LAFAYETTE COLLEGE

Chemical Hygiene Plan

Public Safety Department
Environmental, Health and Safety (EHS) Division
Standard Operating Procedure (SOP) #20

Key Roles and Contact Information

Public Safety Department

Emergency (610)-330-4444

Non-Emergency (610)-330-5330

Environmental, Health and Safety Division

Matthew Hammerstone, Supervisor: (610)-330-5581

Christine Oliver, Specialist: (610)-330-5686

Cindy Pursel, Specialist: (610)-330-5961

Hazardous Materials Technician

Yvonne Noonan (610)-330-5225

Radiation Safety Officer

Matthew Hammerstone: (610)-330-5581

Table of Contents

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 Chairpersons

Department Chairs are responsible for providing a safe and healthy work environment and for maintaining safety programs in their departments. The Department Chairperson 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 Chairperson will:

- Appoint a Chemical Hygiene Officer within their department.
- 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 Chairperson with implementation of the CHP. To satisfy this responsibility the CHO will:

- Review the storage, use, and disposal of laboratory chemicals.
- Conduct inspections of laboratories, prep rooms, and chemical storage areas.
- 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 Chairpersons 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 Chairs 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 other workers should make arrangements for periodic inspection of the operation. Information should be left indicating how to contact you 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

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 below100°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.
- While drum storage is not appropriate for laboratories, chemical stockrooms may purchase bulk containers of flammable and/or combustible liquids used in high volumes. Ground and bond the container and receiving vessel when transferring flammable and/or combustible liquids from a bulk container to prevent static charge buildup.

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.

3.13 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 or other adult.

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

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 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 <u>Chemical Labeling</u>

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:

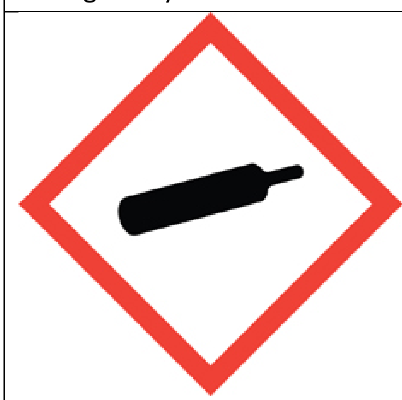
- The original manufacturer label with the date received written on it; or
- A printed label identifying the contents, concentration, primary hazards, owner and date prepared.

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.

Fire Hazard

Health Hazard

Reactivity Hazard

Specific Hazard

Health Hazard	Fire Hazard	Reactivity Hazard	Specific Hazard
4. Deadly	4. FP < 73° F	4. May Detonate	ACID = Acid
3. Extreme Danger	3. FP < 100° F	3. Shock/Heat May Detonate	ALK = Alkali
2. Hazardous	2. 100° F < FP < 200° F	2. Violent Chemical Change	COR = Corrosive
1. Slightly Hazardous	1. FP > 200° F	1. Unstable If Heated	~~W~~ = No Water
0. Normal Material	0. Will Not Burn	0. Stable	☢ = Radioactive
	FP = Flashpoint		

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 work 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.

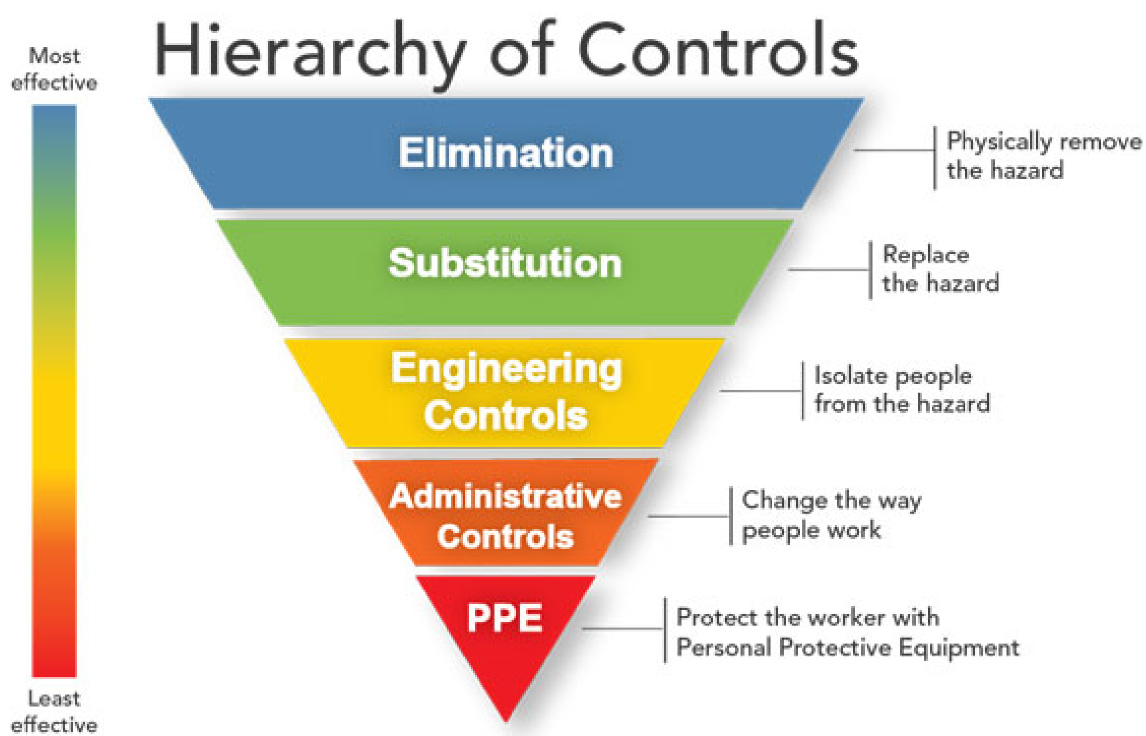
Hazard Communication Standard Hazard Categories		
Physical Hazards		
Fire Hazards	*Reactive Hazards*	*Explosion Hazards*
Combustible Liquid	Organic Peroxide	Compressed Gas
Flammable Liquid	Unstable or Reactive	Explosive
Flammable Aerosol	Water-reactive	
Flammable Gas		
Oxidizer		
Pyrophoric		
Health Hazards		
Systemic Effects	*Target Organ Effects*	
Carcinogen*****	Hepatoxin	
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 comprised 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 stock room 106 and Biology research lab 114.

<u>Airquity System</u>

The Airquity 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 Airquity 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 Airquity 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.

Fire extinguishers are inspected monthly by Facilities Operations and are also inspected and tagged annually by EHS.

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 safety showers and eyewash units in their laboratories once each month. Facilities Operations conducts water flush/flow testing and maintenance on an annual basis. Improper function of eyewashes or safety showers should be reported to EHS or Facilities Operations immediately.

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 eyeglass 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 cryogens, 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 particulate. 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 for 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 Chair 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. 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 Materials Technician. 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 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 Materials Technician 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).

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.

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 biohazardous 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 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.

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 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 official.
    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 located in the Environmental, Health and Safety Division's section of the Public Safety website.

Members of the Department should notify their CHO, Department Chair, 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 additional resource during an incident involving hazardous materials or hazardous waste.

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 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 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.

Chemical Hygiene Plan

Appendix A

Classes of Chemical Hazards

Public Safety Department
Environmental, Health and Safety (EHS) Division
Standard Operating Procedure (SOP) #20

1.0 PHYSICAL HAZARDS

A chemical is a physical hazard if it is likely to burn or support fire, may explode or release high pressures that can inflict bodily injury, or can spontaneously react on its own, or when exposed to water.

1.1 Fire Hazards

1.1.1 Flammable and Combustible Liquids

Flammable and combustible liquids are among the most common hazardous materials found in laboratories. The primary measure of the ease with which a liquid will burn is called the flashpoint. The flashpoint is the lowest temperature at which a liquid will emit sufficient vapors to form an ignitable mixture with air. OSHA uses flashpoint in classifying the fire hazard of a chemical.

Flammable liquids and combustible liquids are discussed together because flashpoint is the standard classification of both. The only difference between a flammable and combustible liquid is the relative ease (temperature) with which the substance burns or supports burning.

A flammable liquid is any liquid with a flashpoint below 100°F. Such flammables are designated as Class 1 liquids that are subdivided into the following classes:

- Class 1A - Flashpoint: Below 73 degrees F, Boiling Point: Below 100°F
- Class 1B - Flashpoint: Below 73 degrees F, Boiling Point: At or Above 100°F
- Class 1C - Flashpoint: At or Above 73 degrees F, Boiling Point: Below 100°F

A combustible liquid is any liquid with a flashpoint at or above 100°F. Combustible liquids are subdivided as follows:

- Class 2 - Flashpoints: At or above 100°F and below 140°F.
- Class 3A - Flashpoints: At or above 140°F and below 200°F.
- Class 3B - Flashpoint: At or above 200°F.

1.1.2 Oxidizers

A chemical as an oxidizer if it is a chemical, other than a blasting agent or explosive, that initiates or promotes combustion in other materials, causing fire either of itself or through the release of oxygen or other gases. The oxidizer may provide the oxygen to the substance being oxidized (in which case the agent has to be oxygen or contain oxygen), or it may receive electrons being transferred from the substance undergoing oxidation (e.g., chlorine is a good oxidizing agent for electron-transfer purposes, even though it contains no oxygen).

The most common oxidizer is atmospheric oxygen. Oxygen-containing chemicals (e.g. hydrogen peroxide and nitrous oxide) and halogens (e.g. bromine, chlorine, and fluorine) can also be strong oxidizers. Some chemicals may be oxidizers with such an extremely fast burning potential that they are classified as explosives or blasting agents rather than oxidizers.

1.1.3 Pyrophoric Hazards

A pyrophoric chemical is a chemical that will ignite spontaneously in air at a temperature of 130°F or below. Fortunately, there are only a few chemicals that have the ability to catch fire without an ignition source when exposed to air. Many of these are elements such as lithium, powdered aluminum, and magnesium or organometallic compounds such as lithium hydride, diethyl zinc and arsine. Moisture in the air often increases the probability of spontaneous ignition of pyrophoric materials.

1.2 Reactive Hazards

There are three types of reactive hazards: organic peroxides, unstable (reactive) materials, and water-reactive materials. In addition to these three categories there are other types of reactive hazards that should be determined such as chemicals that might be involved in slow decomposition processes that give rise to reactive materials or increased pressure in containment vessels.

Additional considerations must be given to compounds, that if combined with other compounds in a procedure, will explode or become uncontrollable. In general, these are materials that may undergo chemical or physical changes during routine use and generate by-products that may overcome standard control measures or penetrate available personal protective equipment.

1.2.1 Organic Peroxides

An organic peroxide is an organic compound that contains the bivalent -O-O structure and which may be considered a structural derivative of hydrogen peroxide. The peroxide functional group (-O-O) is relatively unstable and most organic peroxides will spontaneously decompose at a slow rate. Some organic peroxides, however, are capable of very violent reactions with detonation at environmental temperatures, causing fires and explosions. Organic peroxides are among the most hazardous substances handled in laboratories. All organic peroxides are highly flammable, and most are sensitive to heat, friction, impact, and light.

1.2.2 Unstable (Reactive) Material

An unstable (reactive) material is a chemical which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shock, pressure, or temperature.

The main difference between an unstable material and an explosive is the rate of the reaction. While the rate of reaction for unstable materials is less than that of explosives, unstable materials can still present a serious hazard because of the generation of high temperatures and pressures. In some cases, the reaction may be rapid enough to approach explosive potential.

Polymerization is a reaction in which small molecules (usually monomers) react with each other to form larger molecules (polymers). During this chemical process, a large amount of heat may be released. This raises the temperature of the monomer mixture that further accelerates the polymerization process until the reaction runs away or explodes.

Decomposition reactions can occur with many chemicals and mixtures. In this process, complex molecules dissociate to form simpler substances. This process may require input of heat or there may be a release of heat during the chemical reaction. The most hazardous reactions are those in which heat is released. If the reactions take place within a vessel, the high temperature may increase the pressure to the point that it ruptures or explodes. Examples of unstable materials are acrylonitrile and butadiene.

1.2.3 Water-Reactive Materials

Water-reactive materials are chemicals that react with water to release a gas that is either flammable or presents a health hazard. Many chemicals fall into this category. For example, sodium and potassium, when exposed to water, will react and release hydrogen, presenting an explosive hazard. Carbides (e.g. calcium carbide) can generate acetylene, a flammable gas, when exposed to water. In other cases, the gases released may be highly toxic, as in the case of cyanide that can be released when an inorganic salt containing cyanide (e.g. potassium cyanide) comes in contact with water.

1.3 Explosion Hazards

Explosive substances are materials that decompose under conditions of mechanical shock, elevated temperature, or chemical action, with the release of large volumes of gases and heat. Special precautions are required for the safe use of explosive materials. It is the responsibility of the researcher to evaluate hazards involved in their work and to consult with their supervisor to develop detailed standard operating procedures for any work involving explosive substances. Work with explosive materials will generally require the use of special protective apparel (face shields, gloves, lab coats) and protective devices such as explosion shields and barriers.

1.3.1 Compressed Gases

Compressed gases are gases that are contained in a receptacle at a pressure of 200 kPa (gauge) or more, or are liquefied or liquefied and refrigerated.

OSHA groups gases under pressure into four categories.

- Compressed gases (e.g. hydrogen)
- Liquefied gases (e.g. propane, anhydrous ammonia)
- Refrigerated liquefied gases (e.g. liquid nitrogen)
- Dissolved gases (e.g. acetylene)

The common primary hazard of all compressed gases is the high pressure contained in the cylinder. Gases in high-pressure cylinders contain an extraordinary amount of stored energy. If a cylinder valve is breached (i.e. breaks off when the cylinder falls and strikes a hard surface, etc.), the stored energy in the cylinder is released as thrust. The cylinder can accelerate to speeds great enough to penetrate concrete walls. The pressure in a cylinder will increase when subjected to increased temperatures. Cylinders are designed with a pressure relief valve but if this valve fails then the cylinder can fail. Caution is needed to ensure that systems and devices used with compressed gas cylinders are not over-pressurized, which could lead to forceful rupture and flying fragments.

When released from the confines of a cylinder, gases will expand to occupy several hundred or even a thousand times the space. This can displace oxygen and result in an oxygen- deficient atmosphere and a person can be overcome quickly and without much warning.

If a gas is cryogenic (extremely cold), it can cause brittle fracture of components and freeze skin or mucus membranes upon contact.

2.0 HEALTH HAZARDS

2.1 Systemic Effects

2.1.1 Carcinogens

Carcinogens are chemical or physical agents that cause cancer. Under the OSHA's Hazard Communication Standard, a chemical is considered to be a carcinogen if:

- It has been evaluated by the International Agency for Research on Cancer (IARC), and found to be a carcinogen or potential carcinogen; or
- It is listed as a carcinogen or potential carcinogen in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or,
- It is regulated by OSHA as a carcinogen.

Generally, carcinogens are chronically toxic substances; that is, they cause damage after repeated or long-duration exposures, and their effects may only become evident after a long latency period. Chronic toxins are particularly insidious because they may have no immediate apparent harmful effects.

Certain select carcinogens are classified as particularly hazardous substances and must be handled using special precautions. Particularly hazardous substances include compounds for which there is evidence from human studies that exposure can cause cancer. For a large number of other compounds there is limited evidence of carcinogenicity from studies involving experimental animals. These compounds should be handled using the general procedures for work with hazardous substances.

It is important to recognize that many of the substances involved in laboratory research are new compounds and have not been subjected to testing for carcinogenicity. Researchers should therefore be familiar with the specific classes of compounds and functional group types that have previously been correlated with carcinogenic activity. Always keep in mind that as a general rule, all new and untested compounds should be regarded as being toxic substances.

When evaluating the carcinogenic potential of chemicals, it should be noted that exposure to certain compounds (not necessarily simultaneously) can cause cancer even at exposure levels where neither of the individual compounds would have been carcinogenic.

2.1.2 Toxic and Highly Toxic Agents

Toxic materials can harm humans or the environment and can be measured in a variety of ways. Toxicity is broken into acute (single or one time exposures with immediate effects) and chronic hazards (lower, long term exposures and/or delayed effects). In reality, many toxic materials can produce both acute and chronic health risks with effects that are duration and dose dependent. More importantly, the toxic effects of many research chemicals have not been thoroughly identified.

Thus, it is essential that all laboratory workers understand the types of toxicity, recognize the routes of exposure, and are familiar with the major classes of toxic chemicals. The single most important generalization regarding toxicity in chemical research is treating all compounds as potentially harmful, especially new and unfamiliar materials, and work with them under conditions to minimize exposure by skin contact and inhalation.

When considering possible toxicity hazards while planning an experiment, it is important to recognize that the combination of the toxic effects of two substances may be significantly greater than the toxic effect of either substance alone. Because most chemical reactions are likely to contain mixtures of substances whose combined toxicities have never been evaluated, it is prudent to assume that mixtures of different substances (e.g. chemical reaction mixtures) will be more toxic than the most toxic ingredient contained in the mixture. Furthermore, chemical reactions involving two or more substances may form reaction products that are significantly more toxic than the starting reactants.

OSHA classifies chemical agents as toxic or highly toxic based on the number of deaths that occur following brief (acute) exposure of rodents. The difference in the two categories is strictly the dose at which the toxicity (death) occurs. Exposure is by the three major workplace exposure routes, mouth (oral), skin (dermal), or breathing (inhalation). The analysis is based on the LD_{50} (median lethal dose by oral or dermal exposure) and LC_{50} (median lethal inhalation concentration for a one-hour exposure. The LD_{50} and LC_{50} represent the dose or concentration, respectively, at which 50% of the test animals (and supposedly humans) will be expected to die.

The following table illustrates how a chemical can be classified as Highly Toxic or Toxic, depending on the results of the appropriate animal tests.

Animal Test	Highly Toxic	Toxic
Oral LD_{50}	< 50 mg/kg	50-500 mg/kg
Dermal LD_{50}	< 200 mg/kg	200-1000 mg/kg
Inhalation LC_{50} - gases, vapors	< 200 ppm	200-2000 ppm
Inhalation LC_{50} - mists, fumes or dust	2 mg/L	2-20 mg/L

2.1.3 Corrosives

Corrosives are solids and liquids at the pH extremes that can damage intact skin or mucous membranes on contact. Contact with corrosives must be eliminated by minimizing volumes/use and continuous use of protective equipment (gloves and chemical splash goggles). The EPA defines corrosive wastes as any liquid with a pH <2 (acid) or >12.5 (base). These wastes must be collected for disposal by EHS.

2.1.4 Irritants

Irritants are defined as non-corrosive chemicals that cause reversible inflammatory effects on living tissue by chemical action at the site of contact. The difference between an irritant and a corrosive is the ability of the body to repair the tissue reaction. A wide variety of organic and inorganic compounds are irritants and consequently skin contact with all laboratory chemicals should always be avoided.

2.1.5 Sensitizers

A sensitizer (allergen) is a substance that causes exposed people to develop an allergic reaction in normal tissue after repeated exposure to the substance. Certain chemicals have no immediate health effects. But if you are exposed to them several times, they can make you allergic or sensitive to other chemicals, often quite suddenly. A classic example is formaldehyde (CH_2O). Once you are sensitized to a particular chemical, even minute amounts will cause symptoms.

2.2 <u>Target Organ Effects</u>

2.2.1 Hepatotoxins

Hepatotoxins are chemicals that produce liver damage. The liver is particularly susceptible to foreign chemicals because of its large blood supply and the major role it plays in metabolism. These factors can result in exposure to high doses of a toxic agent and the production and immediate exposure to potentially toxic metabolites. Examples of hepatotoxins are arsenic, carbon tetrachloride, ethyl alcohol, halothane, and vinyl chloride.

2.2.2 Nephrotoxins

Nephrotoxins are chemicals that produce kidney damage. The kidney is highly susceptible to toxic agents for two reasons. There is a very high volume of blood flow through the kidney, and the kidney can filter large amounts of toxins that can concentrate in the kidney tubules. The kidney eliminates body wastes, maintains body levels of electrolytes and fluids, and produces special enzymes and hormones that regulate blood pressure, pH, calcium, and the production of red blood cells. Thus, the effects of nephrotoxicity are systemic in nature, such as hypertension, body fluid and electrolyte imbalance, and anemia. Examples of nephrotoxins are heavy metals (e.g. chromium, lead, mercury, and uranium) and halogenated hydrocarbons (e.g. carbon tetrachloride and chloroform). While some toxins cause acute effects, many exert their toxicity by long-term exposure at lower levels.

2.2.3 Neurotoxins

Neurotoxins are chemicals that produce their primary toxic effects on the nervous system. The nervous system directs many of the body's activities so that changes in the nervous system may be apparent throughout the body. Signs and symptoms of neurotoxicity include narcosis, behavioral changes, and decreases in motor function. Examples of neurotoxins are carbon disulfide, ethylene oxide, hexane, lead, and mercury.

2.2.4 Blood/Hematopoietic Toxins

Blood/hematopoietic toxins are also referred to as hemotoxins or hematotoxins. These chemicals are agents which act on the blood or hematopoietic system by decreasing hemoglobin function and depriving body tissues of oxygen. Toxins can act at various points in the hematopoietic/blood system. Some affect the circulating blood elements, interfering with their function. Others damage the hematopoietic system and may prevent it from producing the blood elements.

2.2.5 Respiratory Toxins

Respiratory toxins are chemicals that irritate or damage pulmonary tissue. Some exert their toxicity quickly (acute effects, such as pulmonary irritation) while others act over a long period to time (chronic effects, such as pulmonary fibrosis). Examples of respiratory toxins are asbestos, formaldehyde, ozone, nitrogen dioxide, and silica.

2.2.6 Reproductive Toxins

Reproductive toxins are chemicals that affect the reproductive capabilities including chromosomal damage (mutagens) and effects on fetuses (teratogens). This definition is comprehensive and incorporates toxic effects on all elements of the process of reproduction. Reproductive toxins are classified as particularly hazardous substances by OSHA and must be handled using special precautions.

Reproductive toxicity can involve toxic agent damage to either the male or female reproductive system. Therefore, both male and female reproductive effects of toxins should be determined. Examples of reproductive toxins are lead and 1,2-Dibromo-3-chloropropane (DBCP).

The period of greatest susceptibility to reproductive toxins is the first 8-12 weeks of pregnancy, a period which includes time when a woman may not know she is pregnant. Consequently, women of child bearing potential should take care to avoid all skin contact with chemicals. Pregnant women and women intending to become pregnant should consult with their doctor, laboratory supervisor and the Bailey Health Center with regard to the type of work they may safely perform and the special precautions they should take.

3.0 PARTICULARLY HAZARDOUS SUBSTANCES

As discussed in section 5.3 of the Chemical Hygiene Plan, there are some substances that pose such significant threats to human health that they are classified as **"particularly hazardous substances"** (PHSs). The OSHA Laboratory Standard requires that special provisions be established to prevent the harmful exposure of researchers to PHSs. Particularly hazardous substances are divided into three primary categories:

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

3.1 Select Carcinogens

Certain potent carcinogens are classified as "select carcinogens" and treated as PHSs. A select carcinogen is defined in the OSHA Lab Standard as a substance that meets one of the following criteria:

- It is regulated by OSHA as a carcinogen; or
- It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or
- It is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest editions); or
- It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:
    - After inhalation exposure of 67 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m3;
    - After repeated skin application of less than 300 (mg/kg of body weight) per week; or
    - After oral dosages of less than 50 mg/kg of body weight per day.

3.2 Reproductive Toxins

Reproductive toxins act during pregnancy and cause adverse effects on the fetus; these effects include embryolethality (death of the fertilized egg, embryo or fetus), malformations (teratogenic effects), and postnatal functional defects. Examples of embryotoxins include thalidomide and certain antibiotics such as tetracycline. Women of childbearing potential should note that embryotoxins have the greatest impact during the first trimester of pregnancy. Because a woman often does not know that she is pregnant during this period of high susceptibility, special caution is advised when working with all chemicals, especially those rapidly absorbed through the skin (e.g., formamide). Pregnant women and women intending to become pregnant should consult with their doctor, laboratory supervisor, and the Bailey Health Center before working with substances that are suspected to be reproductive toxins. The following table lists some common materials that are highly suspected to be reproductive toxins. See Section 3.7 for general procedures for working with reproductive toxins.

Partial List of Reproductive Toxins	
Arsenic and certain arsenic compounds	Lead compounds
Benzene	Mercury compounds
Cadmium and certain cadmium compounds	Toluene
Carbon disulfide	Vinyl chloride
Ethylene glycol monomethyl and ethyl ethers	Xylene
Ethylene oxide	

3.3 Compounds with a High Degree of Acute Toxicity

Compounds that have a high degree of acute toxicity comprise a third category of particularly hazardous substances as defined by the OSHA Lab Standard. Acutely toxic agents include certain corrosive compounds, irritants, sensitizers (allergens), hepatotoxins, nephrotoxins, neurotoxins, agents that act on the hematopoietic systems, and agents which damage the lungs, skins, eyes, or mucous membranes, as described in the previous sections. See Section 3.7 for general procedures for working with reproductive toxins.

3.4 Designated Areas for Particularly Hazardous Substances

A key requirement of the OSHA Laboratory Standard is that all work with particularly hazardous substances be confined to designated areas. 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 there.

It is the responsibility of laboratory supervisors to define the designated areas in their laboratories and to post these area with conspicuous signs reading "DESIGNATED AREA FOR USE OF PARTICULARLY HAZARDOUS SUBSTANCES--AUTHORIZED PERSONNEL ONLY". In some cases it may be appropriate to post additional signs describing unusual hazards present and/or identifying the specific hazardous substance in use.

Laboratory hoods serve as designated areas for most of the research groups. Laboratory supervisors are required to notify the Department Chemical Hygiene Officer of the specific location of any designated areas established in their research groups which are not laboratory hoods.

3.5 Recordkeeping

Every department is required to maintain a list of particularly hazardous substances in use in their laboratories. It is recommended the Chemical Hygiene Officer be assigned the responsibility for ensuring that this inventory list in kept up to date. In addition, records that include amounts of material used and names of workers involved should be kept as part of the laboratory notebook record of all experiments involving particularly hazardous substances.

3.6 Approvals

Prior approval is required for any work involving PHS. Prior approval from the Department Chemical Hygiene Officer and Environmental, Health and Safety is required for work with particularly hazardous substances. A Standard Operating Procedure (SOP) must be prepared, including all relevant information pertaining to the properties and hazards of the substance, plans for the experimental operations, emergency procedures and waste disposal.

3.7 Standard Operating Procedures

Working with particularly hazardous substances entails significant risk to human health. Researchers intending to work with particularly hazardous substances must prepare SOPs for any experimental procedure that involves a PHS. The SOP shall be reviewed and approved by the Chemical Hygiene Officer and Environmental, Health and Safety. This plan should contain the following information:

1. Laboratory Information – Describe the laboratory and user of the chemical (incl. 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 D 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.

The plan should list the names of the researchers who will be working with the restricted substance, the exact location of the designated area(s) in which it will be used, and the approximate amounts that will be employed in the proposed research. All of the following procedures should be followed when working with substances known to have high chronic toxicity.

1. **Restrict access to areas where substances of high chronic toxicity are being used and stored.** Any volatile substances having high chronic toxicity should be stored in a ventilated storage area in a secondary tray or container having sufficient capacity to contain the material should the primary container accidentally break. All containers of substances in this category should have labels that identify the contents and include a warning such as the following: WARNING! HIGH CHRONIC TOXICITY OR CANCER SUSPECT AGENT. Storage areas for substances in this category should be designated areas (see part VI-B), and special signs should be posted if a special toxicity hazard exists. With the exception of materials that require refrigeration, substances of high chronic toxicity should be stored in areas maintained under negative pressure with respect to surrounding areas (e.g. fume hoods).

   All experiments with and transfers of such substances or mixtures containing such substances should be done in a designated area such as suitably posted, efficient laboratory hood. When a negative-pressure glove box in which work is done through attached gloves is used, the ventilation rate in glove box should be at least two volume changes per hour, the pressure should be at least 0.5 in. of water lower than that of the external environment, and the exit gases should be passed through a trap or HEPA filter. Positive-pressure glove boxes are normally used to provide and inert anhydrous atmosphere. If these glove boxes are used with highly toxic compounds, then the box should be thoroughly checked for leaks before each use and the exit gases should be passed through a suitable trap or filter. High-efficiency scrubbers should protect laboratory vacuum pumps used with substances having high chronic toxicity or HEPA filters and vented into an exhaust hood. Motor-driven vacuum pumps are recommended because they are easy to decontaminate. (Note: decontamination of a vacuum pump should be carried out in an exhaust hood). Designated areas should be clearly marked with a conspicuous sign reading: DESIGNATED AREA FOR USE OF PARTICULARLY HAZARDOUS SUBSTANCES -- AUTHORIZED PERSONNEL ONLY. Only authorized and instructed personnel should be allowed to work in or have access to such designated areas.

2. **Wear suitable protective apparel.** Proper gloves should be worn when transferring or otherwise handling substances or solutions of substances having high chronic toxicity. Two gloves should generally be worn on each hand. In the event of an accident, the outer, contaminated gloves can then be removed and the researcher can immediately take steps to deal with the accident. To avoid contamination of the general laboratory environment protective gloves should be removed when leaving a designated area (e.g. to answer the telephone). In some cases, the laboratory worker or the supervisor may deem it advisable to use other protective apparel such as an apron of reduced permeability covered by a disposal coat. Extreme precautions such as these might be taken, for example, when handling large amounts of certain heavy metals and their derivatives or compounds known to be potent carcinogens. After working with such substances, laboratory workers should remove any protective apparel that has been used and thoroughly wash hands, forearms, face, and neck.

If disposal apparel or absorbent paper liners have been used, these items should generally be placed in a closed and impervious container that should then be labeled in some manner such as the following: CAUTION: CONTENTS CONTAMINATED WITH SUBSTANCES OF HIGH CHRONIC TOXICITY. Non-disposable protective apparel should be thoroughly washed, and containers of disposable apparel and paper liners should be incinerated.

3. **Protect the environment and dispose of waste materials properly.** Surfaces on which high-chronic-toxicity substances are handled should be protected from contamination by using chemically resistant trays or pans that can be contaminated after the experiment or by using dry, absorbent, plastic-backed paper that can be disposed of after use.

   Wastes and other contaminated materials from an experiment involving substances of high chronic toxicity should be collected together with the washings from flasks and such and either decontaminated chemically or placed in closed, suitably labeled containers for incineration. If chemical decontamination is to be used, a method should be chosen that could reasonably be expected to convert essentially all of the toxic material into nontoxic materials. For example, residues and wastes from experiments in which beta-propiolactone, bis(chloromethyl)ether, or methly chloromethy ether have been used should be treated for 10 min with concentrated aqueous ammonia. In the event that chemical decontamination is no feasible, wastes and residues should be placed in an impervious container that should be closed and labeled in some manner such as the following: CAUTION: COMPOUNDS OF HIGH CHRONIC TOXICITY OR CAUTION: CANCER SUSPECT AGENT. In general, liquid wastes containing such compounds should be placed in glass or (usually preferable) polyethylene bottles half filled with vermiculite and these should be transported in plastic or metal pails of sufficient capacity to contain the material in case of accidental breaking of the primary container. Consult Environmental, Health and Safety for instructions on the disposal of contaminated waste materials.

   Normal laboratory work should not be resumed in an area that has been used for work with substances of high chronic toxicity until it has been adequately decontaminated. Work surfaces should be thoroughly washed and rinsed. If experiments have involved the use of finely divided solid materials, dry sweeping should not be done. In such cases, surfaces should be cleaned by wet mopping or by use of a vacuum cleaner equipped with a high efficiency particulate air (HEPA) filter. All equipment (e.g. glassware, vacuum traps, and containers) that is known or suspected to have been in contact with substances of high chronic toxicity should be washed and rinsed before they are removed from the designated area.

4. **Be prepared for accidents**. Be prepared for the release of a substance of high chronic toxicity by formulating a contingency plan to deal with any accident, which may occur. Public Safety (X-5330) can provide assistance in preparing these contingency plans. Make sure that the

necessary equipment and materials are on hand to deal with possible accidents before beginning work with substance of high chronic toxicity.

5. **Medical consultation and examinations**. If you anticipate being involved in continued experimentation with a substance of high chronic toxicity (i.e. if you regularly use toxicologically significant quantities of such a substance three times a week). Then a qualified physician should be consulted to determine whether it is advisable to establish a regular schedule or medical surveillance or biological monitoring.

LAFAYETTE COLLEGE

Chemical Hygiene Plan

Appendix B

Emergency Response and Laboratory Shutdown Procedures

Public Safety Department
Environmental, Health and Safety (EHS) Division
Standard Operating Procedure (SOP) #20

Lafayette College's Emergency Response and Laboratory Shutdown Procedures

Unplanned or spontaneous events often disrupt daily operations on campus. In the event that an incident may interrupt your laboratory or facility operations, preparation of an emergency shutdown plan will familiarize faculty, staff, and students with actions to mitigate the loss of research, property, or life. Please be aware that the unpredictable events of nature do not always allow for an orderly progression for emergency response as outlined in the list below.

As described in the College's Incident Action Plan, Lafayette College has adopted Emergency Alert Levels to communicate the severity and time frame associated with an emergency event. The levels are as follows:

Level 1 – An unplanned event that is not likely to adversely impact or threaten life, health or property. Control of the incident is within the capabilities of College employees and the duration of the incident is short term.

Criteria:

- Incident resolved by College employees with assistance or advice from Public Safety and/or Facilities Operations.
- An outside agency may be involved as a precaution or as part of standard College procedure.
- Outside medical assistance not needed.

Examples:

- Fire alarm (no report of fire).
- Small chemical spill.
- Localized water pipe break affecting a portion of a building.
- A localized undetermined odor problem.

Level 2 – An unplanned event that may adversely impact or threaten life, health, or property within a single area. Control of the incident is beyond the capabilities of College employees. Outside agency assistance is necessary.

Criteria:

- Resolution of incident involves both College and outside agency personnel.
- Evacuation is short term and affects immediate localized area only.
- Duration of the incident is relatively short, but could last up to twenty-four hours.

Examples:

- A chemical spill requiring a disruption of services and fire department response.
- A water main break involving most of a building or one which threatens critical services.
- An odor requiring evacuation.
- Loss of heat or power to a building.
- Bomb threat which requires evacuation.

Level 3 – An unplanned event that may adversely impact or threaten life, health or property on a large scale at one or more locations within the College.

Criteria:

- Control of the incident will require specialists in addition to College and outside agency personnel. Long-term implications may result.
- Duration of incident is greater than two hours.
- Extensive evacuation or shutdown of area is required.

Examples:

- A water main break involving service to multiple buildings or a break affecting an entire academic or residential building that requires evacuation.
- Loss of heat or power to multiple buildings.
- A fire affecting an entire building.
- A chemical release causing the evacuation of one or more buildings.
- A large scale civil unrest on College property.

Level 4 – An incident occurring at the College or in the community, which adversely impacts or threatens life, health, or property at the College on a large scale.

Criteria:

- Control of the incident will require multiple agencies and multiple College departments working together.
- Long-term implications are likely.
- Large geographic impact extending beyond the College.
- Serious hazard or severe threat to life, health and property.
- Major evacuation involving implementation of the College relocation plan, interfacing with community plan.
- Duration of event is unpredictable.

Examples:

- Large scale chemical release affecting significant portion of the College.
- Hurricane, earthquake or other natural disaster.
- Major power outage.

- Civil unrest which threatens the College.
- Major fire.
- More severe major illness outbreak

Laboratory Emergency Planning

It is the responsibility of each faculty member to evaluate the hazards of the experiments being performed and to determine appropriate emergency procedures. Faculty members should evaluate the hazards and quantities of the chemicals in use in their laboratories to determine what level of response would be required in the event of a chemical release.

Consider the following questions in regards to your laboratory or building and address each item with specifics (location of primary and secondary rally sites if a building evacuation is required, supplies needed for a shutdown, and contact names and numbers).

- Is the following information posted on the outside of the entrance doors, with current information?
    - Names and contact numbers indicating who to contact for information on the chemicals and hazards in the laboratory.
- Appropriate door signs, if the laboratory contains (Radioactive Materials, Lasers, Carcinogens, Biohazards, Reproductive Hazards, etc.).
- Are all items removed from window ledges?
- Are all containers housing chemical, radioactive, and biohazardous liquids securely capped, properly labeled and stored safely?
- Are all containers securely stored above floor level in case of water events? Check all hazardous waste storage areas (chemical, biohazardous, radiological).
- Are all compressed gas cylinders properly secured and stored in an up-right position?
- Do compressed gas cylinders, not in use, have their valve caps tightly secured?
- Have chemicals been removed from laboratory benches and shelves? Are they stored in an appropriate chemical storage area?
- Are all incompatible chemicals stored separately from one another?
- Are there chemicals or biomaterials that need special storage (ultra-low freezers, etc.)?
- If you are working with animals, have you made arrangements for protective care?
- If you are working with electrical equipment, have you reviewed proper shut down procedures and measures to prevent surging?
- Do you know what power backup system is available to your building?
- Is your critical equipment tied into the emergency backup?
- Is your intellectual property (lab notebooks, ledgers, electronics) removed or safely stored?

Planning Suggestions

- Keep up-to-date procedures to be followed in the event of power or water loss (e.g., equipment shut-off). In the event of power loss, no operations releasing hazardous vapors should be conducted as ventilation is not adequate. In the event of water loss, no hazardous chemicals should be used in the laboratory as emergency eyewashes and showers are not available.

- Laboratories with outside windows should develop a secure area for the storage of water reactive chemicals and biological agents. These secure areas should be in the inner rooms of the building, preferably above the first floor and below the top floor.

- Laboratories using radioactive materials and other controlled substances should place these materials in their designated secure storage location within your building. If these areas are in labs with outside windows, and/or on the first floor, the material should be placed on shelves, inside the designated secured storage cabinet, at least 2 feet above floor level.

Specific planning guidance for each Emergency Alert Level is listed below.

Level 1 – Alert Phase

Begins with the initial notification of an imminent event. The severity and timeframe are contingent upon the event and will be better established in the coming hours.

- Begin the shutdown process if your facility may be impacted; review your laboratory emergency shutdown procedures, gather necessary supplies, make arrangements for storage of hazardous materials, animals as deemed necessary; review powering down procedures for electrical equipment.

Levels 2 and 3 – Partial Activation

Begins with notification and when the event is expected within the next 48 hours.

- Have all windows been properly closed and secured?
- Have you disconnected and secured all electrical equipment, not in present use, from water exposure?
- Are aisle spaces unobstructed?
- Are all floors and counter space clear of equipment, papers, chemicals, etc.?
- Have you placed all containers of water reactive, radioactive, or biohazardous wastes inside plastic break resistant containers (secondary container)?
- Did you fill out and attach a label, identifying contents, on secondary containers?
- Are all documents, records; computer files, etc., in plastic leak proof containers and stored in a secure area away from windows and above floor level (if on first floor)?
- If you are working with animals have you made arrangements for protective care?
- Do pneumatic lines need to be bled?
- Have regulators been removed from gas cylinders?
- Have valve caps been secured on all compressed gas cylinders?
- Have you checked all of your gas alarms?

- Lower the temperature in refrigerators and freezers to preserve contents in the event of a prolonged power failure.
- If electronic equipment has an auto-restart function, has this been disabled?
- Will your experiment take more than 12 hours to safely shut down and be secured? If so - start the process immediately

Level 4 – Full Activation *Mandatory Action Level*

Level 4 begins with notification that the event is likely to occur within 36 hours or is of such magnitude that an instantaneous alert is issued.

- **Immediately end all experiments in progress and stop all use of chemicals, radiological, and biohazardous agents. Safely shut down and secure your experiments.**

If time permits:

- Have you unplugged and covered all non-critical electrical equipment?
- Is equipment protected in areas with windows from hazards associated with broken glass, rain and wind?
- Is there a cover on each piece of electrical equipment with large plastic bags or suitable plastic? Do not cover ventilation vents and/or fan motors that could result in over-heating and possible fire. *CAUTION: Electronic equipment must be turned off, and unplugged from the wall outlet, before covering with a garbage bag or plastic. Failure to do so could result in overheating and possible fire.*
- Are all bench-top items shelved and secured?
- Is all hazardous, biological and radioactive waste containerized, sealed, labeled and stored in their designated secure storage locations?
- Is all material and equipment removed from inside ventilated hoods?
- Have all utility valves been closed?
- Have all refrigerators, freezers, incubators been locked or taped shut?

<u>Recovery Phase</u>

This phase begins when College Administration releases the campus from a state of emergency and notifies the campus population.

Upon returning to your laboratory of facility:

- Visually inspect the laboratory through the room or door windows to determine lab conditions before entering.
- If required, don appropriate personal protective equipment (PPE) before entering your laboratory.
- Submit a damage assessment report with photo documentation to Finance and Business Affairs to begin the process of filing a claim.

- Contact EHS to report damage or hazardous material spills.

Supplies

- Storage of water reactive, radioactive, and biohazardous materials via break resistant plastic containers with screw type closures. These are secondary protective containers and must be large enough so breakable primary containers can be placed inside and secured. They are used to protect against the release of harmful materials into the environment.
- Protection from water damage: use large garbage bags, smaller sealable bags or plastic sheeting to cover electrical equipment and data from possible water damage.
- Labels to place on all containers and bags for identification.
- Permanent markers to write on the labels.
- Tape to secure container screw top lid and tie off garbage bags.
- Chemical spill kits: assure the proper chemical spill supplies are readily available for the types of materials you have in your lab. These materials should be readily available and stored in a designated location, at least 2 feet above floor level.