroughly, and use common sense in determining a course of action.
- Evacuate buildings (except when otherwise instructed) in an orderly manner when an alarm sounds or when directed to do so by emergency personnel.
- Report fires and other emergencies immediately to Public Safety and the proper authorities.
- The Department of Public Safety can provide training and information to help faculty and staff know what to do in emergencies and how they can be prepared ahead of time.
- All members of the Lafayette community should carry their identification card with them at all times.

12.2 Accident Reports

To help identify and correct unexpected hazards, it is necessary that personnel prepare a [Supervisor's Accident Investigation Report](#) describing the circumstances of all serious accidents. One copy of the report should be submitted to Public Safety, and one copy should be given to the supervisor of the laboratory in which the accident took place. Reports should be filed within 24 hours from the date you are made aware of the accident.

[Supervisor's Accident Investigation Reports](#) must be prepared following any of the following incidents:

- Fires that require the use of a fire extinguisher or require sounding a fire alarm.
- Any accident that results in an injury requiring medical attention other than first-aid.
- Any spill of a hazardous substance, which takes place outside a designated area. Any accidental release of a particularly hazardous substance requires the filing of an accident report.
- Accidents involving employees (including student teaching assistants) must be reported and investigated following the College's [Work-related Injury Reporting Procedures](#).

Members of the Department should notify their CHO, Department Head, and/or EHS of any potentially hazardous situations or practices they are aware of in the laboratory.

12.3 Chemical Spills

The College's Incident Action Plan describes emergency response procedures in the event of a fire, explosion, or unplanned release of hazardous materials or hazardous waste which could pose a threat to human health and/or the environment. The Spill Prevention Control and Countermeasures (SPCC) Plan may also be used as an additional resource during an incident involving hazardous materials or hazardous waste. The College utilizes a third-party vendor to respond to emergency chemical spills/releases to contain, clean up and perform any necessary remediation.

An incidental spill may be safely cleaned up by employees who are familiar with the hazards of chemicals with which they are working. An incidental spill is defined by OSHA as a spill in which the substance can be absorbed, neutralized or otherwise controlled at the time of release by employees in the immediate release area and does not pose a significant safety or health hazard to employees.

For categorization as an incidental spill, all of the following criteria must be met:

- There is less than or equal to one gallon of spilled material.
- The material is not acutely toxic and is not releasing toxic gas.
- The spill did not cause a fire/explosion, the material does not pose a fire/explosion hazard, and the material is not releasing flammable/explosive vapors.
- The spill occurred inside a building, away from floor drains, doors, etc.

Cleanup of an incidental spill should follow these guidelines:

- Tend to any injured or contaminated personnel and if necessary, request help (call Public Safety Emergency number X-4444).
- Clear the area of other personnel and students.
- Don appropriate PPE, with eyewear and hand protection as a minimum requirement.
- Use supplies from spill kits to contain and absorb spilled material.
- Visually inspect the area to ensure that all spilled materials have been cleaned.
- Bag all debris, label with proper hazardous waste label, and place in the Satellite Accumulation Area (SAA) or contact EHS if there is no SAA.
- Notify the CHO and/or EHS.

Every department that works with hazardous substances should have a spill kit tailored to deal with the potential hazards of the materials being used in their laboratory. CHOs, or an appropriate designee, are responsible for maintaining these spill control kits. Spill kits should be located near laboratory exits for ready access. Typical spill control kits might include:

- **Spill control pillows** that can be used for absorbing solvents, acids, caustic alkalis, but not HF.
- **Inert absorbents** such as vermiculite, clay, and sand.
- **Neutralizing agents for acid spills** such as sodium carbonate and sodium bicarbonate.
- **Neutralizing agents for alkali spills** such as sodium bisulfate.
- **Large plastic scoops** and other equipment such as brooms, pails, bags, dustpans, etc. as appropriate.

12.4 Handling Leaking Gas Cylinders

Occasionally, a cylinder or one of its component parts develops a leak. Most such leaks occur at the top of the cylinder in areas such as the valve threads, safety device, valve stem, and valve outlet. If a leak is suspected, do not use a flame for detection; rather, a flammable-gas leak detector or soapy water or other suitable solution should be used. If the leak cannot be remedied by tightening a valve gland or a

packing nut, emergency action procedures should be affected and the supplier should be notified. Laboratory workers should never attempt to repair a leak at the valve threads or safety device; rather, they should consult with the supplier for instructions.

The following general procedures can be used for relatively minor leaks where the indicated action can be taken without the exposure of personnel to highly toxic substances. Note that if it is necessary to move a leaking cylinder through populated portions of the building, place a plastic bag, rubber shroud, or similar device over the top and tape it (duct tape preferred) to the cylinder to confine the leaking gas.

- **Flammable, inert, or oxidizing gases** - Move the cylinder to an isolated area (away from combustible material if the gas is flammable or an oxidizing agent) and post signs that describe the hazards and state warnings. If feasible, leaking cylinders should always be moved into laboratory hoods.
- **Corrosive gases** may increase the size of the leak as they are released and some corrosives are also oxidants or flammable. Move the cylinder to an isolated, well-ventilated area and use suitable means to direct the gas into an appropriate chemical neutralizer. Post signs that describe the hazards and state warnings.
- **Toxic gases** - Follow the same procedure as for corrosive gases. Move the cylinder to an isolated, well-ventilated area and use suitable means to direct the gas into an appropriate chemical neutralizer. Post signs that describe the hazards and state the warnings.

Leaking gas cylinders can cause serious hazards that may require an immediate evacuation of the area and activation of the emergency response system. When the nature of the leaking gas or the size of the leak constitutes a more serious hazard, only appropriately trained hazmat responders may respond. Evacuate personnel from the affected area (activate the fire alarm to order the evacuation of the building) and call Public Safety (X-4444) to obtain emergency assistance.

12.5 Control of Fires

Lafayette College policy states that personnel are not required to fight fires. The following guidelines should be followed to prevent and minimize injury and damage from fires.

- **Be prepared!** Know where all of the fire extinguishers are located in your laboratory, what types of fires they can be used for, and how to correctly operate them. Know where the nearest fire alarm is located. Know the location of safety showers and fire blankets.
- **Fires in small vessels** can usually be suffocated by loosely covering the vessel. Never pick up a flask or container of burning material.
- **A small fire, which has just started**, can sometimes be extinguished with a laboratory fire extinguisher. Extinguishing such fires should only be attempted if you are confident that you can do so successfully and quickly, and from a position in which you are always between the

fire and an exit from the laboratory. Do not underestimate fires, and remember that toxic gases and smoke may present additional hazards.

- **Small fires involving reactive metals and organometallic compounds** (such as magnesium, sodium, potassium, metal hydrides, etc.) should be extinguished with Met-L-X or Met-L-Kyl extinguisher or by covering with dry sand. Contact EHS to discuss fire safety related to research with these metals or compounds.
- **In the event of a more serious fire**, evacuate the laboratory and activate the nearest fire alarm. Be prepared to meet and advise the Fire Department and Emergency Response Team with regard to what hazardous substances are present in your laboratory.
- **Personal injuries involving fires.** If a person's clothing catches fire, they should be doused with water from the safety shower. Immediately dropping to the floor and rolling can sometimes extinguish minor clothing fires. Fire blankets should only be used as a last resort measure to extinguish fires since they tend to hold in heat and to increase the severity of burns. Quickly remove contaminated clothing, douse the person with water, and place clean, wet, cold clothes on burned areas. Wrap the injured person in a blanket to avoid shock and get medical attention promptly.