# Mercy College

# Chemical Hygiene Plan

Updated February 2023

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## List of Acronyms/Abbreviations used in the Chemical Hygiene Program

| | |
|---|---|
| **ACGIH** | American Conference of Governmental Industrial Hygienists |
| **AL** | Allowable Limit |
| **BSC** | Biological Safety Cabinet |
| **CFR** | Code of Federal Regulations |
| **CHO** | Chemical Hygiene Program |
| **CHP** | Chemical Hygiene Program |
| **DOT** | Department of Transportation |
| **HEPA** | High Efficiency Particulate Air Filters |
| **EH&S** | Environmental Health and Safety |
| **EPA** | Environmental Protection Agency |
| **HVAC** | Heating Ventilation Air Conditioning |
| **IARC** | International Agency for Research on Cancer |
| **IH** | Industrial Hygiene |
| **JHA** | Job Hazard Assessment |
| **LC50** | Lethal Concentration50 |
| **LD50** | Lethal Dose50 |
| **MSDS** | Material Safety Data Sheet |
| **NFPA** | National Fire Protection Association |
| **NIOSH** | National Institute for Occupational Safety and Health |
| **NTP** | National Toxicology Program |
| **OSHA** | Occupational Safety and Health Administration |
| **PEL** | Permissible Exposure |
| **PPE** | Personal Protective Equipment |
| **PPM** | Parts Per Million |
| **RACE** | Rescue Alert Confine Evacuate |
| **STEL** | Short Term Exposure Limit |
| **TLV** | Threshold Limit Value |
| **TWA** | Time Weighted Average |

# Emergency Phone Numbers

## EMERGENCY TELEPHONE NUMBERS

| | |
|---|---|
| Lab Manager Dobbs Ferry | (914) 674-7115 |
| Lab Assistant Dobbs Ferry | (914) 674-3067 |
| Lab Assistant Bronx | (718) 674-8470 |
| | |
| Campus Safety (Dobbs Ferry)<br><br>Non Emergency | (914) 674-9999<br><br>(914) 674-7225 |
| Campus Safety (Bronx) | (718) 678-8983) |
| | |
| **Police** | **911** |
| **Fire or Smoke** | **911** |
| **Medical Emergencies** | **911** |
| | |
| Hudson Valley Poison Control Center | 1 (800) 222-1222 |
| Westchester Medical Center | (914) 493-7075 |

## SPECIAL INCIDENT REPORTING

| | |
|---|---|
| Gas Leaks or Odors: Facilities Department | (914) 674-7362 (x7540) |
| Chemical Spills: Lab Manager | (914) 674-7115 |
| | |

# I. Introduction

The Mercy College Chemical Hygiene Plan (CHP) is written to comply with Occupational Safety and Health Administration (OSHA) regulations as set forth in 29 CFR 1910.1450, (Occupational Exposure to Hazardous Chemicals in Laboratories). This regulation mandates a program of practices, procedures, and policies designed to protect employees who use hazardous chemicals in a laboratory setting. These hazardous chemicals include not only those regulated by 29 DFR 1910, Subpart Z, but also any chemical meeting the definition of a hazardous chemical with respect to physical and health hazards as defined in OSHA's Hazard Communication Standard, 29 CFR 1910.1200.

This CHP applies to all laboratories operated by Mercy College. The purpose of the CHP is to provide the chemical user with basic safety information regarding the proper use, handling, storage, and disposal of chemicals. Although a number of chemicals are specifically mentioned in this plan, they are not the only chemicals that may be present at a given time. They serve to illustrate potential hazards that may be present.

It is the policy of Mercy College to provide an environment free from recognized hazards that could cause injury or illness. To this end, employees may not be exposed at or above the Permissible Exposure Limits (PEL) of OSHA or the Threshold Limit Values (TLV) of the American Conference of Governmental Industrial Hygienists.

Working with any chemical involves a certain degree of risk. Even though a chemical may not be considered hazardous by today's standards, all employees are advised to minimize their exposure to chemicals in general by using established safe practices. Three main categories exist to control exposure. These include engineering controls, work practices and administrative controls, and personal protective equipment (PPE).

- Engineering controls, the preferred method for reducing exposure, should be used whenever the chemical hazard information on the chemical label or the Safety Data Sheet (SDS) indicates the use of local exhaust. Examples of engineering controls include fume hoods and canopy hoods.

- Work practices and administrative controls are another method for reducing employee exposure in addition to the use of engineering controls. SDS and chemical labels should be reviewed for specific work practice instructions.

- PPE should be used in addition to, but not as a substitute for, engineering controls and work practices to reduce exposure. PPE may consist of respiratory protection, eye protection, face protection, gloves, hearing protection, or protective clothing. SDS and chemical labels contain specific information on the PPE needed. When PPE is selected, its use shall be in accordance with OSHA standard 29 CRF 1910 subpart I, sections 132-134. The CHP is a continually evolving program. The CHP can be modified by the approval of the Chemical Hygiene Officer.

# II. Responsibilities

Responsibility for implementing the CHP resides with the faculty of the Department of Natural and Health Sciences. The Laboratory Supervisor/Manager(s) has been designated as the Chemical Hygiene Officer (CHO). Those individual departments that have labs also share in the responsibility of maintaining a safe and appropriate environment in accordance with established protocols. Additional assistance/guidance may be sought from the Mercy College Department of Campus Safety which oversees life safety measures across all three campuses.

## Department Chair

Department Chair:

- Ensure the department's compliance with health and safety standards.
- Ensure that a Laboratory Supervisor/Manager is designated and officially appointed as Chemical Hygiene Officer.

## Lab Manager

Laboratory Supervisor/Manager:

- Prepare and periodically review, in accordance with established best practice, the Mercy Chemical Hygiene Plan as required by OSHA. Update as necessary.
- Ensure that laboratory personnel meet the training requirements of the Laboratory Standard, including chemical hazard information, safety rules, and good work practices.
- Provide initial training to laboratory personnel, upon employment, in the contents of the Chemical Hygiene Plan. Ensure all employees working in labs undergo annual Hazardous Communication and Blood Borne Pathogen online training. Maintain training records for one year in the laboratory safety notebook.
- Ensure that staff and visitors observe safety rules. Report all cases of non-compliance to the Departmental Chair.
- Complete a chemical inventory for the laboratory locations under their direction. Updated chemical inventories must be done at least annually.
- Obtain Safety Data Sheets (SDSs) for the employees under their direction to determine the personal protective equipment (PPE) required.
- Post appropriate hazard information signs within the laboratory.
- Conduct periodic inspections and take immediate action to abate hazards that may pose a risk to life and safety upon discovery of such hazards.
- Investigate and report incidents related to the use of hazardous chemicals.
- Monitor and test emergency safety showers and eyewashes on a regular basis.
- Ensure lab signage is current and visible.
- Provide oversight of environmental compliance, transport, and disposal of hazardous waste.
- Inform Facilities personnel, non-laboratory personnel, and any outside contractors of potential hazards when they are required to perform necessary work within the confines of laboratory space.

## Faculty and Adjuncts

Faculty and Adjuncts have primary responsibility for the safety of the labs under their jurisdiction. These responsibilities include:

- Knowing applicable health and safety rules and regulations, training, and reporting requirements and standard operating procedures associated with chemical safety.
- Identifying and reporting hazardous conditions.
- Implementing and enforcing standard safety procedures.
- Inform Facilities personnel, non-laboratory personnel, and any outside contractors of potential hazards when they are required to perform necessary work within the confines of laboratory space.

- Ensuring that all chemical containers are appropriately labeled.
- Informing assistants/students of potential hazards associated with the use of hazardous chemicals.
- Providing specific training for all lab employees using hazardous chemicals in their labs.
- Selecting and employing engineering controls and laboratory practices to reduce potential exposure to the lowest practical level in accordance with the CHP.
- Ensuring that proper safety supplies and equipment, such as gloves, safety glasses and/or goggles, lab coats, and respirators (if needed) are available for all people in the laboratory.
- Reporting incidents related to the use of hazardous chemicals.
- Selecting chemicals, making arrangements through the Laboratory Supervisor for monitoring the use of chemicals, disposing of hazardous chemical wastes, and maintaining a record of chemicals posing a high chronic toxicity for all personnel under their direction.
- Maintaining an updated chemical inventory.

## Laboratory Employees

Laboratory employee responsibilities include:

- Studying instant Chemical Hygiene Plan and other information provided by your supervisor as necessary.
- Planning and conducting laboratory procedures in accordance with the CHP.
- Developing and practicing good, personal hygiene habits.
- Reporting unsafe conditions to the Professor/Instructor or the Laboratory Supervisor/Managers.
- Reporting incidents of hazardous chemical exposure to the Professor/Instructor or the Laboratory Safety Officer.
- Ensuring hazardous waste is collected at the point of generation and handled in accordance with protocols issued by the Laboratory Supervisor.

## Laboratory Safety Committee

Laboratory Safety Committee is formed to provide an alternative checks and balances system. The committee is comprised of faculty and staff who together have the ability to oversee the functionality of the Chemical Hygiene plan an =d work together to maintain its functionality.

- Provide feedback when there is an aspect of the chemical hygiene plan that is not being executed properly.
- Work with EHS/CHO to revise and review the Chemical Hygiene Plan on an annual basis.

Attend regular meetings and review research protocol if/when necessary.

## Facilities

Facilities personnel have direct control over the laboratory's general and local ventilation systems, as well as other utility systems (gas, water, electrical, HVAC). Facilities personnel must be informed of the hazards that are present in the laboratory before beginning any work in a laboratory, on sanitary waste lines, or the HVAC system. Facilities responsibilities include:

- Informing laboratory personnel in advance of scheduled utility or maintenance shutdowns (gas, water, fume hoods, etc.).
- Maintaining local exhaust (fume hoods, slot hoods, ducted biological safety cabinets, etc.) blowers and ducts to provide the engineering controls necessary to maintain safe laboratory conditions.
- The internal blowers of biological safety cabinets are NOT to be serviced by Facilities personnel. Only an outside contractor who has attended special training on the servicing of these units in accordance with the National Sanitation Foundation Standard 49 may work on the internal blowers or filters of these special units. Activities such as the repair of external electrical outlets, gas outlet repairs, and light bulbs are permitted.

# III. Employee Information and Training

**Required Training and Purpose**

The Laboratory Supervisor is required to provide general laboratory safety training to laboratory personnel. This training will include:

- The existence of the CHP and the requirements of OSHA's Laboratory Standard.
- Control methods (engineering controls, workplace practices, administrative controls, and personal protective equipment) to minimize employee exposure to hazardous chemicals in the laboratory.
- Signs and symptoms associated with exposure to common hazardous chemicals used in the laboratory.
- The location and availability of reference materials – including SDSs, information on the hazards, safe handling, and storage of hazardous chemicals.
- How to read and understand the material found on an SDS.
- The proper use of emergency equipment and the limitations of PPE and safety equipment.
- Emergency procedures to follow in the event of a fire, exposure, or spill.
- Requirements for the collection, storage, emergency response, and disposal of hazardous waste in laboratory locations.
- Locations of emergency exits, fire suppression systems, first aid kits, and shower/eyewash stations.

The professor/supervisor must provide employees with training/orientation for the laboratories under their direction. This information is to include departmental safety policies and special procedures followed in the employees work location(s). When a new hazard(s) is/are introduced in the workplace, the professor/supervisor must train the employees to these hazard(s).

Mercy College provide its employees involved with the labs of SHNS via online OSHA training modules on Hazardous Communication and Bloodborne Pathogen at zywave.com.

**Documentation of Training**

Relevant training records are maintained electronically in the Office of the Dean.

**Frequency of Training**

All laboratory employees are required to take online Laboratory Safety Training sessions annually. These sessions will include information on the college's Chemical Hygiene Program, potential laboratory hazards, how these hazards may enter and affect the body, how to read an SDS, the disposal of waste, and any applicable emergency information. Each laboratory course includes a slide deck on lab specific safety topics. All students taking the courses with laboratory components must sign the student contract which is collected by the teaching faculty and kept in the Lab Manager's office.

# IV. Hazardous Chemicals

At Mercy College, it is expected that each laboratory room is provided with its own chemical inventory which may be accessed at any time by EHS if necessary. It is important to know the location of hazardous, and other chemicals in a time of emergency. It is expected that each laboratory Instructor will cooperate and make it possible to access required information.

- Lab signs have been posted already and will continue to be updated on an annual basis to ensure that all information is current. All lab signs are required to state at the very least the most hazardous substance found within the lab, its classification.
- Regular audits of laboratory inventory will occur to keep records current, and account for any missing items.
- It is the right of all persons working in a laboratory to know the hazardous substances contained within that room or facility. It is the responsibility of the Laboratory Instructor to determine the hazardous substances that are present in their lab and which will be used in experimentation, according to those defined by OSHA.

The term “hazardous chemical” refers to a chemical for which there is statistical evidence that acute or chronic health effects may occur in exposed employees, or if it is listed in any of the following:

- OSHA, 29 CFR 1910 Subpart Z, Toxic and Hazardous Substances;
- Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment, ACGIH (latest edition); or,
- The Registry of Toxic Effects of Chemical Substances, NIOSH (latest edition).

## Types of Hazards

- **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.
- **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 which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes

| Physical Hazards | Health Hazards |
|---|---|
| ***Fire Hazards*:** combustible liquid, flammable liquid, flammable aerosol, flammable gas, flammable solid, oxidizer, pyrophoric | **Systemic effects:** carcinogen, toxic agent, acute toxicity agent, corrosive, irritant, sensitizer |
| **Explosion Hazards:** Compressed gas, explosive<br><br>**Reactive Hazards:** Organic peroxide, Reactive and water-reactive | **Target Organ Effects:** hepatotoxin, neurotoxin, nephrotoxin, blood toxin, respiratory toxin, reproductive toxin, cutaneous hazard, eye hazard |

**Fire Hazards**: A number of highly flammable substances are in common use in campus laboratories. Combustible liquids are those with a flash point at or above 100 degrees Fahrenheit. Flammable liquids include those chemicals that have a flashpoint of less than 100 degrees Fahrenheit. It should be mentioned that flash point was selected as the basis for classification of flammable and combustible liquids because it is directly related to a liquid's ability to generate vapor, i.e., its volatility. Since it is the vapor of the liquid, not the liquid itself that burns, vapor generation becomes the primary factor in determining the fire hazard. These materials must be stored in flammable storage cabinets if aggregate quantities of 10 gallons/room or more are stored in the lab. No more than 60 gallons should be stored inside a flammable cabinet at a time. Flammable gases include examples such as hydrogen and oxygen which could cause an explosion upon ignition. Pyrophoric chemicals are a special classification of reactive materials that spontaneously combust when in contact with air and require laboratory-specific training. Particular attention should be given to preventing static electricity and sparks when handling flammable liquids.

**Reactivity Hazards**: Reactive and explosive substances are materials that decompose under conditions of mechanical shock, elevated temperature, or chemical action, and release of large volumes of gases and heat. Some materials, such as peroxide formers, (ex. Ethyl ether, THF) may not be explosive, but may form explosive substances over time. These substances pose an immediate potential hazard and procedures which use them must be carefully reviewed. Peroxide formers must be monitored using peroxide strips every three months. These materials must also be stored in a separate flame-resistant storage cabinet or, in many cases, in laboratory grade refrigerator or freezer that are designed for flammable and reactive chemicals.

**Corrosive Substances:** As a health hazard, corrosive substances cause destruction of, or alterations in, living tissue by chemical action at the site of contact. Major classes of corrosive substances include:

• Strong acids – e.g., sulfuric, nitric, hydrochloric and hydrofluoric acids

• Strong bases – e.g., sodium hydroxide, potassium hydroxide and ammonium hydroxide

• Dehydrating agents – e.g., sulfuric acid, sodium hydroxide, phosphorus pentoxide and calcium oxide

• Oxidizing agents – e.g., hydrogen peroxide, chlorine and bromine.

**Irritants:** Irritants are agents that can cause inflammation of the body surface with which they come in contact. A wide variety of organic and inorganic compounds, including chemicals that appear in either powder or crystallin forms, are irritants. Irritants can also cause changes in the mechanics of respiration and lung function. Common irritants include:

| Common Skin Irritants | Common Respiratory Irritants |
|---|---|
| Ammonia | Acetic acid |
| Alkaline dusts and mists | Acrolein |
| Hydrogen chloride | Formaldehyde |
| Hydrogen fluoride | Formic acid |
| Halogens | Halogens |
| Nitrogen dioxide | Sulfur dioxide |
| Ozone | Sulfuric Acid |
| Phosgene | |
| Phosphorous chloride | |

**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. Examples of sensitizers include diazomethane, chromium, nickel, formaldehyde, isocyanates, arylhydrazines, benzylic and allylic halides, and many phenol derivatives. Sensitizer exposure can lead to all of the symptoms associated with allergic reactions, or can increase an individual's existing allergies.

**Asphyxiants**: Asphyxiants are broken into two groups. Simple asphyxiants deprive the tissue of oxygen. Chemical asphyxiants render the body incapable of maintaining an adequate oxygen supply. Examples include:

| Simple Asphyxiants | Chemical Asphyxiants |
|---|---|
| Carbon Dioxide | Carbon Monoxide |
| Helium | Cyanides |
| Nitrogen | |
| Nitrous Oxide | |

**Hepatotoxic agents**: Hepatotoxic agents cause damage to the liver. Examples include:

| | | |
|---|---|---|
| Carbon tetrachloride | Nitrosamines | Tetrachloroethane |

**Nephrotoxic agents:** Nephrotoxic agents damage the kidneys. Examples include:

| | |
|---|---|
| Halogenated hydrocarbons | Uranium compound |

**Neurotoxic agents:** Neurotoxic agents damage the nervous system. Generally, the nervous system is sensitive to organometallic compounds and sulfide compounds. Examples include:

| | |
|---|---|
| Carbon disulfide | Tetraethyl lead |
| Manganese | Thallium |
| Methyl mercury | Trialkyl tin compounds |
| Organic phosphorous insecticides | |

**Hematopoietic System Effects:** These agents act on the blood. The blood cells can be directly affected or the bone marrow can be damaged. Examples include:

| | |
|---|---|
| Analine | Nitrobenzene |
| Benzene | Toluidine |
| Nitrites | |

**Carcinogens**: A carcinogen is any agent that can initiate or speed the development of malignant or potentially malignant tumors, or malignant neoplastic proliferation of cells. Effects may become evident only after a long latency period. Some of these compounds are common materials used in many laboratories, such as acrylamide, chloroform, carbon tetrachloride, benzene, hydrazine, and thiourea. Select carcinogens are those substances that meet one of the following criteria:

- It is regulated by OSHA as a carcinogen;
- It is listed under the category "known to be carcinogens", as listed in the latest edition of the National Toxicology Program's (NTP) "Annual Report of Carcinogens".
- IT is listed under Group 1, "carcinogenic to humans" by the International Agency for Research on cancer Monographs (IARC); or,
- It is listed under Group 2A or 2B by IARC or under the category "reasonably anticipated to be carcinogens" by the NTP, and causes tumors in experimental animals according to any of the following criteria:

    a. After inhalation exposures of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to doses of less than 10 mg/m3.

    b. After repeated skin application of 300 mg/kg of body weight per week; or,

    c. After oral doses of less than 50 mg/kg of body weight per day.

**Reproductive hazard**: Reproductive hazards are those chemicals that affect the reproductive capabilities including chromosomal damage (mutagens) and effects on the fetus (teratogens). Such a chemical affects the chromosome chains of the exposed cells. The change becomes part of the genetic pool passed on to future generations. A teratogen is an agent that interferes with normal embryonic development without damage to the mother or lethal effects on the fetus. Any effect would not be hereditary.

**Sensitizer**: A sensitizer is an agent that causes a majority of the exposed population to develop an allergic reaction in normal tissue after repeated exposures to the chemicals. Reactions can range from mild, such as a rash, to severe, such as anaphylactic shock.

**Acutely Toxic Chemicals**: These chemicals are substances falling into the following categories:

- A chemical that has a median lethal dose (LD50) of 50 mg/kg or less of body weight, when administered to rats weighing 200 to 300 g each;
- A chemical that has a median lethal dose (LD50) of 2000 mg/kg or less of body weight, when administered by continuous contact for 24 hours to the bare skin of rabbits weighing 200 to 300 g each; or,
- A chemical that has a median lethal concentration (LC50) in air of 200 ppm by volume or less when administered by continuous inhalation for one hour to rates weighing 200 to 300 g each.

## List of Known / Suspected Carcinogens

The National Institute for Occupational Safety and Health (NIOSH) considers the following list of substances to be potential occupational carcinogens.

**A**

Acetaldehyde
2-Acetylaminofluorene
Acrylamide
Acrylonitrile
Aldrin
4-Aminodiphenyl
Amitrole
Aniline and homologs
*o*-Anisidine
*p*-Anisidine
Arsenic and inorganic arsenic compounds
Arsine
Asbestos
Asphalt fumes

**B**

Benzene
Benzidine
Benzidine-based dyes
Beryllium
Butadiene
*tert*-Butyl chromate; class, chromium hexavalent

**C**

Cadmium dust and fume
Captafol
Captan
Carbon black (exceeding 0.1% PAHs)
Carbon tetrachloride
Chlordane
Chlorinated camphene
Chlorodiphenyl (42% chlorine); class polychlorinated biphenyls
Chlorodiphenyl (54% chlorine); class polychlorinated biphenyls
Chloroform
Chloromethyl methyl ether
bis(Chloromethyl) ether
*B*-Chloroprene

Chromium, hexavalent [Cr(VI)]
Chromyl chloride; class, chromium hexavalent
Chrysene
Coal tar pitch volatiles; class, coal tar products
Coke oven emissions

**D**

DDT (dichlorodiphenyltrichloroethane)
Di-2-ethylhexyl phthalate (DEHP)
2,4-Diaminoanisoleo
*o*-Dianisidine-based dyes
1,2-Dibromo-3-chloropropane (DBCP)
Dichloroacetylene
*p*-Dichlorobenzene
3,3'-Dichlorobenzidine
Dichloroethyl ether
1,3-Dichloropropene
Dieldrin
Diesel exhaust
Diglycidyl ether (DGE); class, glycidyl ethers
4-Dimethylaminoazobenzene
Dimethyl carbomoyl chloride
1,1-Dimethylhydrazine; class, hydrazines
Dimethyl sulfate
Dinitrotoluene
Dioxane

**E-G**

Environmental tobacco smoke
Epichlorohydrin
Ethyl acrylate
Ethylene dibromide
Ehtylene dichloride
Ethylene oxide
Ethyleneimine
Ethylene thiourea
Formaldehyde
Gallium arsenide
Gasoline

**H-K**

Heptachlor
Hexachlorobutadiene
Hexachloroethane
Hexamethyl phosphoric triamide (HMPA)
Hydrazine
Kepone

**M**

Malonaldehyde
Methoxychlor
Methyl bromide; class, monohalomethanes
Methyl chloride
Methyl iodide; class, monohalomethanes
Methyl hydrazine; class, hydrazines
4,4'-Methylenebis(2-chloroaniline) (MBOCA)
Methylene chloride
4,4-Methylenedianiline (MDA)

**N**

*a*-Naphylamine
*B*-Naphylamine
Nickel, metal, soluble, insoluble, and inorganic; class, nickel, inorganic
Nickel carbonyl
Nickel sulfide roasting
4-Nitrobiphenyl
*p*-Nitrochlorobenzene
2-Nitronaphthalene
2-Nitropropane
*N*-Nitrosodimethylamine

**P**

Pentachloroethane; class, chloroethanes
*N*-Phenyl-*b*-naphthylamine; class, *b*-naphthalene
Phenyl glycidyl ether; class, glycidyl ethers
Phenylhydrazine; class, hydrazines
Propane Sultone
*B*-Propiolactone
Propylene dichloride
Proplyene imine
Propylene oxide

**R-S**

Radon
Rosin core solder, pyrolysis products (containing formaldehyde)
Silica, crystalline cristobalite
Silica, crystalline quartz
Silica, crystalline tripoli
Silica, crystalline tridymite
silica, fused
Soapstone, total dust silicates

**T**

Tremolite silicates
2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (TCDD) (dioxin)
1,1,2,2-Tetrachloroethane
Tetrachloroethylene
Titanium dioxide
*o*-Tolidine-based dyes
*o*-Tolidine
Toluene diisocyanate (TDI)
Toluene diamine (TDA)
*o*-Toluidine
*p*-Toluidine
1,1,2-Trichloroethane; class, chloroethanes
Trichloroethylene
1,2,3-Trichloropropane

**U-Z**

Uranium, insoluble compounds Uranium, soluble compounds
Vinyl bromide; class, vinyl halides
Vinyl chloride
Vinyl cyclohexene dioxide
Vinylidene chloride (1,1-dichloroethylene); class, vinyl halides)
Welding fumes, total particulates
Wood dust
Zinc chromate; class, chromium hexavalent


WYND
WYND
WYND

# V. Controls

Safety controls are the first line of defense in a laboratory setting against exposure to hazardous chemicals. Exposure means to either ingest, inhale, inject or absorb. Of these four routes of exposure, the most likely to occur is inhalation. Whenever possible, it is the goal of this Chemical Hygiene Plan to eliminate all routes of exposure to a hazardous chemical. Three types of controls will be outlined to make the lab the safest place possible. This document will describe engineering controls, administrative controls, and protective equipment as protection against hazards.

**Engineering Controls**

Engineering controls are what we consider to be "built in" controls. These installed controls are designed to try and eliminate hazardous conditions in the lab when hazards are present. These controls require little to no extra procedure to be followed by the end user, except monitoring and observing control functionality. Examples of engineering controls are ventilation systems, flammable storage areas, and secondary containments.

- **Ventilation Systems**. Laboratories should not be part of the recirculated air system in a building. They should be completely ventilated to the outdoors. The air inside a laboratory should also be set at a negative pressure to prevent the spreading of fumes from that laboratory to outside rooms or areas, so instructors should keep their lab doors closed at all times, so that the hoods can function at the proper velocities and have the maximum output.
- **Fume Hoods**. Fume hoods are the most commonly used local exhaust system on campus. 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 reduce or eliminate volatile liquids, dusts and mists. EHS is responsible for hood inspections on an annual basis. Each hood should have a tag identifying its certification and the date of its last inspection. Each fume hood should have a current calibration sticker and a marker indicating the highest sash height to be used when working with hazardous materials. Contact EHS for a hood evaluation if these labels are missing. Air flow for fume hood ventilation is measured at nine points. The average of the nine readings must be at least 100 linear feet per minute (lfm) with a minimum of 70 lfm for any measurement. Each fume hood must be equipped with at least one type of continuous quantitative monitoring device designed to provide the user with current information on the operational status of the hood. When hazardous materials are in a fume hood, but it is not under active use (e.g., during an unattended reaction or experiment), the sash should be closed. Fume hoods are not designed for storage of hazardous materials. Outside of routine inspections, individuals in each lab are responsible for monitoring equipment, and helping to notice if there is a problem or malfunction with any fume hood or ventilation. Upon realization of malfunction Facilities should be notified and that hood should not be used until the problem is resolved. Laboratory fume hoods are one of the most important pieces of equipment used to protect laboratory and other workers from exposure to hazardous chemicals. Chemical fume hoods should be inspected upon installation, renovation, when a deficiency is reported, or a change has been made to the operating characteristics of the hood. Since fume hoods used for regulated carcinogens have additional requirements, such as increased face velocity (average of 100-150 lfm, with no measurement less than 100 lfm), contact EHS if the intended use changes.

Fume Hood Functionality

| Fume Hood Inspections | |
|---|---|
| ***Step 1 – Physical Inspection (End User)*** | ***Step 2 – Hood Performance Inspection (EHS/Professional Contractor)*** |
| Evaluates the physical condition of the hood and the materials being used in the hood. This includes checking for:<br>• Improper storage of materials inside the fume hood<br>• Use of proper materials<br>• General hood cleanliness<br>• Physical damage to the fume hood (e.g., broken sash)<br>• Fully functioning lighting, fume hood indicator, airflow monitor, and alarm | Evaluates the overall hood performance to ensure that it is functioning properly. This involves checking the:<br>• Average face velocity and set minimum face velocity, which is used to determine the rating of the hood and what the hood can be used for<br>• Noise generated by the fume hood, to ensure that it is below 85 dB<br>• If fume hood does not pass inspection, it will be labeled with a "DO NOT USE" sign until it can be repaired. |

https://ucla.app.box.com/ehs-chemical-hygiene-plan

- **Other engineering controls**. In addition to the elements listed above, consideration must be given to providing sufficient engineering controls for the storage and handling of hazardous materials. No more than 10 gallons of flammable chemicals may be stored outside of an approved flammable storage cabinet. For refrigerated or frozen storage, flammable and explosive materials must be kept in refrigeration units specifically designed for storing these materials. Generally these units do not have internal lights or electronic systems that could spark and trigger an ignition; additionally, the cooling elements are external to the unit. These units should be labeled with a rating from Underwriters Laboratory or other certifying organization Secondary containment must be provided for corrosive and reactive chemicals and is recommended for all other hazardous chemicals. Secondary containment should be made of chemically resistant materials and should be sufficient to hold the volume of at least the largest single bottle stored in the container. Laboratories that use hazardous materials must contain a sink, kept clear for hand washing to remove any final residual contamination. Hand washing is recommended whenever a staff member who has been working with hazardous materials plans to exit the laboratory or work on a project that does not involve hazardous materials. Many areas of research buildings may contain critical fire doors as part of the building design. These doors are an important element of the fire containment system and should remain closed unless they are on a magnetic self-closing or other automated self-closing system.

**Administrative Controls.**

The next layer of safety controls are Administrative Controls. These controls consist of policies and procedures; they are not generally as reliable as engineering controls in that the user has to carefully follow the appropriate procedures and must be fully trained and aware in order to do so.

- Standard Operating Procedures Standard operating procedures (SOPs) that are relevant to safety and health considerations must be developed and followed when laboratory work involves the use of hazardous processes, and/or hazardous chemicals, especially for "particularly hazardous substances" (PHS). SOPs are written instructions that detail the steps that will be performed during a given experimental procedure and include information about potential hazards and how these hazards will be

mitigated. SOPs should be written by laboratory personnel who are most knowledgeable and involved with the experimental process. The development and implementation of SOPs is a core component of promoting a strong safety culture in the laboratory and helps ensure a safe work environment. While general guidance regarding laboratory work with chemicals is contained in this plan, instructors and coarse coordinators are required to develop and implement laboratory-specific SOPs for certain hazards, hazardous chemicals, and PHS that are used in their laboratories. The course coordinator and all personnel responsible for performing the procedures detailed in the SOP shall work together to make sure the requirements and responsibilities outlined in the SOP are correct. The SOPs shall be reviewed by qualified personnel and shall be amended and subject to additional review and approval by the course coordinator where changes or variations in conditions, methodologies, equipment, or use of the chemical occurs. For certain hazardous chemicals, PHS, or specialized practices, consideration must be given to whether additional consultation with safety professionals is warranted or required. SOPs must be developed prior to initiating any experiments with potentially hazardous biologicals and chemicals or PHS and are to be filed and maintained in the laboratory where they are available to all laboratory personnel. When drafting an SOP, consider the type and quantity of the chemical being used, along with the frequency of use. The Safety Data Sheet (SDS) for each hazardous chemical or PHS that will be addressed in the SOP should be referenced during SOP development. The SDS lists important information that will need to be considered, such as exposure limits, type of toxicity, warning properties, and symptoms of exposure. If a new chemical will be produced during the experiment, an SDS will not necessarily be available. In these cases, the toxicity is unknown and it must be assumed that the substance is particularly hazardous, as a mixture of chemicals will generally be more toxic than its most toxic component.

# VI. Personal Protective Equipment (PPE)

Laboratory personnel must wear PPE to help prevent chemical exposures. The needed PPE is provided by the professor/supervisor at no cost to the employee. PPE may include, but is not limited to:

**Eye and Face Protection** – College policy on eye protection requires students, faculty, staff, and visitors in laboratories wear eye protective devices during any experiment or laboratory procedure (regardless of anticipated eye hazards). The type of safety device required depends on the nature of the hazard and the frequency with which the wearer encounters it. There are three basic types of eye and face protection that meet the majority of the College laboratory requirements: safety glasses with side shields, goggles, and face shields. Each of these meets basic eye protection standards for frontal exposure to flying particles. Faculty member must determine the appropriate level of eye protection for the particular task at hand, and enforce eye protection rules.

- **Safety Glasses**: Ordinary prescription glasses do not provide adequate protection from injury to the eyes. Adequate eye protection requires the use of hardened-glass or plastic safety spectacles with side shields. Safety glasses used in the laboratory must comply with the Standard for Occupational and Educational Eye and Face Protection (Z87.1) established by the American National Standards Institute. This standard specifies a minimum lens thickness of 3 mm, impact resistance requirements, passage of a flammability test, and lens-retaining frames. Three important dimensions for fit and comfort include temple length, nose bridge width, and lens diameter. Safety spectacles with side shields, bendable temples, and universal nose bridges are available in several lens diameters. Prescription safety spectacles are recommended for employees wearing glasses. Do not wear photogrey (transition) lenses indoors in laboratory environments, because the percentage of light transmitted under normal light conditions is below ANSI standards.

- **Chemical splash goggles or full-face shields where applicable** when significant liquid splash hazards exist. The side shields on safety glasses offer some protection from objects approaching from the side, but do not provide adequate splash protection.
- **Face Shields:** Goggles or safety glasses alone do not meet ANSI standards for protection to the face and neck. When greater protection from flying particles and harmful liquids is required, wear full-face shields that protect the face and throat. For full protection, always wear a pair of safety glasses or goggles in combination with a face shield. Consider using a face shield or mask when operating a vacuum system (which may implode), or conducting a reaction with the potential for mild explosions. Always use a UV-blocking face shield when working with transilluminators or other devices that produce ultraviolet radiation.
- **Cost, Care and Reclamation**: Mercy College is committed to a providing eye and face protection devices without cost to employees and visitors. Students are individually responsible for purchasing their eye protection device.

Eye protective devices are personal items, issued for the exclusive use of each individual. Clean with soap and water and store in a clean, protected area. Thoroughly clean and disinfect all eye protective devices before re-issue.

**Use of Gloves**

Mercy College provides nitrile low allergenic gloves for its employee and students.

Appropriate gloves are to be worn when the potential exists for contact with corrosive materials, materials of unknown toxicity, sharp edged objects, and very hot or cold materials. Select gloves based on the material handled, the particular hazard involved, and their suitability for the operation conducted. The gloves are to be inspected before each use and replaced periodically. Disposable gloves should never be reused.

Chemicals eventually permeate all glove materials. However gloves are safe for limited periods if one knows the specific use and glove characteristics (such as thickness and permeation rate and time). Common glove materials include neoprene, polyvinyl chloride, nitrile, butyl, and natural rubbers (latex). These materials differ in their resistance to various substances. The selection of gloves is to be based on chemical permeability. Because of the wide number of gloves and manufacturers available, information from the manufacturer should be obtained to ensure the appropriate glove selection has been made.

Laboratory gloves have a shelf life stamped on the box. Dispose of expired gloves. Gloves may be disposed of in the regular trash if not contaminated with blood borne pathogens, highly toxic chemicals, or select carcinogens. For gloves contaminated with these substances, dispose of in the proper waste stream. Gloves are to be removed and hands washed before leaving the lab to prevent contaminating surfaces (door knobs, elevator buttons, etc.) outside of the lab.

**Laboratory Clothing and Protective Apparel**

The clothing worn in the laboratory can affect safety. Do not wear loose (e.g., scarves, dangling neckties, oversized or ragged laboratory coats), skimpy (e.g., shorts, halter-tops), or torn clothing in the laboratory. Loose or torn clothing and unrestrained long hair can easily catch fire, come into contact with chemicals, or become ensnared in apparatus and moving machinery. Skimpy clothing offers little protection to the skin in the event of chemical splash. If the possibility of chemical contamination exists, cover any personal clothing with protective apparel. Rings may react with chemicals and should not be worn around equipment with moving parts. Appropriate protective apparel is advisable for most laboratory work and may be required for some. Such

apparel can include laboratory coats and aprons which can be either washable or disposable in nature. No excessively open and/or short clothing is suitable for wear in labs. Legs must be completely covered with ankle length pants/skirt if working in chemistry lab.

**Foot Protection**

Wear closed-toe shoes or the equivalent at all times in laboratories or other chemical use and storage areas. Do not wear perforated shoes, sandals, or cloth sneakers in laboratories.

**Respiratory Protection**

Although not typically required, respiratory protection may be necessary when working with highly toxic chemicals and biological hazards or in any of the following situations:

- Dealing with an accidental spill.
- Performing an unusual operation that cannot be conducted under a fume hood.
- When weighing powdered chemicals or microbiological media outside of a protective enclosure.
- As required.

Respirators are, however, to be considered a "last line" of defense, and should not be used until all engineering controls (e.g. ventilation) and work practice controls (e.g. product substitution) are exhausted. Respirators have specific regulatory requirements for equipment certification, fit testing, medical evaluation, and training. These requirements are from the OSHA Respiratory Protection Standard 29 CFR 1910.134. Requirements differ based on respirator type.

The respirator regulations do not cover "comfort masks" or surgical masks. These are technically not respirators, as they are not certified by NIOSH (the National Institute for Occupational Safety and Health) and have no protection factor rating.

# VII. Emergency Equipment

All Mercy College laboratories working with combustible of flammable chemicals and/or hazardous chemicals must be equipped with the following:

- A “hands free” eyewash station is required within 50 feet of work areas where hazardous materials are used or stored.
- An easily accessible drench-type safety shower is required within 100 feet of a lab where hazardous chemicals are used or stored.
- A fire extinguisher suitable for the particular substances on hand.
- Spill control chemicals and equipment adequate to take care of minor chemical spills that may be released within a laboratory.
- A basic first aid kit.

# VIII. Chemical Procurement and Distribution

A. **Procurement**

- Before a substance is used, information on proper handling, storage, and disposal is to be obtained and made available to those who will be using the substance. This information is often listed in the SDS. No container is to be accepted without an adequate identifying label.
- The SDS for any chemical is available from Lab Manager. Requests can be made in person by calling 914-674-7115.
- Whenever possible, professors should consider using safer, alternative chemicals in place of hazardous chemicals.
- To reduce future wastes, purchase only those quantities necessary.

B. **Distribution**

When chemicals are transported by hand or cart, the container is to be sealed and placed within a secondary containment vessel to prevent spillage.

# IX. Chemical Storage and Handling

Minimum quantities of chemicals are to be purchased. The quantity/volume of chemicals stored in Prep Rooms must be minimized. Smaller package sizes provide the following advantages:

- Reduced storage hazards
- Reduced storage space safety as a result of handling smaller quantities
- Reduced losses due to out-of-date chemicals
- Minimized cost of disposal of "leftovers"

Exposure to heat or direct sunlight should be avoided.

**Chemical Inventories**

Chemical inventories should be updated continuously. The minimum requirement is that chemical inventories be completed annually. A visual inspection of container integrity should be performed when inventories are done. Stored chemicals will be examined at least annually for expiration dates and container integrity.

Each laboratory room is required to maintain a current chemical inventory that lists the chemicals used and stored in the labs and the quantity of these chemicals. Specific storage locations must be kept as part of the inventory list to ensure that they can be easily located. Chemical inventories are used to ensure compliance with storage limits and fire regulations and can be used in an emergency to identify potential hazards for emergency response operations. The chemical inventory list should be reviewed prior to ordering new chemicals and only the minimum quantities of chemicals necessary for the course should be purchased. As new chemicals are added to the inventory, each laboratory room must update Safety Data Sheet (SDS) folder for that chemical. Where practical, each chemical should be dated so that expired chemicals can be easily identified for disposal.

Indications for disposal include:

- Cloudiness in liquids
- Color change
- Evidence of liquids in solids, or solids in liquids
- "Pooling" of material around outside of containers
- Pressure build-up within containers
- Obvious deterioration of containers

Access to hazardous chemicals, including toxic and corrosive substances, should be restricted at all times.

**Chemical labeling**

Every chemical found in the laboratory must be properly labeled. Most chemicals come with a manufacturer's label that contains the necessary information, so care should be taken to not damage or remove these labels. Each chemical bottle, including diluted chemical solutions, must be labeled with its contents and the hazards associated with this chemical.

Peroxide forming chemicals (e.g., ethers) must be labeled with a date on receipt and on first opening the bottle. These chemicals can degrade to form shock sensitive, highly reactive compounds and should be stored and labeled very carefully.

**Proper Sealing of Chemical Containers**

To prevent leakage, odors, or reaction to air, tightly seal all containers of highly toxic, highly volatile, malodorous, carcinogenic or reactive chemicals. Make sure that caps and other closures are tight on all hazardous chemicals. A limited exception is freshly-generated mixtures such as acids and organics that may generate gas pressure sufficient to burst a tightly sealed bottle. Keep the lids loose until sufficient time passes to complete the reactions, and then tightly close the lids. Until all reactions are completed, the contents of the bottle are not waste, but are instead the last step of the chemical procedure.

A preferred seal is the screw-cap with a conical polyethylene or Teflon insert. Seal the caps with tape or Parafilm® "M" as a further precaution. Additional protection can include wrapping in an absorbent paper and sealing inside a plastic bag and storing the bag inside a metal can with a friction-fitting lid.

**Chemical Storage Recommendations**

Each chemical in the laboratory must be stored in a specific location and returned there after each use. Acceptable chemical storage locations may include corrosive cabinets, flammable cabinets, laboratory shelves, or appropriate refrigerators or freezers. Fume hoods should not be used as general storage areas for chemicals, as this may seriously impair the ventilating capacity of the hood. Chemicals should not be routinely stored on bench tops or stored on the floor.

Chemicals must be stored at an appropriate temperature and humidity level and should never be stored in direct sunlight or near heat sources, such as laboratory ovens. Incompatible materials should be stored in separate cabinets, whenever possible. If these chemicals must be stored in one cabinet, due to space limitations, adequate segregation and secondary containment must be ensured to prevent adverse reactions. All stored containers and research samples must be appropriately labeled and tightly capped to prevent vapor interactions and to alleviate nuisance odors. Flasks with cork, rubber or glass stoppers should be avoided because of the potential for leaking.

Laboratory refrigerators and freezers must be labeled appropriately with "No Food/Drink" and must never be used for the storage of consumables. Freezers should be defrosted periodically so that chemicals do not become trapped in ice formations. Never store peroxide formers (e.g., ether) in a refrigerator!

**Storage Locations**. Optimally, incompatible chemicals such as acids and alkalis should be stored completely separate from one another to prevent mixing in the event of an accidental spill or release of the materials. Limited If space is limited, incompatible chemicals may be stored in the same storage cabinet if segregated the according to their hazard class and stored in individual tubs, trays, or buckets while in the cabinet. These secondary containers reduce the chance that incompatible chemicals will inadvertently contact each other.

**Laboratory Hoods.** Highly odorous chemicals should be stored in the cabinet under a fume hood or within a fume hood. Do not store chemicals for prolonged periods of time on bench tops in laboratory hoods because they may impede airflow and reduce the effectiveness of the hood.

**Refrigerated Storage**. Building code requirements limit the quantity of flammable liquids that can be stored in a laboratory or fire area. Store flammable solvents that require storage at reduced temperature (such as isopentane) in refrigerators or freezers designed for storage of flammable liquids. "Safety" refrigerators for flammable liquid storage and "explosion-proof" refrigerators are both acceptable.

Because refrigerators and freezers have no interior space venting, all chemicals should have tightly sealed caps.

Refrigerators and ice machines used for storage of chemicals or specimens/samples should never be used for the storage of human consumables. Apply signage to the doors of chemical refrigerators and ice machines stating: "NO FOOD, BEVERAGE, OR ICE FOR HUMAN CONSUMPTION." Never store peroxide formers (ether) in a refrigerator.

**Flammable and Combustible Liquid Storage.**

Based on the presence of Mercy College laboratories on the Bronx Campus and the official designation of the Bronx laboratories as Class B, the following storage limit tables from the FDNY are provided as a reference:

Table II-3. Quantity Limitation in the New Fire Code[a]

| Laboratory unit hazard classification | Excluding Quantities in Storage Cabinets or Safety Cans | | Including Quantities in Storage Cabinets or Safety Cans | |
|---|---|---|---|---|
| | Maximum Quantity Class I Liquids Alone per Lab Unit (gal) | Maximum Quantity Class I, II, IIIA Liquids per Lab Unit (gal) | Maximum Quantity Class I Liquids Alone per Lab Unit (gal) | Maximum Quantity Class I, II, IIIA Liquids per Lab Unit (gal) |
| **Class B** | 5 gals/100 ft² 25 (max) | 10 gals/100 ft² 25 (max) | 10 gals/100 ft² 25 (max)[b] | 20 gals/100 ft² 25 (max)[b] |
| **Class D** | 1 gals/100 ft² 75 (max)[c] | 1 gals/100 ft² 75 (max)[c] | 2 gals/100 ft² 150 (max)[d] | 2 gals/100 ft² 150 (max)[d] |

a. Educational and instructional labs and labs in health care occupancies shall comply with Class D requirement only
b. Increased to 30 gallons with 2-hr laboratory fire rating
c. Increased to 100 gallons in the labs other than educational and instructional labs or labs in health care occupancies
d. Increased to 200 gallons with 2-hr laboratory fire rating in the labs other than educational and instructional labs or labs in health care occupancies
e. Laboratory units used for the instruction of students through the 12th grade shall be limited to 50 percent of the flammable and combustible liquids quantity.

*Note that only 30 gallons (113.6 liters) of Class I liquids are permitted per room. Class I liquids have flashpoints less than 100°F (37.8°C) and are traditionally known as "flammable" liquids. Most liquids labeled as flammable are Class I liquids. Combustible liquids are Class II or III liquids and have flashpoints above 100 °F (37.8°C). Regulations permit up to 60 gallons (227.3 liters) of combustible plus flammable liquids per room with three approved storage cabinets, provided no more than 30 gallons are Class I.

These limits are for the total quantities on hand, including chemicals in storage, chemicals in use, and wastes. Each lab can have a maximum of three flammable storage cabinets per room, with each cabinet containing a maximum of 30 gallons (113.6 liters) of Class I-III liquids (OSHA **1926.152(b)(3))**.

The maximum quantity allowed to be kept outside a flammable storage cabinet, safety can, or approved refrigerator/freezer is 10 gallons per 100 sq ft. with a 25-gallon maximum. Only the amounts needed for the current procedure should be kept on bench tops and the remainder should be kept in flammable storage cabinets, explosion proof refrigerators/freezers that are approved for the storage of flammable substances, or approved safety cans or drums that are grounded. Always segregate flammable or combustible liquids from oxidizing acids and oxidizers. Flammable materials must never be stored in domestic-type refrigerators/freezers and should not be stored in a refrigerator/freezer if the chemical has a flash point below the temperature of the equipment. Flammable or combustible liquids must not be stored on the floor or in any exit access.

Handle flammable and combustible substances only in areas free of ignition sources and use the chemical in a fume hood whenever practical. Only the amount of material required for the experiment or procedure should be stored in the work area. Always transfer flammable and combustible chemicals from glass containers to glassware

or from glass container/glassware to plastic. Transferring these types of chemicals between plastic containers may lead to a fire hazard due to static electricity.

**Pyrophoric and Water Reactive Chemicals**. Because pyrophoric substances can spontaneously ignite on contact with air and/or water, they must be handled under an inert atmosphere and in such a way that rigorously excludes air and moisture. Some pyrophoric materials are also toxic and many are dissolved or immersed in a flammable solvent. Other common hazards include corrosivity, teratogenicity, or peroxide formation.

Only minimal amounts of reactive chemicals should be used in experiments or stored in the laboratory. These chemicals must be stored as recommended in the SDS. Reactive materials containers must be clearly labeled with the correct chemical name, in English, along with a hazard warning.

Suitable storage locations may include inert gas-filled desiccators or glove boxes; however, some pyrophoric materials must be stored in a flammable substance approved freezer. If pyrophoric or water reactive reagents are received in a specially designed shipping, storage or dispensing container (such as the Aldrich Sure/Seal packaging system), ensure that the integrity of that container is maintained. Ensure that sufficient protective solvent, oil, kerosene, or inert gas remains in the container while pyrophoric materials are stored. Never store reactive chemicals with flammable materials or in a flammable liquids storage cabinet. Never return excess reactive chemical to the original container. Small amounts of impurities introduced into the container may cause a fire or explosion.

**Oxidizers**. Oxidizers (e.g., hydrogen peroxide, ferric chloride, potassium dichromate, sodium nitrate) should be stored in a cool, dry place and kept away from flammable and combustible materials, such as wood, paper, Styrofoam, plastics, flammable organic chemicals, and away from reducing agents, such as zinc, alkaline metals, and formic acid.

**Peroxide forming chemicals**. Peroxide forming chemicals (PFC) should be stored in airtight containers in a dark, cool, and dry place and must be segregated from other classes of chemicals that could create a serious hazard to life or property should an accident occur (e.g., acids, bases, oxidizers). The containers should be labeled with the date received. This information, along with the chemical identity should face forward to minimize container handling during inspection. These chemicals must also be tested and documented for the presence of peroxides every 3 months using test strips. Minimize the quantity of peroxide forming chemicals stored in the laboratory and dispose of peroxide forming chemicals before peroxide formation.

Carefully review all cautionary material supplied by the manufacturer prior to use. Avoid evaporation or distillation, as distillation defeats the stabilizer added to the solvents. Ensure that containers are tightly sealed to avoid evaporation and that they are free of exterior contamination or crystallization. Never return unused quantities back to the original container and clean all spills immediately.

If old containers of peroxide forming chemicals are discovered in the laboratory, (greater than two years past the expiration date or if the date of the container is unknown), do not handle the container. If crystallization is present in or on the exterior of a container, do not handle the container.

*Class 1 PFCs* Class 1 chemicals form peroxides after prolonged storage. The chemicals listed below should be tested for the formation of peroxides on a periodic basis. Several methods are available to check for peroxides; the two most common are the use of peroxide test strips or the potassium iodide test.

Examples of class 1 PFCs:

- Isopropyl ether

- Potassium amide
- Vinylidene chloride
- Divinyl acetylene
- Potassium metal
- Divinyl ether
- Sodium amide

*Class 2 PFCs*. This group of chemicals will readily form peroxides when they become concentrated (e.g., via evaporation or distillation). The concentration process defeats the action of most auto-oxidation inhibitors. As a result, these chemicals should be disposed of within12 months of receiving.

Examples of Class 2 PFCs:

- Acetal
- Diethyl ether*
- Methyl isobutyl ketone
- Cumene*
- Dioxane*
- Tetrahydrofuran
- Cyclohexene*
- Ethylene glycol dimethyl ether *
- Tetrahydronaphthalene
- Cyclopentene*
- Furan
- Vinyl ethers
- Diacetylene
- Methylacetylene
- Dicyclopentadiene
- Methyl cyclopentane

*used in Mercy organic chemistry lab

*Class 3 PFCs*. This group of chemicals forms peroxides due to initiation of polymerization. When stored in a liquid state, the peroxide forming potential dramatically increases. These chemicals should be disposed of if they become degraded or are no longer needed.

Examples of Class 3 PFCs:

- Acrylic acid
- Chlorotrifluoroethylene
- Vinyl acetate
- Acrylonitrile
- Methyl methacrylate
- Vinyl acetylene
- Vinyl chloride
- Butadiene
- Styrene
- Vinyl pyridine

- Chlorobutadiene
- Tetrafluoroethylene
- Vinylidene chloride

**Corrosives.** Store corrosive chemicals (i.e., acids, bases) below eye level and in secondary containers that are large enough to contain at least 10% of the total volume of liquid stored or the volume of the largest container, whichever is greater. Acids must always be segregated from bases and from active metals (e.g., sodium, potassium, magnesium) at all times and must also be segregated from chemicals which could generate toxic gases upon contact (e.g., sodium cyanide, iron sulfide).

Specific types of acids require additional segregation. Mineral acids must be kept away from organic acids and oxidizing acids must be segregated from flammable and combustible substances. Perchloric acid should be stored by itself, away from other chemicals. Picric Acid is reactive with metals or metal salts and explosive when dry and must contain at least 10% water to inhibit explosion.

**Cabinets**. Cabinets under hoods and laboratory benches may be used for storage of chemicals. In some cases, laboratory furniture manufacturers design cabinets specifically for storage of flammable and/or corrosive materials. However, do not store laboratory chemicals near or under sinks where there may be exposure to water. Storage of cleaning supplies under sinks is acceptable. Cabinets for chemical carcinogens or highly toxic chemicals should have a lock. Regulations of the Drug Enforcement Administration and Bureau of Alcohol, Tobacco, and Firearms require locked storage for controlled substances and some specific explosive compounds.

**Desiccator Jars or Cabinets**. Desiccator jars and cabinets are useful for storage of air and water reactive, toxic, and malodorous chemicals. In case of especially malodorous compounds such as mercaptans, replace the desiccator material with a vapor absorber (e.g. charcoal) to control odors.

**Bench Tops and Shelves**. Chemical storage on bench tops is undesirable, and is vulnerable to accidental breakage by laboratory, housekeeping, and emergency response personnel. Do not store liquids on shelves that are above eye-level. When storing chemicals on open shelves, consider several factors such as compatibility grouping (see below), the container material (plastic or metal versus breakable glass), physical state of the chemical (it's riskier to store liquids on open shelves compared to solids), the relative toxicity of the chemical, and the height and depth of the shelving.

**Compressed gas cylinders**. Compressed gas cylinders must be stored with the safety cap in place when not in use. Cylinders must be stored either chained to the wall or chained within in a cylinder storage rack. For wall storage, no more than three cylinders may be chained together in the laboratory. Bolted "clam shells" may be used in instances where gas cylinders must be stored or used away from the wall. Store liquefied fuel-gas cylinders securely in the upright position. Cylinders containing certain gases are prohibited from being stored in a horizontal position, including those which contain a water volume of more than 5 liters. Do not expose cylinders to excessive dampness, corrosive chemicals or fumes.

Certain gas cylinders require additional precautions. Flammable gas cylinders must use only flame-resistant gas lines and hoses which carry flammable or toxic gases from cylinders and must have all connections wired. Compressed oxygen gas cylinders must be stored at least 20 feet away from combustible materials and flammable gases. Gas cylinder connections must be inspected frequently for deterioration and must never be used without a regulator. Never use a leaking, corroded or damaged cylinder and never refill compressed gas cylinders. When stopping a leak between cylinder and regulator, always close the valve before tightening the union nut. The regulator should be replaced with a safety cap when the cylinder is not in use. Move gas cylinders with the safety cap in place using carts designed for this purpose.

**Liquid Nitrogen**. Because liquid nitrogen containers are at low pressure and have protective rings mounted around the regulator, they are not required to be affixed to a permanent fixture such as a wall. However, additional protection considerations should be addressed when storing liquid nitrogen in a laboratory. The primary risk to laboratory personnel from liquid nitrogen is skin or eye thermal damage caused by contact with the material. In addition, nitrogen expands 696:1 when changing from a cryogenic liquid to a room temperature gas. The gases usually are not toxic, but if too much oxygen is displaced, asphyxiation is a possibility. Always use appropriate thermally insulated gloves when handling liquid nitrogen.

**Storage by Compatibility Group**

Store chemicals in the laboratory according to their compatibility groups. Do not store chemicals in alphabetical order, as this might place incompatible chemicals next to each other (examples include acetic acid and acetaldehyde, sodium cyanide and sulfuric acid, sodium borohydride and sodium chlorate), increasing the potential for accidental mixing of incompatible chemicals. The diagram entitled "Suggested Shelf Storage Pattern" (Appendix 7) indicates a recommended arrangement of chemicals according to compatibility. Mercy College follows Flinn Scientific guidelines to segregate chemicals for storage (See Appendix 7). These compatibility groups should be stored separately, especially chemicals with an NFPA 704 or HMIS reactive rating of 3 or higher, (see Section IV) and in dedicated and labeled cabinets. Within any compatibility group, you can arrange chemicals alphabetically to facilitate ease of retrieval.

The following are recommended compatibility groups:

**Group A – Acids, Inorganics**

Store large bottles of acid in special acid cabinets, cabinets under lab benches, or on low shelves. Place acids in plastic trays for secondary containment in case of breakage. Segregate inorganic and oxidizing acids from organic compounds including organic acids and other combustible materials. Segregate nitric acid (>40%) from other inorganic acids. Store acids separate from bases and other reducing agents. Inorganic salts, except those of heavy metals, may be stored in this group. Glacial acetic acid should be stored with flammable and combustible materials since it is combustible.

**Group B – Bases**

Segregate bases from acids and oxidizers on shelves near the floor. The preferred storage container for inorganic hydroxides is polyethylene instead of glass. Place containers in trays for secondary containment in the event of leakage or breaks.

**Group C – Organic Chemicals**

Segregate organic compounds from inorganic. Organics and inorganics with NFPA 704 or HMIS reactive hazard rating of two (2) or less may be stored together. Chemicals with a reactive hazard rating of three (3) or four (4) are to be stored separately.

**Group D – Flammable and Combustible Organic Liquids**

Flammable and combustible liquid storage per room is limited to 10 gallons (37.9 liters) in open storage and use, 25 gallons (94.7 liters) in safety cans, and 60 gallons (227.3 liters) in any one flammable storage cabinet. According to the OSHA publication **1926.152(b)(3)** only three flammable storage cabinets are allowed per

room. Also remember that only 30 gallons (113.6 liters) of Class I liquids are permitted per room. Store flammable and combustible materials away from sources of ignition such as heat, sparks, or open flames, and segregated from oxidizers.

**Group E – Inorganic Oxidizers and Salts**

Store inorganic oxidizers in a cool, dry place away from combustible materials such as zinc, alkaline metals, formic acid, and other reducing agents. Inorganic salts may also be stored in this group. Store ammonium nitrate separately.

**Group F – Organic Peroxides and Explosives**

Peroxides contain a double-oxygen bond in their molecular structure. They are shock and heat sensitive (e.g. benzoyl peroxide), and readily decompose in storage. Store shock and heat-sensitive chemicals in a dedicated cabinet. Peroxidizable compounds must be dated when received and opened. See Appendix 4 for a listing of Peroxidizable compounds. Some non-peroxide chemicals can readily form shock-sensitive, explosive peroxides when stored in the presence of oxygen. Examples include ethyl ether, tetrahydrofuran, and cumene. See Chapter 12 for information on safe storage of peroxidizable compounds.

**Group G – Reactives**

**Water Reactive**: Store water reactives in a cool dry place protected from water sources. Alkali metals (lithium, sodium, potassium, rubidium, and cesium) should be stored under mineral oil, or in waterproof enclosures such as glove boxes. A Class D fire extinguisher should be available in case of fire. Contact Mercy Security if one is not available in your laboratory. As an added precaution, store containers in trays or other secondary containers filled with sand.

**Pyrophorics (Air Reactive)**: Store pyrophorics in a cool, dry place, and provide for an air-tight seal. Store white or yellow phosphorous under water in glass-stoppered bottles inside a metal can for added protection.

**Group H – Cyanides and Sulfides**

Cyanides and sulfides react with acids to release highly toxic gases. They must be isolated from acids and other oxidizers.

**Group I – Carcinogenic and Highly Toxic Chemicals (specifically hazardous chemicals)**

Provide a dedicated lockable storage cabinet in a "designated area" for highly toxic and carcinogenic chemicals. Use unbreakable, chemically resistant secondary containers. Post the storage cabinet with a sign stating, "HIGHLY TOXIC CHEMICALS" or "CANCER-SUSPECT AGENT". These signs are available at the EHS Safety Labels Page and are depicted and described in Chapter 7. Maintain a separate inventory of all highly acute toxics, carcinogens, and reproductive toxins.

Carcinogens – A carcinogen is a substance capable of causing cancer. Carcinogens are chronically toxic substances; that is, they cause damage after repeated or long-duration exposure, and their effects may become evident only after a long latency period. A chemical is considered a carcinogen if it appears in the OSHA Standards List under General Industry (29 CFR 1910) Subpart Z.

Reproductive Toxins – Reproductive toxins are substances that have adverse effects on various aspects of reproduction, including fertility, gestation, lactation, and general reproductive performance. When a pregnant

woman is exposed to a chemical, the fetus may be exposed as well because the placenta is an extremely poor barrier to chemicals. Reproductive toxins can affect both men and women. Male reproductive toxins can in some cases lead to sterility.

Substances with a High Acute Toxicity – High acute toxicity includes any chemical that falls within any of the following OSHA defined categories:

- A chemical with a median lethal dose (LD50) of 50 mg or less per kg of body weight when administered orally to certain test populations.
- A chemical with an LD50 of 200 mg less per kg of body weight when administered by continuous contact for 24 hours to certain test populations.
- A chemical with a median lethal concentration (LC50) in air of 200 parts per million (ppm) by volume or less of gas or vapor, or 2 mg per liter or less of mist, fume, or dust, when administered to certain test populations by continuous inhalation for one hour, provided such concentration and/or condition are likely to be encountered by humans when the chemical is used in any reasonably foreseeable manner.

Incompatible chemicals

| A incompatible with | B |
|---|---|
| Alkali and alkaline earth<br>Carbides<br>Hydrides<br>Hydroxides<br>Metals<br>Oxides<br>Peroxides | Water<br>Acid<br>Halogenated organic compounds<br>Halogenating agents<br>Oxidizing agents |
| Azides, inorganic | Acids<br>Heavy metals and their salts<br>Oxidizing agents |
| Cyanides, inorganic | Acids<br>Strong bases |
| Nitrates, inorganic | Acids<br>Reducing agents |
| Nitrates, inorganic | Acids<br>Oxidizing agents |
| Organic compounds<br>Organic acyl halides<br>Organic anhydrides<br>Organic halogen compounds<br>Organic nitro compounds | Oxidizing agents<br>Bases<br>Organic hydroxyl and amino compounds<br>Group IA and IIA metals<br>Aluminum<br>Strong bases |
| Oxidizing agents<br>Chlorates<br>Chromates<br>Chromium trioxide<br>Dichromates<br>Halogens<br>Halogenating agents | Reducing agents<br>Ammonia, anhydrous and aqueous<br>Carbon<br>Metals<br>Metal hydrides<br>Nitrites<br>Organic compounds |

| | |
|---|---|
| Hydrogen peroxide<br>Nitric acid<br>Nitrates<br>Perchlorates<br>Peroxides<br>Permanganates<br>Persulfates | Phosphorus<br>Silicon<br>Sulfur |
| Reducing agents | Oxidizing agents<br>Arsenates<br>Arsenites<br>Phosphorus<br>Selenites<br>Selenates<br>Tellurium salts and oxides |
| Sulfides, inorganic | Acids |

Separate storage areas should be provided for incompatible chemicals. Consult Appendix 5 for a listing of "Incompatible Chemicals". Most chemicals should be stored by general groups, as listed in Appendix 6.

Chemicals must NOT be stored on the floor, even as a temporary measure.

# X. Waste Disposal Program

The purpose of the Waste Disposal Program is to assure the minimization of any harm to people, the facility, and the environment that result from the disposal of laboratory wastes. If a particular waste material is not listed, contact the Lab Supervisor for information/assistance.

A variety of wastes are generated from labs. Examples include recyclable papers, glassware, plastic-ware, glassware, biohazardous waste, and chemical (hazardous) wastes. Many locations at the college participate in a recycling program for papers and non-laboratory glass products. Lab employees are encouraged to participate in this program. For chemical wastes, the term "hazardous waste" will be used hereafter.

EPA regulations define hazardous waste as substances having one of the following hazardous characteristics:

- Corrosive: pH < 2 or >12.5
- Ignitable: liquids with flash point below 60º C or 140º F [e.g. Methanol, Acetone]
- Reactive: unstable, explosive or reacts violently with air or water, or produces a toxic gas when combined with water [e.g. Sodium metal]
- Toxic: Determined by toxicity testing [e.g. Mercury]

The EPA definition of hazardous waste also extends to the following items:

- Abandoned chemicals
- Unused or unwanted chemicals
- Chemicals in deteriorating containers
- Empty containers that have visible residues
- Containers with conflicting labels
- Unlabeled or unknown chemicals

Chemicals not in frequent use must be carefully managed to prevent them from being considered a hazardous waste. This is especially true for certain compounds that degrade and destabilize over time and require careful management so that they do not become a safety hazard.

Minimize the generation of hazardous wastes. Before purchasing chemicals, limit the quantities ordered: purchase only those quantities that are needed. Upon receiving a chemical order, properly store the chemicals. Rotate chemicals by placing older chemicals in front of newer chemicals containers to ensure the older chemicals are used fist.

Hazardous waste will be routinely removed from laboratories throughout the College. Lab Manager schedules chemical and biological waste removal with Triumvirate and Cyntox respectively.

All personnel who are responsible for handling, managing, or disposing of hazardous waste must be trained prior to working with any hazardous materials.

While accumulating hazardous waste, the following rules are to be followed to comply with EPA regulations:

- Hazardous waste includes those chemicals that are listed wastes or have the characteristics of ignitability, toxicity, corrosiveness, or reactivity.

- Federal and state regulations prohibit the disposal of hazardous waste into the sewer or into the trash.
- Waste collection containers must be marked with the words "Hazardous Waste" and other words that identify the contents of the containers. The concentration/volume of the waste must also be listed on the container.
- Hazardous waste containers are to be placed in a designated and labeled "Hazardous Waste Satellite Accumulation Area". These areas must be selected to permit the proper containment of the waste and must be located in the area where the waste is generated. Storage of hazardous waste on the floor, even with the use of secondary containment, is not recommended. Should this area be within a fume hood, sufficient space must be maintained to use the hood for its intended purpose, the handling of higher hazard chemicals. Please note, in NYC chemical waste cannot be stored under the hood and must be placed in flammable cabinet instead if required by chemical properties of waste substances.
- Waste containers must be closed when not being filled. The outside of the waste containers must be clean and be compatible for the waste being collected.
- Waste collection containers must be placed in a secondary containment tray that can hold the contents of the largest container. More than one secondary containment tray may be needed to accommodate wastes of different hazard classes.

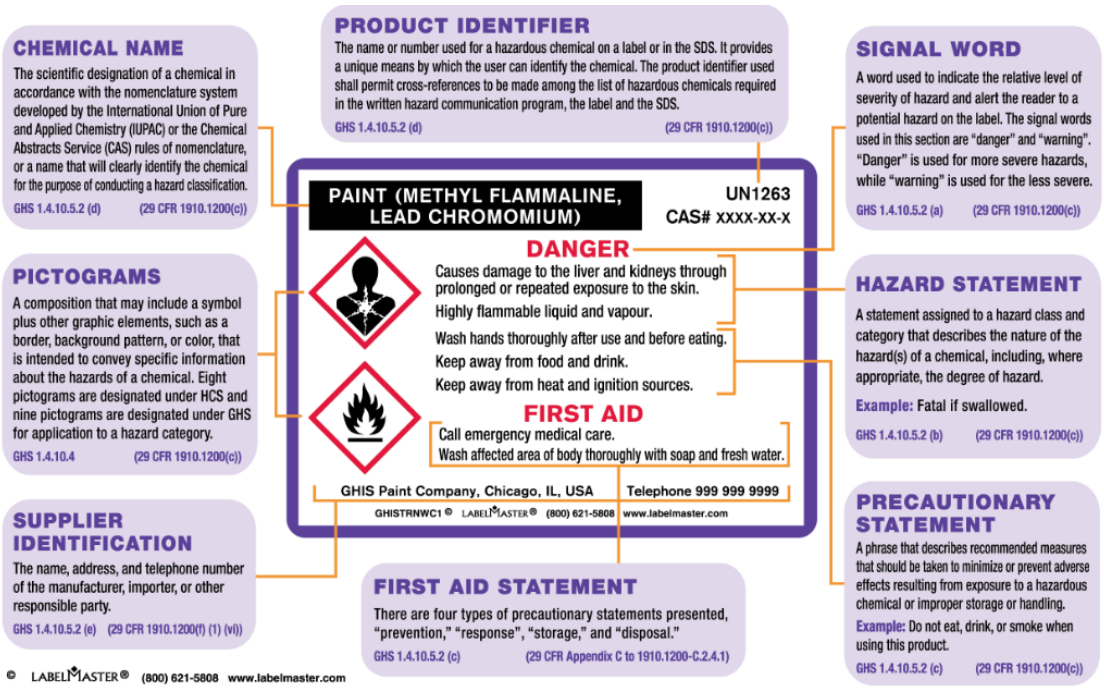
# XI. Signs and Labels

A. **Signs:** Signs of the following types are to be displayed:

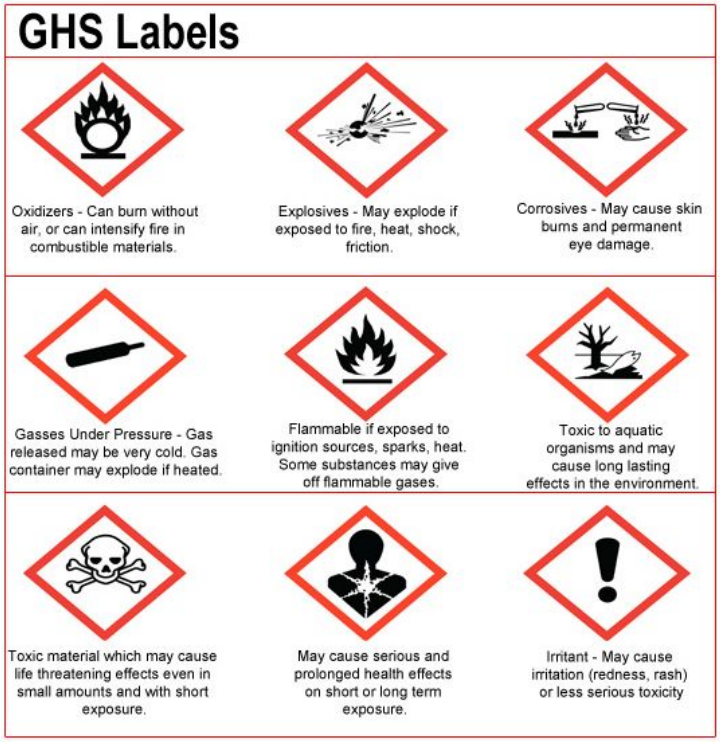
- Location signs for safety showers, eyewash stations, other safety and first aid equipment and emergency exits.
- Warnings in areas or on equipment where special or unusual hazards exist.
- Cabinets where flammable liquids are stored must be labeled 'FLAMMABLE LIQUID STORAGE".
- A "Hazardous Waste Satellite Accumulation Area" label/sign posted where hazardous waste is stored within the laboratory.
- Laboratories having biological hazards or biohazards will have the appropriate biohazard signage as required by OSHA.

B. **Secondary Labels**

- All chemicals and solutions must have identification labels showing the contents of the containers and the associated hazards. The labels must be written in English. For those locations that wish to use abbreviations on chemical labels, only those approved abbreviations listed in Appendix 8 can be used. Personnel may use these abbreviations provided the appendix is prominently posted in the lab or the listing is placed in the Standard Operating Procedure manual of the lab.
- For the secondary labels Mercy College Labs follow the general GHS approved example below with the few editions:




- Product identifier (chemical name must be present (concentration should be indicated as well as a solvent if this not water)
- Signal word (warning or danger)
- Hazard Statement(s)
- Precautionary statement(s)
- Supplier Information (name and telephone number)
- GHS pictograms applicable for the particular chemical (see below)



- According to OSHA with respect to secondary labeling:

**Question**: What is the expectation for labeling portable (secondary) containers in an academic or research laboratory?

**Response:** Academic and research laboratories that are covered under 1910.1450 are exempt from the HCS 2012. The Laboratory standard requires that labels on incoming containers of hazardous chemicals not be removed or defaced, 1910.1450(h)(1)(i), but does not have a specific labeling requirement for secondary containers of hazardous chemicals in a covered laboratory. The Laboratory standard allows laboratories flexibility in tailoring their written Chemical Hygiene Plan (CHP) and standard operating procedures to be protective of employees in laboratories (29 CFR 1910.1450(b)). In addition, 1910.1450(f)(4), *Training*, requires the employer to train employees regarding the physical and health hazards of chemicals in the work area, the measures employees can take to protect themselves from these hazards, and the employer's CHP. (Published on OSHA.gov website under interpretations of standards on Nov 10, 2014)

With regards to above statement, for small bottles and vials, Mercy College uses secondary labels containing:

- Product identifier (with concertation if applicable)
- Signal word
- Hazard GHS pictogram
- Supplier name

- Emergency phone numbers for Campus Safety (x7225) should be posted near all phones.

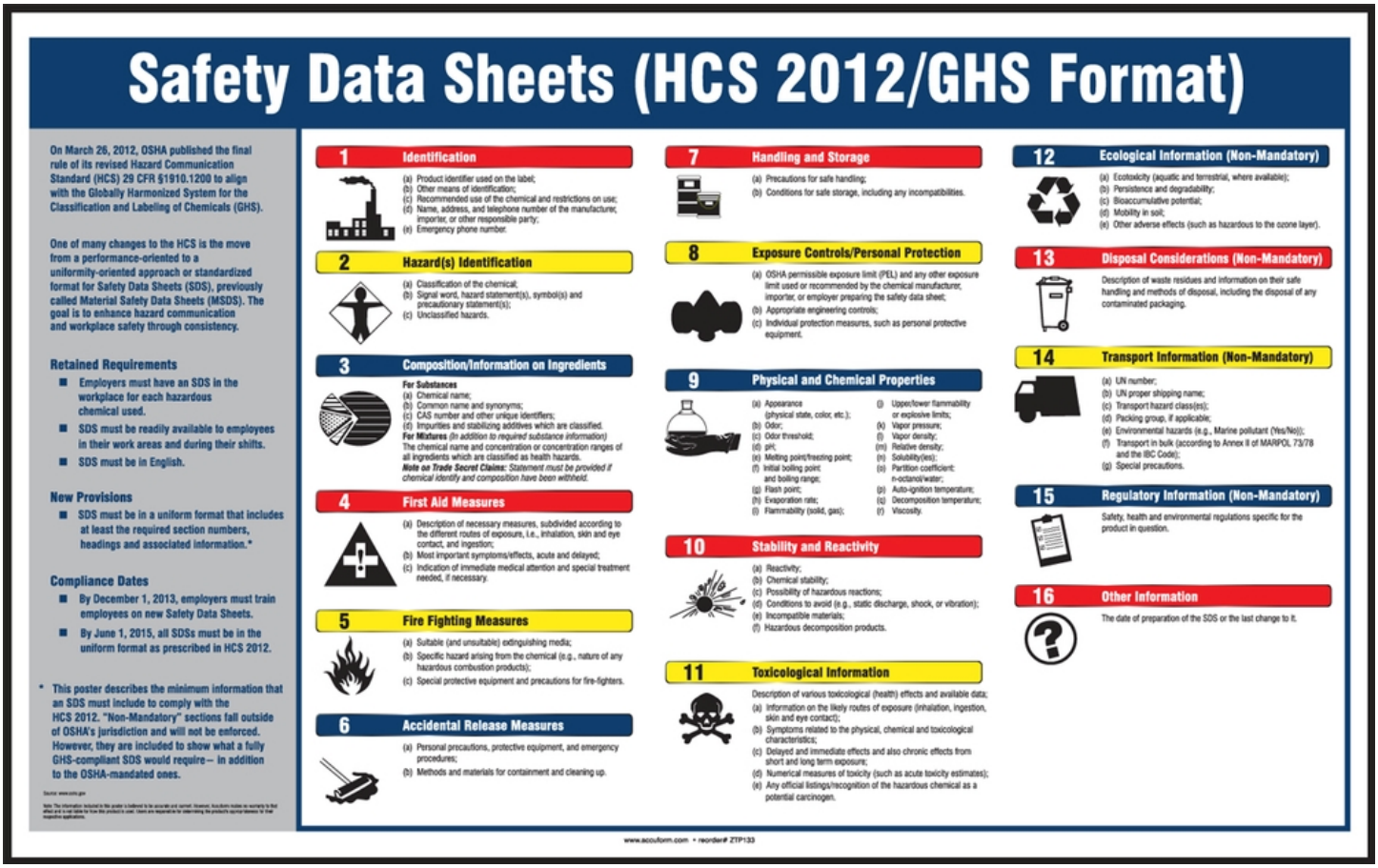
# XII. Record Keeping

A. Injuries or chemical exposures will be recorded using Mercy College's Incident Reporting procedures. This is accomplished by initiating an Incident report by contacting Campus Safety (x7522). A copy is to be retained by the Supervisor and the employee.
B. Attendance sheets for Laboratory Safety Training sessions will be retained by Lab Supervisor and a training report will be issued to each department bi-annually.
C. Chemical inventories will be maintained as specified above.
D. Medical records will be retained as established by College protocol.
E. Site-specific training records are to be retained by the Site Supervisor (currently applicable only to human anatomy lab MH305 under the supervision of Dr. F. Esser).

# XIII. Safety Data Sheets

Safety Data Sheet (SDS) must be readily available for all chemicals used in the laboratory. The SDS should be kept in a notebook in alphabetical order and be available to laboratory personnel during any working hours. SDS may be kept in a central location in the department. A copy of the SDS should be retained within a lab for those chemicals that may pose an acute toxicity hazard to personnel, including First Responders.

SDS are sent by manufacturers for hazardous chemicals that have been ordered. The SDS for any chemical is available from Lab Manager. Requests can be made in person, electronically, or by calling 914-674-7115.



# XIV. Emergency Management

Laboratory personnel have a vital role in emergency management. Personnel must be prepared to respond in the event of a fire, spill, or other situation requiring emergency action or evacuation.

## A. Emergency Management Process

**All emergencies are to be called in to Campus Safety (x7225**).

Effective emergency management includes Mitigation, Preparedness, Response, and Recovery.

1. **Mitigation**: Designed to alleviate the effects of an incident or reduce the probability of the incident occurring. Examples include compliance with building codes or regulations.
2. **Preparedness**: Preparedness and prevention activities are designed to prevent injuries and minimize damage. Examples include minimizing the quantity of hazardous materials in laboratory areas, placing materials in storage after use, having emergency shutdown procedures in place.
3. **Response**: These activities are designed to provide emergency assistance to personnel and reduce the likelihood of secondary damage. Should an emergency occur, lab staff should know and be prepared for emergency shutdown procedures to allow for emergency evacuation.
4. **Recovery**: Recovery is a short-term activity to return the area to normal or improved condition. Recovery planning should include a review of procedures to avoid future emergencies.

## B. Fires

Individual reaction to a fire can determine whether the incident escalates into an out of control situation or remains controlled. All personnel should learn and practice the emergency procedures appropriate to their work area. Those who do not have the necessary training or confidence in fighting a fire should evacuate. OSHA 1910.157 states that only those who receive annual training on the use of a fire extinguisher should attempt to extinguish a fire. Those who do not receive this training at the University or through a fire department should evacuate.

Before deciding to fight a fire, follow **RACE**:

**R**escue anyone in immediate danger and remove the person to a safe area.

**A**ctivate the building fire alarm. Then call Campus Safety (x7225) from a safe location to report the fire.

**C**onfine the fire by closing all doors, beginning with the door to the room of origin.

**E**vacuate if the fire has spread beyond the point of origin, if the fire could block your exit, or if you are not sure how to use an extinguisher. **E**xtinguish the fire if you have activated the fire alarm and have received training on the use of a fire extinguisher, closed the doors, if the fire is small and contained, and if you have a clear means of exit.

C. **Spills**

1. Chemical spills are to be cleaned up immediately. Some spills can create conditions that can lead to additional hazards.

2. Spills can be classified as either a minor clean-up procedure or a major spill. Minor spills do not expose laboratory employees to over-exposure and should be cleaned up immediately by laboratory staff wearing the appropriate PPE.

3. Many hazardous substances necessitate special clean-up procedures to minimize hazards to clean-up personnel. **Major spill** clean-up should **not** be attempted by laboratory assistants. If assistants are present at the time of the major spill and a spill kit is readily available, the contents of the spill kit can be emptied on the spill to assist in stabilizing the spill until the Laboratory Supervisor/Faculty member arrives.

4. The following is **emergency preplanning** to follow prior to working with toxic chemicals:

   a. Determine the potential location of releases.

   b. Determine the quantities of material that might be released.

   c. Know the chemical and physical properties of the material (physical state, vapor pressure, air or water reactivity).

   d. Know the hazardous properties of the material (toxicity, reactivity, corrosivity, flammability).

   e. Have available the personal protective equipment that may be needed.

5. In the event of a minor spill, defined by OSHA as one that does not pose a significant safety or health hazard, the following **general procedures** are to be followed:

   a. Survey the situation for any potential hazards present before approaching a spill area. If possible, attend to anyone who may have been contaminated. Contaminated clothing must be removed immediately and the skin flushed with water for no less than 15 minutes.

   b. Immediately alert co-workers and supervisor(s) .

   c. Evacuate non-essential personnel from the spill area.

   d. Close the door.

   e. Untrained laboratory personnel are not to clean up spills.

   f. If the spill material is flammable, turn off ignition and heat sources.

   g. Avoid breathing vapors of the spilled material.

   h. Leave the local exhaust ventilation (fume hoods, etc.) on.

**Exposures**:

Avoid unnecessary exposure to chemicals. Develop and encourage safe work habits. Do not smell or taste chemicals. Should an exposure occur, personnel should consult Section IV, Medical Consultations and Examinations, for additional details. For exposures, the following actions are recommended:

- **Inhalation**: Remove the affected person to fresh air. If breathing becomes difficult, seek medical attention.
- **Eye Contact**: Promptly flush eyes with room temperature water for a prolonged period (15 minutes), and seek medical attention.
- **Skin Contact**: Promptly remove any contaminated clothing and flush the affected area with water for a minimum of 15 minutes. If symptoms persist after washing, notify the supervisor or the Laboratory Supervisor and seek medical attention. The use of chemical neutralizers or absorbers directly on the skin is NOT recommended.
- **Ingestion**: Call the Hudson Valley Poison Control Center at (800) 222-1222 for immediate first aid procedures to follow.

**Fill out an Incident Report**: All chemical exposures are to be documented by initiating an Incident report with the Department of Campus Safety.

# XV. Exhaust Systems

OSHA requires the use of engineering controls to prevent exposures to laboratory employees. Many chemicals should be used only within a local exhaust system (fume hoods, slot hoods, canopy hoods, glove boxes, etc.). **It is nevertheless advisable to use a laboratory hood when working with any/all hazardous substances.**

A. **Fume Hoods**

1. Fume Hood Standard (New Fume Hoods)

   a. New hoods must undergo acceptance testing.

   b. Once a hood is found to meet acceptable face velocity by the certifying company, a sticker is placed on the hood indicting the acceptable sash height for use, the date of the testing, the initials of the inspector, and an expiration date.

   c. All new hoods must have either a mechanical or electrical flow indicator to warn personnel when the hood is not functioning properly.

2. Existing Fume Hoods

   a. The face velocities of fume hoods at Mercy College will be checked annually certifying company

## B. Fume Hood Face Velocity Measurements

- The fume hood face velocity shall be 100 ± 10 linear feet per minute (fpm) with the fume hood sash approximately 2/3 open (18-19.5" opening)
- The face velocity shall be no more than 100 fpm with the sash fully open.
- A sticker is placed on the hood indicating the acceptable sash height for use, the date of the testing, the initials of the inspector, and an expiration date. If the hood is found not to have an acceptable face velocity, the problem will be reported by Lab Supervisor to Facilities for corrective action.
- The face velocities of all fume hoods are to be measured annually.

## C. Hoods not meeting University Standards

- If a fume hood is found to be functioning improperly, lab personnel must notify Facilities immediately by calling x7540.
- Upon notification that the hood has been repaired, Lab Supervisor will measure the face velocity of the fume hood. If the hood still does not work or conform to College standards, Facilities will be notified immediately. Those fume hoods that do not pass will have a sign posted on the sash stating **"DO NOT USE FUME HOOD".**
- Those hoods not meeting College Standards can be used for storage of materials. These hoods must have a sign posted on the sash stating **"FUME HOOD FOR STORAGE ONLY'.**

## D. Class II Biological Safety Cabinets

- Biosafety cabinets are traditionally used for the control of particulates that may be released while working with biological materials and are designed to provide product, environment, and employee protection. Biosafety cabinets use vertical laminar airflow to create a barrier to airborne particles. HEPA filters (High Efficiency Particulate Air), within the biosafety cabinet, filter the air going into the environment or laboratory with an efficiency of 99.97% for a 0.3 micron size particle. HEPA filters do not filter out gases or vapors.
- There are two major groups of Class II biosafety cabinets, the Type A and the Type B. Class II Type A biosafety cabinets vent directly into the laboratory, while the Type B cabinets are ducted like a fume hood and vent outside. Since the Type A and B cabinets recirculate much of the air entering the cabinet, it is important to avoid large quantities of flammable materials such as alcohols that are frequently used to wash down the cabinet prior to use. Class II B2 cabinets or fume hoods are required for using larger amounts of hazardous volatile chemicals; both of these devices use negative pressure and single-pass air for employee protection.
- All biosafety cabinets are certified according to the National Sanitation Foundation (NSF) 49 Class II (Laminar Flow) Biosafety Cabinetry when initially installed. As a general rule, biosafety cabinets then must be re-certified at least annually; following service; and following re-location. Servicing of the internal workings of these units is performed by outside contractors only.
- As a general rule, biosafety cabinets must be decontaminated with paraformaldehyde gas prior to being moved to another location and prior to service or maintenance that involves opening a contaminated plenum.
- A laminar flow "Clean Bench" provides the horizontal or vertical positive pressure flow air environment for product protection only. The horizontal flow clean benches are used in clinical, pharmaceutical, and laboratory facilities without toxic, infectious, radioactive, or sensitizing materials. A "Clean Bench" may

be useful for certain manipulations of clean materials (e.g. pouring agar plates, etc.) but must not be used for biohazard materials.

- Refer to the Centers for Disease Control and Prevention booklet: **Primary Containment for Biohazards: Selection, Installation and Use of Biosafety Cabinets** for more detailed information regarding biosafety cabinets.

# XVI. General Safety Procedures for Working with Chemicals

**Safety Awareness**

Everyone involved in laboratory operations – from the highest administrative level to the individual worker – must be safety minded. Safety awareness will become part of everyone's everyday habits only if senior and responsible staff demonstrate a sincere and continuing interest in safety. Over-familiarity 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. Be alert for unsafe conditions and actions and call attention to them so that corrections can be made. Each laboratory worker has a basic responsibility to himself/herself and colleagues to plan and execute laboratory operations in a safe manner.

1. **Glassware:** Accidents involving glassware are the leading cause of injury in the laboratory.

- Handle and store laboratory glassware with care to avoid damage. Discard damaged glassware immediately.
- Use adequate hand protection, when inserting glassware into rubber stoppers, corks or rubber tubing.
- Provide proper instructions for the use of specialized glass equipment, which can pose risks for first-time users. (For example, separator funnels containing volatile solvents can develop considerable pressure during use).
- Glassware that is heated should be Pyrex or of a similar heat-treated type.
- Use gloves when picking-up broken glassware. Small pieces of broken glassware should be swept up using broom and dustpan. All broken glassware should be disposed of in a Box labeled " Broken Glass Only".
- Clamps are to be placed on all condenser hook-ups.

2. **Choice of Chemicals**: Use only those chemicals for which the quality of the available ventilation system is appropriate. Working with hazardous chemicals (and procedures) alone in a laboratory or chemical storage area is strictly PROHIBITED. Lab personnel must schedule research and experiments involving hazardous substances and procedures so that other lab members are present. Rules are as follows

- Undergraduate teaching laboratories: A faculty member must be present in the lab at all times when undergraduate students are conducting experiments;

*General Considerations*:

- Personnel should plan a route of escape in case of an emergency;
- Wear appropriate eye protection at all times;
- When working with flammable chemicals, be certain that there are no sources of ignition near enough to cause a fire or explosion in the event of a vapor release or liquid spill;
- Use a tip-resistant shield for protection whenever an explosion or implosion might occur.
- For the chemicals they are using, all employees should be aware of: The chemicals' hazards, as determined from the SDS and other appropriate references; • Appropriate safeguards (e.g. chemical fume hood, personal protective equipment, etc.); • The location(s) and proper use of emergency equipment (e.g. emergency shower/eyewash, fire extinguisher, spill kit); • How and where to properly store the chemical when it is not in use;
- The proper methods of transporting chemicals within the facility;
- Appropriate procedures for emergencies, including evacuation routes, spill cleanup procedures and proper waste disposal.

3. **Eating, Smoking, etc.**

   - Eating, drinking, smoking, chewing gum, or applying cosmetics in areas where laboratory chemicals are present is not allowed. Wash hands before conducting these activities. Wash hands and any potentially exposed skin before leaving the laboratory.
   - Food and beverages must not be stored in refrigerators, freezers or cold room used for specimens or chemical storage. Laboratory glassware or utensils are not be used for the storage or consumption of food or beverages.

4. **Mouth Suction:** Mouth suction for pipetting or starting a siphon is prohibited.

5. **Personal Apparel**: Confine long hair and loose clothing. Safe laboratory practice dictates that appropriate shoes and clothing be worn; excessively short and open clothes as well as open toe shoes are not allowed in the course labs. The PI or laboratory supervisor shall define appropriate apparel for each lab. Mercy College provides PPE for its employees and hypoallergenic nitrile gloves for its students. All students must purchase their own lab coat and safety googles. In some labs, such as the Cadavers Lab and cell biology labs, Mercy College provides disposable lab coats and gowns.

6. **Personal Housekeeping**: Safety performance and orderliness in the laboratory are related. When housekeeping standards fall, safety performance inevitably deteriorates. Keep work areas clean and properly label and store chemicals and equipment. Cleanup should follow the completion of any operation or at the end of each day. Each instructor is responsible for directing students to wipe benches and ensure there are no spills around balances and other lab common areas. Spills must be reported to the Lab Manager. Deposit wastes in appropriately labeled receptacles and in clearly marked temporary holding containers. Do not accumulate unneeded chemicals. Stairways and hallways cannot be storage areas. Maintain free, unobstructed access to exits and emergency equipment, such as eyewash stations and emergency showers.

7. **Planning:** Employees are to seek information and advice about hazards, plan appropriate protective procedures and escape routes in case of emergency, and plan positioning of equipment prior to beginning any new operation.

8. **Unattended Operations:** An appropriate sign (including an emergency contact person) is to be placed on the door for any unattended operation. Provisions for the containment of toxic substances in the event of the failure of a utility service (such as cooling water) are to be made for all unattended operations.

9. **Working Alone:** Multiple personnel need not be present when using common chemicals. However, the Lab Manager or responsible faculty member must be notified for procedures involving the use of chemicals of moderate, chronic, or high acute toxicity. No students are allowed to work on their own in Mercy labs.


10. **Hazard Information Signs and Placards.** Post laboratory areas that have special or unusual hazards with hazard information signs and labels. Standard signs and symbols exist for a number of special situations, such biological hazards and fire hazards. Other signs shall be posted to show the locations of safety showers, eyewash stations, exits and fire extinguishers. Fire extinguishers are to be labeled to show the type of fire for which they are intended. A green on white placard must be posted to designate emergency eyewash and shower facilities. Waste containers must be labeled for the type of waste for which they are intended. The safety- and hazard- sign systems in the laboratory should enable a person unfamiliar with the usual routine of the laboratory to escape in an emergency.

11. **Labels on Chemical Containers.** Label all containers of hazardous materials to identify the contents. College labeling requirements and guidelines include the following: Inspect incoming containers of hazardous chemicals to ensure that containers have legible labels; if a new chemical (one not previously used in your laboratory), retain the Safety Data Sheet (SDS) for the laboratory file. Inform laboratory personnel about the hazards of the chemical. If the composition of a chemical produced in the lab is unknown, assume it is hazardous. Clearly spell out the name of the chemical on the label when transferring substances from original containers to secondary containers, or when synthesizing/mixing new substances, if the substances are not for the immediate use of the handler or preparer. Do not use molecular formulas as sole identifiers. For example, do not write $H_2SO_4$ only on a label to identify the contents as sulfuric acid. The label must read "Sulfuric Acid". In the case of buffer solutions, it is appropriate to identify the contents as "Buffer Solution" and include the type of buffer in its abbreviated form (e.g. "Buffer Solution – Tris").

12. **Eyewash and Safety Shower Facilities.** Emergency eyewash and safety showers are required in buildings within 10 seconds travel distance and not more than 75 feet from where toxic chemicals are used. These facilities must be on the same level as the chemical area; there can be no stairs or ramps between the hazard and the eyewash and/or safety shower. Units must be plumbed units that meet ANSI Standard Z358.1-2004.

Handheld drench hoses are a supplement, not a substitute, for an eyewash station and a safety shower. Personal eye flush squeeze bottles do not meet ANSI requirements, because they cannot deliver the required minimum flow rate and duration. The presence of these bottles in labs is discouraged because they have a limited shelf life, are prone to contamination, and are ineffective at dual-eye or eye-face irrigation.

Because some chemicals, even in small amounts, can irritate or damage skin upon contact, flush affected areas with water as soon as possible. Remove personal protective equipment and clothing that may have come in contact with the hazardous material once the shower has been activated. Fellow workers may need to help remove contaminated clothing. Call 911 if immediate medical attention is necessary. Contact the Safety Office and the Lab Supervisor as soon as possible. Remain in the shower or continue flushing the eyes for no less than 15 minutes.

The Lab Supervisor is responsible for ensuring that emergency eyewash facilities, both within laboratory spaces and in nearby common areas, remain operational and accessible.

13. **Compressed Gasses and Gas Cylinders:**

As previously noted in Chapter VIII, the use of compressed gasses at Mercy College is to be done in accordance with the recommendations published by the Compressed Gas Association. The basic guidelines for the use and/or storage of compressed gasses are:

All compressed gas cylinders must bear labels clearly identifying their contents.

Compressed gas cylinders must always be supported, regardless if full or empty. Acceptable methods of support include:

- Wall or bench mounted gas cylinder brackets.
- Belts or chain anchored to wall or bench.
- Free standing dollies or carts designed for gas cylinders and quipped with safety chains or belts.

Make sure that belts, chains, and/or wall brackets which are supporting multiple cylinders are not overloaded past their effective support strength.

Gas cylinders must have a valve protection cap in place except when in use. A cylinder properly supported and connected to a piece of equipment is “in use”.

Gas cylinders must be positioned vertically and clamped at all times.

Use appropriate hand-trucks or dollies to move cylinders weighing more than 50 lbs. Cylinders should never be moved by rolling, spinning, or sliding.

Pressure regulators and gauges must be compatible with the cylinder valves.

There are two general types of compressed gas cylinders: returnable (owned by gas supplier, demurrage charged to the College) and non-returnable. Most suppliers will accept the return of their cylinders even if they are not empty (pressure approaching atmospheric). However, suppliers will not accept non-returnable cylinders under any circumstances. Therefore, purchase compressed gases in returnable cylinders if available.

## 14. Working with Chemicals of Moderate Chronic or High Acute Toxicity

Examples of these materials include hydrofluoric acid, diisopropylfluorophosphate, and hydrogen cyanide. The following supplemental rules are also to be followed:

- **Location**: Use and store these substances only in areas of restricted access with special warning signs. Always use a hood (previously evaluated to confirm adequate performance with a face velocity of at least 100 linear feet per minute) or other containment device for procedures that could result in the generation of aerosols or vapors containing the substance. Trap released vapors to prevent their discharge into the workspace by exhausting them into the hood exhaust.
- **Personal Protection**: Always avoid skin contact by use of gloves and long sleeves and other protective apparel, as appropriate. Always wash hands and any potentially exposed skin immediately after working with these materials.
- **Prevention of Spills and Accidents**: Be prepared for accidents and spills. Ensure that at least 2 people are present at all times when using a highly toxic chemical or one of unknown toxicity. Store breakable containers of these substances in chemically resistant trays. Also, work and mount apparatus on trays, or cover work and storage surfaces with removable, absorbent, plastic backed paper. If a major spill occurs outside the hood, evacuate the area and notify Safety of the location of the spill, the chemicals, and the quantities involved.

## 15. Working with Chemicals of High Chronic Toxicity

Examples of these materials include acroline, arsine, chlorine, diazomethane, diborane (gas) hydrogen cyanide, hydrogen fluoride, methyl fluorosulfonate, nickel carbonyl, nitrogen dioxide, osmium tetroxide, ozone, phosgene, sodium azide, sodium cyanide, human carcinogens and other substances with high carcinogenic potential in animals. Further supplemental rules are to be followed, in addition to those listed previously. These include:

- **Access:** Conduct all transfers and work with these substances in a "controlled area" – a restricted access hood, glove box, or portion of a lab designated for use of highly toxic substances for which all people with access are aware of the substances being used and necessary precautions.
- **Non-Contamination/Decontamination**: Protect vacuum pumps against accidental contamination by using cold traps (fingers), scrubbers, or HEPA filters, and vent the exhaust into a fume hood. Decontaminate vacuum pumps or other contaminated equipment, including glassware, in the hood before removing them from the controlled area. The controlled area must be decontaminated before normal work is resumed.
- **Exiting:** On leaving a controlled area, reusable protective equipment is to be decontaminated and any disposable protective apparel is to be discarded in an appropriately labeled waste container. Hands and any potentially exposed skin surface should be washed thoroughly.
- **Housekeeping:** Use a wet mop or a vacuum cleaner equipped with a HEPA filter instead of dry sweeping if the toxic substance was a dry powder.
- **Records:** Users should keep accurate records of the amounts of these substances stored and used, the dates of use, and the names of users.
- **Signs and Labels**: Ensure that the controlled area is conspicuously marked with warning and restricted access signs and that all containers of these substances are appropriately labeled with identification and warning labels.
- **Spills:** Assure that contingency plans, equipment, and materials to minimize exposure to people and property in case of accident are available.

- **Storage:** Store containers of these chemicals only in a ventilated, limited access area in appropriately labeled, unbreakable, chemically resistant, secondary containers.
- **Waste and Decontamination:** Prepare a plan for the disposal of these materials prior to use. Use chemical decontamination whenever possible; ensure that containers of contaminated waste (including washings from contaminated flasks) are transferred to the hazardous waste container for disposal.
- **Site Specific Procedures:** The CHP is to be used for all Mercy College laboratories. Because of the variety of labs, the inclusion of site-specific procedures should be handled at the laboratory level.

## Appendices

1. Annual Lab Training Documentation Form
2. Abbreviations
3. OSHA's 29CFR1910.1450