TEMPLE UNIVERSITY
Environmental Health and Radiation Safety

TEMPLE UNIVERISTY

CHEMICAL HYGIENE PLAN



The most recent version of this plan and associated documents can be found on the [Temple University Chemical Hygiene Program webpage.]

Summary: The Chemical Hygiene Plan (CHP) outlines the processes and procedures which will be implemented at Temple University to minimize and reduce laboratory personnel exposure to hazardous chemicals.

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1. INTRODUCTION

1.1. Purpose

The Temple University Chemical Hygiene Plan (CHP) serves as a comprehensive safety guidance document for laboratory operations involving hazardous chemicals at Temple University (TU). Grounded in OSHA's Laboratory Standard (29 CFR 1910.145) and other relevant regulatory standards, it incorporates best practices from universities nationwide, national recognized recommendations, and Temple's own laboratory experiences. While the plan provides essential guidelines, it is not exhaustive, acknowledging that not all safety measures apply universally to every laboratory activity.

The CHP provides direction on the types of procedures, equipment, work practices, and personal protective equipment that, combined, protect our laboratory personnel from the potential health and physical hazards inherent to working with hazardous chemicals.

1.2. Scope

The CHP applies to all laboratory personnel who manage or may be exposed to hazardous chemicals in laboratories on Temple University (TU) campuses. A laboratory, as defined by the Occupational Safety and Health Administration (OSHA) is a workplace where hazardous chemicals are used or stored in small quantities for research. This includes teaching and research laboratories that use small quantities of commercially available ("off the shelf") hazardous chemicals as part of their research.

The information presented in this document represents best practices and provides a broad overview of the information necessary for the safe operation of laboratories that utilize potentially hazardous chemicals. It is not intended to be all inclusive, nor should it be considered a complete Chemical Hygiene Plan. To be considered a complete Chemical Hygiene Plan, this document must be accompanied by laboratory-specific information, Standard Operating Procedures (SOPs) and requirements developed by laboratory personnel and approved by the Principal Investigator (PI).

The CHP does not apply to those using commercially available products containing chemical hazards as those products were intended in a standard, non-experimental process (e.g., cleaning products used by housekeeping, commercial paints used by the paint shop). Use of chemicals by these individuals is covered by TU Hazard Communication Program and is governed by OSHA's Hazard Communication Standard. The Chemical Hygiene Plan also does not apply to students enrolled in laboratory courses occurring in teaching labs where hazardous chemicals are used or stored, as course-specific lab safety is covered by course safety protocols as required and provided by the instructing faculty member.

The CHP does not apply to any activity involving exclusively radiological or biological materials, as these safety procedures and regulatory requirements are outlined separately in the Radiation Safety Program and the Biosafety Program, respectively. Research that involves more than one type of hazard must comply with all applicable regulatory requirements and follow guidance outlined in the relevant safety programs.

1.3. Chemical Hygiene Plan Components

The CHP, in accordance with the OSHA Standard on Occupational Exposure to Hazardous Chemicals in Laboratories (29 CFR 1910.1450), addresses eight key elements in a generalized format to ensure the safety and protection of laboratory employees. These elements provide a broad framework for laboratory safety, but not all information will be directly applicable to every lab. To ensure full protection, the generalized guidelines must be supplemented with lab-specific information and procedures tailored to the unique hazards present in each individual laboratory.

1.3.1. **Standard Operating Procedures (SOPs):** *Prudent laboratory practices which must be followed when working with hazardous chemicals in a laboratory. These include general and laboratory-specific procedures for work with hazardous chemicals.*

1.3.2. **Criteria for Exposure Control Measures:** *Criteria used by the employer to determine and implement control measures to reduce worker exposure to hazardous chemicals including engineering controls, the use of PPE and hygiene practices.*

1.3.3. **Adequacy and Proper Functioning of Fume Hoods and other Protective Equipment:** *Specific measure that must be taken to ensure proper an adequate performance of protective equipment, such as fume hoods.*

1.3.4. **Information and Training:** *The employer must provide information and training required to ensure that workers are apprised of the hazards of chemicals in their work area and related information.*

1.3.5. **Requirement of Prior Approval of Laboratory Procedures:** *The circumstances under which certain laboratory procedures or activities require approval from the employer or employer's designee before work is initiated.*

1.3.6. **Medical Consultation and Examinations:** *Provisions for medical consultation and examination when exposure to a hazardous chemical has or may have taken place.*

1.3.7. **Designation or personal responsible for the implementation of the Chemical Hygiene Program:** *Identification and responsibilities of personal responsible for the Chemical Hygiene Program, Chemical Hygiene Officer and, where appropriate, establishment of a Chemical Hygiene Committee.*

1.3.8. **Provisions for Additional employee protection for work with Particularly Hazardous Substances (PHS):** *Outlines additional worker protections for work with particularly hazardous substances. These include select carcinogens, reproductive toxins, and substances which have a high degree of acute toxicity.*

1.4. Laboratory-Specific Information & Requirements

The CHP serves as an operational guide to promote the incorporation of prudent practices in the daily

use of hazardous chemicals within laboratories. While the CHP provides a general framework, it must be adapted and supplemented by departments, laboratories, and specific research groups or centers to address their unique needs.

Each Principal Investigator (PI) is responsible for augmenting the CHP with laboratory-specific requirements, such as Standard Operating Procedures (SOPs), Personal Protective Equipment (PPE) requirements, engineering and administrative controls, and training protocols. PIs are also responsible to communicate specific hazards present in their labs and the controls in place to minimize exposure.

Laboratory-specific information must be reviewed and updated at least annually, or whenever significant changes occur in laboratory activities.

All laboratory personnel are required to familiarize themselves with the CHP and any relevant lab-specific SOPs or information. This material must be accessible in either electronic or hard-copy format for reference at any time.

1.5. Temple University-Environmental Heal & Safety Assistant (EHSA)

EHRS has incorporated a new web-based system into the Chemical Hygiene Program. Goals of EHSA implementation are to reduce administrative and management burden, improve efficiency, improve data accuracy, and increase data transparency.

EHSA is a user-friendly, comprehensive, online information management system that assists TU researchers with managing their safety and compliance responsibilities and information related to the use of hazardous research materials and equipment. TU PIs can use one portal to manage chemical safety information as well as the following:

- Access safety data sheets (SDS)
- Chemical Inventories
- Review training records via the PI Overview
- Lab Hazard Profile (Lab Registration & Lab Hazard Identification)
- Request chemical waste collection services (Coming CY 25)

Please contact EHRS via ehrs@temple.edu for information on accessing TU-EHSA

1.6. Plan Availability, Review & Update

On an annual basis, this document will be reviewed by EHRS, evaluated for effectiveness, and updated as necessary to reflect changing regulations and circumstances. The Plan's effectiveness will be evaluated by reviewing incident reports, safety related complaints, completion of training, and audits.

The most current copy of this document as well as guidelines and policies for other laboratory specific hazards and conditions are available on the Temple University Chemical Hygiene Program webpage.

For each laboratory where hazardous chemicals are used or stored, the PI is required to review the CHP and laboratory specific materials for adequateness annually and whenever the nature of the work changes (e.g., change in chemicals, chemical amounts, facilities, etc.)

2. PROGRAM RESPONSIBILITY & ACCOUTNABILITY

Temple University supports the use of chemicals and other potentially hazardous materials for purposes of research, clinical and academic activities. The University is committed to ensuring the safety of its students, employees, volunteers, and visitors and to complying with all regulatory requirements, which impact its facilities and operations relating to the environment, health, and safety. University administration, faculty, staff, and students are asked to support this goal in all university activities.

Temple University has designated the following specific responsibilities for developing and implementing the Chemical hygiene Program.

2.1. University Administration

The University administration has overall responsibility for instituting policies and programs, establishing systems, and providing resources to help ensure that research and teaching activities involving hazardous chemicals are conducted in a responsible manner and in accordance with all applicable requirements.

2.2. Dean(s), Directors(s) & Department Chair(s)

Dean(s), Director(s) and Department Chair(s) are responsible for providing the resources and leadership necessary to ensure the CHP is adopted and implemented for laboratories under their administrative control.

2.3. Principal Investigators (PIs)

The Principal Investigator (PI) has the primary responsibility for the health and safety of all personnel working in laboratories under their direction and are required to ensure that all the procedures and guidelines established in this document are strictly followed by all laboratory personnel under their supervision.

The PI may delegate safety duties but remains responsible for ensuring that delegated safety duties are adequately performed. The PI has the primary responsibility for establishing a strong safety culture within the laboratory they supervise.

2.4. Laboratory personnel

All individuals in laboratories who potentially use, handle or store hazardous chemicals are considered laboratory personnel and are expected to follow all applicable practices and procedures contained in the CHP, complete designated training, and report hazardous and unsafe laboratory conditions to the Principal Investigator (PI) and/or Environmental Heath and Radiation Safety (EHRS).

2.5. Environmental Health & Safety-Safety Committee (EHSSC)

The Environmental Health & Safety-Safety Committee (EHSSC) was established to assist and guide the University with the development and implementation of applicable Chemical and Occupational Safety programs. The EHSSC consist of representatives from colleges and departments with facilities and personnel that are affected by the programs and procedures applicable to Chemical and Occupational Safety. Responsibilities applicable to the CHP include, but not limited to:

- Assist and guide the University Chemical Hygiene Officer (CHO) with the implementation of the CHP.
- Provide a mechanism or point of contact to distribute essential information to departments with laboratories and personnel covered by the CHP.
- Support the CHO with the authority for the enforcement of the CHP.

2.6. Environmental Health & Radiation Safety (EHRS)

The principal role of EHRS is to serve as the primary universal resource for all matters pertaining to chemical safety, biological safety, radiation safety, occupational safety, and emergency response support within Temple University (TU). EHRS provides technical guidance, compliance assistance, remediation oversight and training to the TU community.

For the purpose, the TUCHP, the key role of EHRS is to oversee the adoption and implementation of the content in this plan at all levels of responsibility as it pertains to the laboratory use of hazardous chemicals. The Executive Director of EHRS will designate a University Chemical Hygiene Officer to oversee the Chemical Hygiene Program.

Contact Environmental Health & Radiation Safety (EHRS) via ehrschem@temple.edu if you have any questions about the content of this document.

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3. TRAINING

The OSHA Lab Standard requires that individuals who will be working with chemicals in the laboratory be provided with sufficient training and information about the physical and health hazards of the hazardous chemicals in the laboratory and of the methods and procedures laboratory personnel should follow to protect themselves from these chemicals. The training occurs at two levels:

3.1. University Training

General chemical safety training is provided by the Department of Environmental Health and Radiation Safety (EHRS). All laboratory personnel and PI(s) are required to complete all required training at the time of the time of the initial assignment to the lab and prior to assignments involving new exposure situations. Some training courses or modules may require regular updates, refreshers, and/or renewals. Refer to the EHRS Training Webpage to access training and to determine applicable training requirements.

EHRS supplied training and training certificates can be accessed online via the EHRS Training Webpage.

3.2. Laboratory-Specific Training

Laboratory-specific training is required to be provided by the laboratory PI or his or her designee. This training must be performed and documented before the employee is permitted to work unsupervised in the laboratory. This training must be provided before the laboratory personnel begins laboratory work. It should include the specific types of the hazardous chemicals to be used, and the specific safe work practices for each hazardous chemical. This additional laboratory-specific training is the responsibility of the Principal Investigator (PI) and must be specific to the activities in the laboratory as possible.

At a minimum, this training must include:

- A lab orientation to familiarize the new researcher with the available safety controls and lab safety rules or work practices.
- Specific physical and health hazards of chemicals in the work area (available on Safety Data Sheets (SDS))
- Training on all laboratory-specific Standard Operating Procedures (SOPs) relevant to their assigned research tasks or workspaces.
- Management of hazardous waste streams in the laboratory; and
- Emergency procedures and equipment.

EHRS recommends an annual review (refresher) of all laboratory-specific training topics with all laboratory personnel

3.3. Training Recordkeeping

All safety training must be documented. Principal Investigators (PIs) are responsible for maintaining laboratory specific training records. Lab-specific training can be documented using the Laboratory-specific Training checklist. All training records must be made available upon request.

EHRS maintains training records of laboratory personnel that attend any trainings session provided by EHRS. Training certificates are available via the EHRS Training webpage.

4. HAZARD ASSESSMENT

Chemicals pose many health and safety hazards to researchers as well as to the environment. Recognizing these hazards is integral to developing a plan to control or mitigate the hazards and prevent researcher exposures and injuries.

4.1. Types of Chemical Hazards

Chemical hazards are grouped by hazard type, called hazard classes, and are described using the Globally Harmonized System (GHS) pictograms, as shown in Table 1. The hazard classes and severity of these hazards are defined by manufacturers or importers and listed in the safety data sheet (SDS).

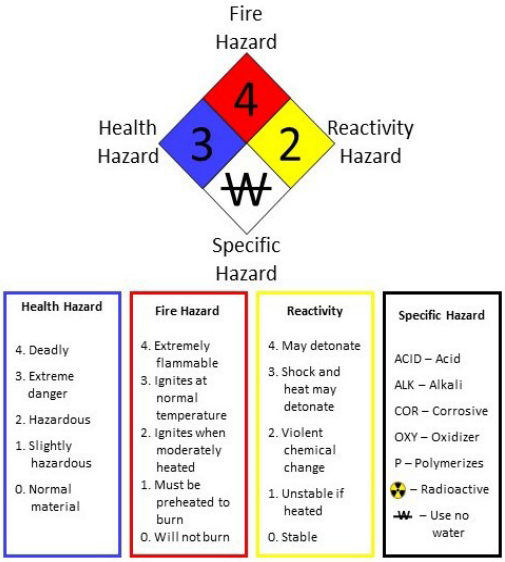
The severity of the hazard within a class is described by the Hazard Category as well as by the combination of a Hazard Code (H-Code) and Hazard Statement. The most severe hazard within a Class is described using the lowest numbered Category and H-Code. For example, the Acute Toxicity, Oral class is divided into four categories. Category 1—the most severe—is also described using H-Code H300 and the statement "fatal if swallowed," while Category 4—the least severe—is assigned the H-Code H302 and the statement "harmful if swallowed."

All PIs and laboratory personnel areresponsible for recognizing and controlling hazardous chemicals in their lab and research. This means that researchers need to be familiar with the hazards listed on the SDS and have made a plan for how to manage these hazards appropriately (See Section 4.3:Laboratory Hazard Assessment). Examples of chemical Hazard Classes and their associated GHS pictograms is described in the table below:

GHS Pictograms and Hazard Classes		
Health Hazard	**Flame**	**Exclamation Mark**
		
Carcinogen Mutagenicity Reproductive Toxicity Respiratory Sensitizer Target Organ Sensitizer Aspiration Toxicity	Flammable Pyrophoric Self-Heating Emits Flammable Gas Self-Reactive Organic Peroxide Desensitized Explosive	Irritant (skin and eye) Skin Sensitizer Acute Toxicity (harmful) Narcotic Effects Respiratory Tract Irritant Hazard Not Otherwise Classified (Non-Mandatory) Hazardous to Ozone Layer (Non-Mandatory)
Gas Cylinder	**Corrosion**	**Exploding Bomb**
		
Gases Under Pressure Chemicals Under Pressure	Skin Corrosion/Burns Eye Damage	Explosives Self-Reactive

	Corrosive to Metals	Organic Peroxides
Flame Over Circle	**Environment (Non-Mandatory)**	**Skull and Crossbones**
		
Oxidizer	Aquatic Toxicity	Acute Toxicity (fatal or toxic)

Another common method to communicate hazards is with the National Fire Prevention Association (NFPA) hazard diamond, shown in the figure below. This system is used to placard a building or room and provides an overview of the hazards contained within. The hazard diamond is broken up into four color-coded hazard sections: red for flammability hazards, yellow for reactivity, blue for health hazards, and white for any special hazards such as water reactive, biohazard, etc. The relative level of hazard is listed on a scale of 1-4, where 4 is the most severe hazard. Note that the numbering system used by NFPA runs counter to the GHS numbering system. For example, a chemical that is "fatal if swallowed" would be listed as a 4 in NFPA and as Category 1 or H300 in GHS.



NFPA hazard diamond

4.2. Safety Data Sheets (SDS)

A Safety Data Sheet (SDS), formerly known as a material safety data sheet (MSDS) is a detailed informational document prepared by the manufacturer or importer of a hazardous chemicals. It describes the physical and chemical properties of the product. SDS's contain useful information such as toxicity, flash point, procedures for spills and leaks, storage guidelines, and exposure controls.

SDS must be available for each hazardous chemical in a laboratory's chemical inventory. SDSs are available from the TU-EHSA's online SDS library. TU-EHSA's, chemical inventory module has an attached SDS for most chemical entries.

Principal Investigators are required to ensure that all laboratory personnel have access to SDSs. SDSs must be current and available to all laboratory workers throughout the workday. SDSs must be in a central location that can be accessed immediately in the event of an emergency. Electronic copies may be kept in a file on a group drive, or hard copies maintained in a central location in the laboratory.

New Global Harmonization System (GHS) requires the standardization of SDSs. The minimum information required for an SDS is listed in the table below.

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

4.3. Laboratory Hazard Assessment

A hazard assessment is required to be conducted by the Principal Investigator to assess the potential risks to laboratory personnel working in a laboratory and to evaluate the specific types of engineering controls, administrative controls and, personal protective equipment (PPE) needed for work in that laboratory.

Information from the manufacturer, such as manufacturer's label and Safety Data Sheets (SDS), may be relied upon in making hazard determinations. However, PIs are responsible for making reasonable determinations of the health and/or physical hazards of any *materials produced in their laboratories*.

Any chemical of unknown composition should be presumed to be hazardous. Chemical derivatives of known materials should be presumed to be at least as hazardous as their parent compound. In all such cases, appropriate steps must be taken to prevent exposure.

Further information on hazard assessments can be found in Identifying and Evaluating Hazards in Research Laboratories published by the American Chemical Society. Contact EHRS via ehrschem@temple.edu for consultation on conducting a laboratory hazard assessment.

4.3.1. Lab Hazard Profile

The Lab Hazard Profile, found at TU-EHSA, was developed to broadly identify activities involving chemicals and other types of hazards and is an effective method of hazard

communication. Identifying hazards in the workplace is the fundamental first step in developing the appropriate controls for a safe workplace. Conversely, it is impossible to protect oneself from risks in the workplace if the hazards present have not been fully identified and understood.

The Lab Hazard Profile tool, through a series of questions, captures information on the specific type of hazard(s), the location of the hazard(s) and other relevant chemical safety information.

This tool allows the PI to:

- Determine hazards that are present in the laboratory through a set of guided questions.
- Manage laboratory locations and personnel.
- Easily communicate laboratory hazards to group members

4.4. Additional Sources of Chemical Hazard Information

4.4.1. Various Texts

There are several sources available that are helpful in the evaluation of the hazards of chemicals, including the following:

- Annual Report on Carcinogens: Published by The National Toxicology Program (NTP),
- U.S Public Health Service. IARC Working Group Monographs: Published by The International Agency for Research on Cancer (IARC) covering specific agents, groups of agents or selected industries in which cancer has been caused or suspected.
- The Merck Index: A compendium of chemical information.
- The Chemical Abstracts: A serial collection providing detailed bibliographies and abstracts on research papers on hazards, toxicity, and related topics. These citations are based on the Chemical Abstracts Services registry number (CAS number)
- PubChem-published by the National Institutes of Health (NIH)

4.4.2. Manufacturers/Suppliers

In addition to providing the SDS, many manufacturers/suppliers have telephone numbers that access customer service or technical representatives of the company, who may be able to provide additional information about the product. Furthermore, many manufacturers/suppliers have websites that will allow you to access information regarding their chemicals.

4.4.3. NIOSH & Other Government Sources

The National Institute of Occupational Safety and Health (NIOSH), the Centers for Disease Control and Prevention (CDC), and OSHA all have published information related to chemical

hazards/exposures which are available on their websites or can be requested there.

5. CLASSES OF HAZARDOUS CHEMICALS

The Globally Harmonized System (GHS) of hazard communication was developed to identify both the hazards and the risks associated with a material to the user it. This system recognizes thirty-one classes of chemical hazards. These classes fall into three broad categories: physical hazards, health hazards, and environmental hazards. These categories are rigorously defined for each hazard class in the OSHA publication Hazard Communication: Hazard Classification Guidance for Manufacturers, Importers and Employers. A material may exhibit more than one hazard. A material's hazard class(es) determine how it is stored and managed, what special equipment may be needed, and what procedures need to be established to ensure safe handling. GHS information can be found on all commercial chemical labels printed after 2015, and the Safety Data Sheet (SDS) associated with that chemical.

5.1. Flammable Chemicals

A **flammable chemical** is one that readily catches fire and burns in air. Three conditions must exist for a fire to occur: an oxygen-containing atmosphere, a fuel, and an ignition source. There are 3 categories of a flammable chemical:

- **Flammable liquids:** Defined by having a flash point at or below 93°C (199.4°F), meaning they can ignite under typical working conditions. These are often volatile and pose a higher risk of fire when exposed to ignition sources, especially in ambient environments.

- **Flammable gases:** Defined by their ability to form flammable mixtures with air at 20°C (68°F) and 101.3 kPa (standard atmospheric pressure). These gases can be highly dangerous in confined spaces or when ventilation is inadequate.

- **Flammable solids:** Defined by their ability to catch fire easily and sustain combustion once ignited. The spread of flames through such materials occurs quickly, often requiring only brief exposure to an ignition source like a spark or flame.

Safety Data Sheets (SDS) use GHS pictograms, signal words and numbered hazard statements to communicate hazards, although the number may not always be present. The presence of the following hazard information indicates the chemical is a flammable chemical.

GHS Pictogram	TU Hazard Category	GHS Category	GHS H-Code	Signal Word
	High-Risk Chemical	Aerosols (Cat 1)	H222 & H229	Danger
		Flammable Gases (Cat1A; Flammable gas, Pyrophoric gas, chemicals unstable gas A, B, 1B);	H220, H221	
		Flammable Gases, 1 A, chemically unstable (Gas A, B)	H230, H231	
		Flammable gases, 1A-Pyrophoric Gas	H232	
		Flammable Liquids (Cat 1 & 2)	H224 & H225	
		Flammable Solids (Cat 1 & 2)	H228	
		Aerosols (Cat 2 & 3)	H223 & H229	

	Hazardous Chemical	Flammable Gases (Cat 2)	H228	Warning
		Flammable Liquids (Cat 3 & 4)	H226 & H227	

Refer to CHE035-Chemical Hazard Guideline (CHG)-Flammable Chemicals for general information on the management of flammable chemicals.

Laboratory-specific Standard Operating Procedures (SOP) are required to be developed and implemented for any chemical that is categorized as a "Particularly Hazardous Substance (PHS) or a "High-Risk" chemical. PI approval and training are required prior to any use involving a PHS or a high-risk chemical.

5.2. Pyrophoric Chemicals

Pyrophoric chemicals are a special classification of flammable materials that have autoignition temperatures below 130 °F, and thus may spontaneously combust in contact with air. Pyrophoric materials can be a solid or a liquid.

Some examples of pyrophoric chemicals include Grignard reagents (e.g. RMgX), alkyl and aryl metals (e.g. tert-butyllithium, n-butyllithium, phenyl lithium), metal carbonyls (e.g. lithium carbonyl, nickel tetracarbonyl), finely divided metal powders (e.g. cobalt, iron, zinc, zirconium, lithium), and non-metal alkyls (e.g. R_3B, R_3P, R_3As).

Safety Data Sheets (SDS) use GHS pictograms, signal words and numbered hazard statements to communicate hazards, although the number may not always be present. The presence of the following hazard information indicates the chemical is a pyrophoric chemical.

GHS Pictogram	TU Hazard Category	GHS Category	GHS H-Code	Signal Word
	High-Risk Chemical	Pyrophoric Liquids & Solids (Cat. 1 & 2)	H250	Danger

Refer to CHE078-Chemical Hazard Guideline (CHG)-Pyrophoric Chemicals for general information on the management of pyrophoric chemicals.

Laboratory-specific Standard Operating Procedures (SOP) are required to be developed and implemented for any chemical that is categorized as a "Particularly Hazardous Substance (PHS) or a "High-Risk" chemical. PI approval and training are required prior to any use involving a high-risk chemical.

5.3. Explosive Chemicals

Explosives are materials that can cause a sudden, almost instantaneous release of pressure, gas, or heat when subjected to sudden shock, pressure, or elevated temperature. Due to the potential for severe injury and property damage, work with any reagent known to be explosive or suspected to be explosive must be performed with great care. Some examples of these types of materials are:

- Compounds containing the functional groups azide, acetylide, diazo, nitrso, halomine.
- Nitrocellulose
- Di- and Tri-nitro compounds
- Picric acid (dry)
- 2,4-Dinotrophenylhydrazine (dry)
- Benzoyl peroxide (dry)

Safety Data Sheets (SDS) use GHS pictograms, signal words and numbered hazard statements to communicate hazards, although the number may not always be present. The presence of the following hazard information indicates the chemical is an explosive chemical.

GHS Pictogram	TU Hazard Category	GHS Category	GHS H-Code	Signal Word
	High-Risk Chemical	Explosives (Cat. Unstable Explosive, Div 1.1, 1.2, 1.3 & 1.5)	H200, H201, H202, H203, H205	Danger
		Explosives (Cat. 1,2A)	H209, H210, H211	Danger
		Explosives (Cat 2B)	H204	Warning
	High-Risk Chemical	Explosives (Cat 2C)	H204	Warning
	High-Risk Chemical	Desensitized Explosives (cat 1,2)	H206, H207	Danger
		Desensitized Explosives (Cat. 3,4)	H207, H208	Warning

Refer to CHE078-Chemical Hazard Guideline (CHG)-Explosive Chemicals for general information on the management of explosive chemicals.

Laboratory-specific Standard Operating Procedures (SOP) are required to be developed and implemented for any chemical that is categorized as a "Particularly Hazardous Substance (PHS) or a "High-Risk" chemical. PI approval and training are required prior to any use involving a PHS or a high-risk chemical.

5.4. Compressed Gasses

Compressed Gases are gases which are stored above atmospheric pressure in metal cylinders.

Safety Data Sheets (SDS) use GHS pictograms, signal words and numbered hazard statements to communicate hazards, although the number may not always be present. The presence of the following hazard information indicates the chemical is a compressed gas.

GHS Pictogram	TU Hazard Category	GHS Category	GHS H-Code	Signal Word
	Hazardous Chemical	Gases Under Pressure	H280	Warning
 **OR** 	High-Risk Chemical	Chemicals Under Pressure (Cat.1)	H282	Danger
		Chemicals Under Pressure (Cat.2,3)	H283, H284	Warning

Refer to CHE032-Chemical Hazard Guideline (CHG)-Compressed Gases Chemicals for general information on the management of compressed gases.

Laboratory-specific Standard Operating Procedures (SOP) are required to be developed and implemented for any chemical that is categorized as a "Particularly Hazardous Substance (PHS) or a "High-Risk" chemical. PI approval and training are required prior to any use involving a PHS or a high-risk chemical.

5.5. Cryogenic Liquids

A special subset of compressed gases are cryogenic liquids. Cryogenic liquids are gases that are kept in a liquid state at extremely low temperatures and are used in research to provide extremely low temperatures for frozen storage and experimentation.

Safety Data Sheets (SDS) use GHS pictograms, signal words and numbered hazard statements to communicate hazards, although the number may not always be present. The presence of the following

hazard information indicates the chemical is a cryogenic liquid.

GHS Pictogram	TU Hazard Category	GHS Category	GHS H-Code	Signal Word
	Hazardous Chemical	Gases Under Pressure-Refrigerated liquified gas	H281	Warning

Refer to CHE033-Chemical Hazard Guideline (CHG)-Cryogenic Liquids for general information on the management of cryogenic liquids.

Laboratory-specific Standard Operating Procedures (SOP) are required to be developed and implemented for any chemical that is categorized as a "Particularly Hazardous Substance (PHS) or a "High-Risk" chemical. PI approval and training are required prior to any use involving a PHS or a high-risk chemical.

5.6. Oxidizing Chemicals

Oxidizing chemicals are chemicals that can cause or accelerate fires involving other combustible or flammable materials, typically by providing oxygen to trigger or accelerate combustion.

Safety Data Sheets (SDS) use GHS pictograms, signal words and numbered hazard statements to communicate hazards, although the number may not always be present. The presence of the following hazard information indicates the chemical is an oxidizing chemical.

GHS Pictogram	TU Hazard Category	GHS Category	GHS H-Code	Signal Word
	High-Risk Chemical	Oxidizing Gases (Cat. 1)	H270	Danger
		Oxidizing Liquids (Cat. 1 & 2)	H271 & H272	
		Oxidizing Solids (Cat. 1 & 2)	H271 & H272	
	Hazardous Chemical	Oxidizing Liquids (Cat. 3)	H272	Warning
		Oxidizing Solids (Cate. 3)	H221	

Refer to CHE077-Chemical Hazard Guideline (CHG)-Oxidizing Chemicals for general information on the management of oxidizing chemicals.

Laboratory-specific Standard Operating Procedures (SOP) are required to be developed and implemented for any chemical that is categorized as a "Particularly Hazardous Substance (PHS) or a "High-Risk" chemical. PI approval and training are required prior to any use involving a PHS or a high-risk chemical.

5.7. Water-Sensitive Chemicals

Water-sensitive chemicals are those that react violently with water to produce heat and flammable gas(es), which can ignite or combine explosively with atmospheric oxygen.

Safety Data Sheets (SDS) use GHS pictograms, signal words and numbered hazard statements to communicate hazards, although the number may not always be present. The presence of the following hazard information indicates the chemical is an oxidizing chemical.

GHS Pictogram	TU Hazard Category	GHS Category	GHS H-Code	Signal Word
	High-Risk Chemical	Substances and Mixtures Which, in Contact with Water, Emit Flammable Gases (Cat 1,2, & 3)	H260 & H261	Danger
Generally, includes all chemicals with an NFPA special notation (white) of "W".				

Refer to chemical management procedures and guidelines contained in the CHP and chemical specific Safety Data Sheets (SDS) for general information on the management of water-sensitive chemicals.

Laboratory-specific Standard Operating Procedures (SOP) are required to be developed and implemented for any chemical that is categorized as a "Particularly Hazardous Substance (PHS) or a "High-Risk" chemical. PI approval and training are required prior to any use involving a PHS or a high-risk chemical.

5.8. Self-Reactive & Self-Heating Chemicals

Self-reactive chemicals are thermally unstable liquid or solid chemicals that undergo a strongly exothermic decomposition even without participation of oxygen(air). A self-reactive chemical is regarded as possessing explosive properties when in laboratory testing the formulation is liable to detonate, to delegate rapidly or to show a violent effect when heated under confinement.

A self-heating chemical is a solid or liquid chemical, other than a pyrophoric liquid or solid, which by reaction with air and without energy supply, is liable to self-heat; this chemical differs from a pyrophoric liquid or solid in that it will ignite only when in large amounts (kilograms) and after long periods of time (hours or days)

Safety Data Sheets (SDS) use GHS pictograms, signal words and numbered hazard statements to communicate hazards, although the number may not always be present. The presence of the following hazard information indicates the chemical is an oxidizing chemical.

GHS Pictogram	TU Hazard Category	GHS Category	GHS H-Code	Signal Word
 **OR** 	High-Risk Chemical	Self-Reactive Substances and mixtures; Organic Peroxides (Types A, B, C, D)	H240, H241,	Danger
		Self-Reactive Substances and mixtures; Organic Peroxides (Types E, F)	H242	Warning
None	High-Risk Chemical	Sel-Reactive Substances and mixtures; Organic Peroxides (Type G)	H242	None
	High-Risk Chemical	Self-Heating Substances and mixtures (Cat. 1)	H251	Danger
		Self-Heating Substances and mixtures (Cat. 2)	H252	Warning

Refer to chemical management procedures and guidelines contained in the CHP and chemical specific Safety Data Sheets (SDS) for general information on the management of self-reactive or self-heating chemicals.

Laboratory-specific Standard Operating Procedures (SOP) are required to be developed and implemented for any chemical that is categorized as a "Particularly Hazardous Substance (PHS) or a "High-Risk" chemical. PI approval and training are required prior to any use involving a PHS or a high-risk chemical.

5.9. Peroxide Forming Chemicals

Materials that may form potentially explosive organic peroxides are not classified under GHS but are of significant concern. Peroxide forming chemicals (PFC) are chemicals that react with atmospheric oxygen to form peroxides (chemicals containing an O-O bond) over time and can become sensitive to heat, shock, and/or friction. Accumulation of peroxide formers in the laboratory has resulted in numerous explosions. Peroxide formation is an autoxidation reaction that can be initiated by light, heat, concentration, contamination, and/or loss of an inhibitor.

Peroxide-forming chemicals are divided into three categories (Class A, B, and C) outlined in the table below. The tables below list some common peroxide forming chemicals and testing frequencies. The tables are non-exhaustive - review each material's SDS to determine if a chemical can form peroxides, and to check for other hazards.

	Class A	Class B	Class C
Definition	Chemicals form explosive levels of peroxides without concentration. These are the most hazardous and can form explosive peroxide levels even if not opened.	Chemicals form explosive levels of peroxides upon concentration through distillation, evaporation, or exposure to air after opening	Chemicals may auto polymerize as the result of peroxide formation
Testing for Peroxides Frequency	Test or discard after 3 months of receiving	Evaluate or discard after 6 months.	Evaluate or discard after 12 months
Common Examples	• Isopropyl ether • Divinyl acetylene • Potassium metal • Potassium amide • Sodium amide • Vinylidene chloride	• Benzyl Alcohol • Dicyclopentadiene • Diethyl ether • Tetrahydrofuran • 1,4-Dioxane • Vinyl Ethers • Sec. Alcohols	• Acrylic acid • Acrylonitrile • Butadiene • Chloroprene • Methyl methacrylate • Styrene • Vinyl acetate

Refer to CHE036-Chemical Hazard Guideline (CHG)-Peroxide-Forming Chemicals for information on the management of peroxide-forming chemicals.

All potentially peroxide forming chemicals are considered a High-Risk chemical.

Laboratory-specific Standard Operating Procedures (SOP) are required to be developed and implemented for any chemical that is categorized as a "Particularly Hazardous Substance (PHS) or a "High-Risk" chemical. PI approval and training are required prior to any use involving a PHS or a high-risk chemical.

5.10. Corrosive Chemicals

Corrosive chemicals are those that cause destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact. Corrosive chemicals can be liquids, solids, or gases. Corrosive materials may corrode materials they come in contact with, such as metal, and may be highly reactive with other substances.

Personnel handling corrosives should implement controls to minimize the likelihood of contact or

exposure. Symptoms of exposure by inhalation may include coughing, burning sensation, wheezing, shortness of breath, nausea, and vomiting. For eye contact, symptoms may include pain, blood shot eyes, tearing, and blurring of vision. For skin contact, symptoms may include reddening, pain, inflammation, bleeding, blistering, and burns.

Common types of corrosive substances include:

- Strong acids (nitric, hydrochloric, and sulfuric acids)
- Strong bases (potassium hydroxide and ammonium hydroxide)
- Dehydrating agents (sulfuric acid, phosphorus pentoxide, and calcium oxide)
- Oxidizing agents (chlorine, bromine, hydrogen peroxide)

Safety Data Sheets (SDS) use GHS pictograms, signal words and numbered hazard statements to communicate hazards, although the number may not always be present. The presence of the following hazard information indicates the chemical is a corrosive chemical.

GHS Pictogram	TU Hazard Category	GHS Category	GHS H-Code	Signal Word
	High-Risk Chemical	Skin Corrosion/Irritation (Cat 1, 1A, 1B, 1C)	H314	Danger
		Serious Eye Damage/Irritation (Cat. 1)	H318	
	Hazardous Chemical	Corrosive to Metals (Cat.1)	H290	Warning

Refer to CHE034-Chemical Hazard Guideline (CHG)-Corrosive Chemicals for general information on the management of corrosive chemicals.

Laboratory-specific Standard Operating Procedures (SOP) are required to be developed and implemented for any chemical that is categorized as a "Particularly Hazardous Substance (PHS) or a "High-Risk" chemical. PI approval and training are required prior to any use involving a high-risk chemical.

5.11. Irritant Chemicals

Irritant chemicals cause reversible effects to living tissue by chemical action at the point of contact. While irritants are not as hazardous as corrosives, personnel handling irritants should take similar care to avoid contact. Symptoms of exposure can include reddening of skin or eyes, discomfort, and irritation to the respiratory system. Wide varieties of chemicals are irritants, including organic and inorganic chemicals, of both solids and liquids.

GHS Pictogram	TU Hazard Category	GHS Category	GHS H-Code	Signal Word

	Hazardous Chemical	Skin Corrosion/Irritation (Cat 1, 2)	H315, H316	Warning
		Serious Eye Damage/Irritation (Cat. 2A, 2B)	H319, H320	

Refer to chemical management procedures and guidelines contained in the CHP and chemical specific Safety Data Sheets (SDS) for general information on the management of irritant chemicals.

5.12. Sensitizers

Sensitizers are substances that cause hypersensitivity and an allergic response after repeated exposures. Caution to avoid initial contact by personnel handling sensitizers should be taken. Exposure to sensitizers can lead to symptoms associated with allergic reactions or can increase an individual's existing allergies. Common examples of sensitizers include phenol derivatives, latex, and formaldehyde.'

Safety Data Sheets (SDS) use GHS pictograms, signal words and numbered hazard statements to communicate hazards, although the number may not always be present. The presence of the following hazard information indicates the chemical is a sensitizer.

GHS Pictogram	TU Hazard Category	GHS Category	GHS H-Code	Signal Word
	Hazardous Chemical	Sensitization, Skin (Cat 1, 1A,1B)	H317	Warning
		Sensitization, Respiratory (Cat. 1, 1A, 1B)	H334	

Refer to chemical management procedures and guidelines contained in the CHP and chemical specific Safety Data Sheets (SDS) for general information on the management of irritant chemicals.

5.13. Acutely Toxic Chemicals

Acute toxicity is the ability of a chemical to cause an adverse or lethal effect after a single exposure or exposures of short duration via one of more of four routes (ingestion, skin absorption, injection, and inhalation) which is defined as any of the following:

- A chemical with a median lethal dose (LD50) of 50 mg or less (oral) per kg of body weight.
- A chemical with a median lethal dose (LD50) of 200 mg or less (dermal) per kg of body weight; or
- A chemical that has a median lethal concentration (LC50) in air of 500 ppm by volume or less of

gas, 2.0 mg per liter or less of vapor, or 0.5 mg per liter or less of dust, when administered by continuous inhalation for 4 hours (or less if death occurs within 4 hours).

Safety Data Sheets (SDS) use GHS pictograms, signal words and numbered hazard statements to communicate hazards, although the number may not always be present. The presence of the following hazard information indicates the chemical is an acutely toxic chemical.

GHS Pictogram	TU Hazard Category	GHS Category	GHS H-Code	Signal Word
	Particularly Hazardous Substance (PHS)	Acute Toxicity-either oral, dermal or inhalation (Cat. 1, 2, 3)	H300, H301, H310, H311, H330, H331	Danger
		Acute Toxicity (Cat. 4 & 5)	H302, H303, H312, H313, H332, H333	Warning

Refer to CHE074-Chemical Hazard Guideline (CHG)-Acutely Toxic Chemicals for general information on the management of acutely toxic chemicals.

Laboratory-specific Standard Operating Procedures (SOP) are required to be developed and implemented for any chemical that is categorized as a "Particularly Hazardous Substance (PHS) or a "High-Risk" chemical. PI approval and training are required prior to any use involving a PHS or a high-risk chemical.

5.14. Carcinogens

Carcinogens are chemicals that are known to cause cancer or tumor development, usually after repeated or chronic exposures. Many carcinogens do not cause immediate harmful effects, and carcinogenicity only become evident after a long latency period. As such, it is crucial to keep exposures to carcinogens as low as possible.

OSHA considers a chemical to be a carcinogen if it meets any of the below criteria:

- Specifically regulated by OSHA as a carcinogen,
- Listed as "known to be carcinogens" by the National Toxicology Program (NTP),
- Listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer (IARC), or
- Listed in either Group 2A or 2B by IARC, or under the category "reasonably anticipated to be

carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

- After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages less than 10 mg/m^3.
- After repeated skin application of less than 300 mg/kg of body weight per week.
- After oral dosages of less than 50 mg/kg of body weight per day.

Safety Data Sheets (SDS) use GHS pictograms, signal words and numbered hazard statements to communicate hazards, although the number may not always be present. The presence of the following hazard information indicates the chemical is a carcinogen.

GHS Pictogram	TU Hazard Category	GHS Category	GHS H-Code	Signal Word
	Particularly Hazardous Substance (PHS)	Carcinogenicity (Cat. 1, 1A, 1B & 2)	H350, H351	Danger or Warning

Refer to CHE075-Chemical Hazard Guideline (CHG)-Carcinogens for general information on the management of carcinogens.

Laboratory-specific Standard Operating Procedures (SOP) are required to be developed and implemented for any chemical that is categorized as a "Particularly Hazardous Substance (PHS) or a "High-Risk" chemical. PI approval and training are required prior to any use involving a PHS or a high-risk chemical.

5.15. Reproductive Toxicants

Reproductive toxicants are chemicals that may affect the reproductive capabilities in humans, including chromosomal damage (mutations) and effects on the fetuses (teratogenesis). Examples of reproductive toxicants found in laboratories include ethidium bromide, lead, and toluene.

Safety Data Sheets (SDS) use GHS pictograms, signal words and numbered hazard statements to communicate hazards, although the number may not always be present. The presence of the following hazard information indicates the chemical is a reproductive toxicant chemical.

GHS Pictogram	TU Hazard Category	GHS Category	GHS H-Code	Signal Word
		Germ Cell Mutagenicity (Cat. 1A, 1B)	H340	
	Particularly	Reproductive Toxicity (Cat 1, 1A, 1B)	H360, H360F, H360D,	Danger

	Hazardous Substance (PHS)		H360FD, H260fD, H360Df	
		Germ Cell Mutagenicity (Cat.2)	H341	Warning
		Reproductive Toxicity (Cat. 2)	H361, H261f, H361d, H361fd	
None		Reproductive Toxicity-Additional Category	H362	None

Refer to chemical management procedures and guidelines contained in the CHP and chemical specific Safety Data Sheets (SDS) for general information on the management of reproductive toxicants.

Laboratory-specific Standard Operating Procedures (SOP) are required to be developed and implemented for any chemical that is categorized as a "Particularly Hazardous Substance (PHS) or a "High-Risk" chemical. PI approval and training are required prior to any use involving a PHS or a high-risk chemical.

5.16. Toxic Chemicals

Toxic chemicals can refer to chemicals with acute toxicity or chronic toxicity. In addition to organ-specific toxicities, toxic chemicals may also have LD50 (oral, dermal) or LC50 (inhalation) values of the following:

- Oral LD50 >50 mg/Kg but ≤500 mg/Kg in rats.
- Dermal LD50 >200 mg/Kg but ≤1000 mg/Kg in rabbits.
- Inhalation LC50 >200 ppm but ≤2000 ppm of gas or vapor when administered for 1 continuous hour to rats.
- Inhalation LC50 >2 mg/L but ≤20 mg/L of mist, fume, or dust when administered for 1 continuous hour to rats.

Toxicity may target a specific organ including substances that are hepatotoxins, nephrotoxins, neurotoxins, and hematotoxins. Symptoms of exposure to these materials vary, so personnel should review the Safety Data Sheet for the specific material being used for the associated symptoms.

Safety Data Sheets (SDS) use GHS pictograms, signal words and numbered hazard statements to communicate hazards, although the number may not always be present. The presence of the following hazard information indicates the chemical is an acutely toxic chemical.

GHS Pictogram	TU Hazard Category	GHS Category	GHS H-Code	Signal Word

	High-Risk Chemical	Acute Toxicity-either oral, dermal or inhalation (Cat 1, 2, 3)	H300, H301, H310, H311, H330, H331	Danger
	High-Risk Chemical	Aspiration Hazard (Cat. 1)	H304	Danger
	Hazardous Chemical	Specific target organ toxicity-single or repeated exposure (Cat.1)	H370, H372	Danger
		Aspiration Hazard (Cat. 2)	H305	Warning
		Specific target organ toxicity-single or repeated exposure (Cat. 2)	H305, H371, H373	Warning
	Hazardous Chemical	Acute Toxicity, either oral, dermal or inhalation (Cat.4)	H302, H312, H332	Warning
		Specific target organ toxicity-single exposure-Respiratory tract irritation (Cat. 3)	H335	Warning
		Specific target organ toxicity-single exposure-Narcotic effects (Cat. 3)	H336	Warning
None	Hazardous Chemical	Acute Toxicity, oral or dermal (Cat 5)	H303, H313, H333	None

Refer to chemical management procedures and guidelines contained in the CHP and chemical specific Safety Data Sheets (SDS) for general information on the management of toxic chemicals.

Laboratory-specific Standard Operating Procedures (SOP) are required to be developed and implemented for any chemical that is categorized as a "Particularly Hazardous Substance (PHS) or a "High-Risk" chemical. PI approval and training are required prior to any use involving a PHS or a high-risk chemical.

5.17. Chemicals Hazardous to The Environment

Materials with demonstrated toxicity to aquatic organisms or hazardous to the ozone layer. It is particularly important that such materials be stored in a manner which minimizes the risk of accidental release, and that they be disposed as hazardous waste.

Safety Data Sheets (SDS) use GHS pictograms, signal words and numbered hazard statements to communicate hazards, although the number may not always be present. The presence of the following hazard information indicates the chemical is hazardous to the environment.

GHS Pictogram	TU Hazard Category	GHS Category	GHS- H-Code	Signal Word
	Hazardous Chemical	Hazardous to the aquatic environment, acute hazard. (Cat. 1, 2 & 3)	H400, H401, & H402	Warning Or None
		Hazardous to the aquatic environment, long-term hazard (Cat. 1,2,3, & 4)	H410, H411, H412 & H413)	
		Hazardous to the Ozone Layer (Cat.1)	H420	

Refer to chemical management procedures and guidelines contained in the CHP and chemical specific Safety Data Sheets (SDS) for general information on the management of chemicals hazardous to the environment.

5.18. Nanomaterials

Nanomaterials include any materials or particles that have an external dimension in the nanoscale (approximately 1–100 nanometers). Nanomaterials occur naturally in the environment, are products of combustion, and can be created by chemical synthesis. Synthesized nanomaterials are referred to as Engineered Nanomaterials.

Nanomaterials are categorized by the risk of potential exposure to Laboratory Personnel, which is impacted by physical state, surface area, and how they are used. Dry or powdered nanomaterials pose the greatest risk, while those bound to a solid matrix pose the least risk.

Principal Investigators using nanomaterials in their research must define a combination of engineering controls, standard operating procedures (SOPs), and personal protective equipment to minimize exposures of their researchers working with nanomaterials. Helpful resources for developing a nanomaterial control plan and SOPs include:

- "General Safe Practices for Working with Engineered Nanomaterials in Research Laboratories" published by the National Institute of Occupational Safety and Health (NIOSH)
- Dow Chemical's nanoparticle safety video
- A compilation of Resources for Nanotechnology Laboratory Safety is available from the National Nanotechnology Initiative

All work involving Nanomaterials are considered a High-Risk chemical.

Laboratory-specific Standard Operating Procedures (SOP) are required to be developed and implemented for any chemical that is categorized as a "Particularly Hazardous

Substance (PHS) or a "High-Risk" chemical. PI approval and training are required prior to any use involving a PHS or a high-risk chemical.

5.19. Chemicals Under the Toxic Substances Control Act (TSCA)

The regulatory landscape governing chemical health and safety has significantly changed in ways that will impact Temple University faculty and staff. The recent amendments to the Toxic Substances Control Act (TSCA) under the **Frank R. Lautenberg Chemical Safety for the 21st Century Act** reflect the United States Environmental Protection Agency's (EPA) enhanced authority to evaluate and mitigate risks associated with chemicals that pose unreasonable risks to human health or the environment. As part of these changes, new rules and risk management processes are being implemented that will directly impact laboratory practices and the use, storage, and even procurement of TSCA regulated chemicals.

Chemicals currently being managed at Temple University include the following:

- Methylene Chloride

5.19.1. Workplace Chemical Protection Program (WCPP)

A WCPP may be required if the EPA issues a final rule under the **Toxic Substance Control Act (TSCA)**, determining that a specific chemical poses an "unreasonable risk to human health." In most cases, the majority of consumer and commercial uses of TSCA regulated chemicals are prohibited. However, research use may be exempted if a **Workplace Chemical Protection Program (WCPP)** is established and maintained to control exposure.

A written WCPP must be developed by PIs if their research involving the regulated chemical is exempted and unavoidable to limit exposure and ensure compliance with the new EPA standards. The WCPP must be developed and implemented prior to any EPA mandated deadlines. Additional requirements may be specified by the EPA.

EHRS can provide resources (ECP template) and assist in the development and implementation of the WCPP. All WCPP must be submitted to EHRS (ehrs@temple.edu) for review and be readily available in the laboratory.

The WCPP includes, but not limited to the following key components:

5.19.1.1. Initial Monitoring & Assessment

EHRS will coordinate initial assessment and monitoring for all employees or individuals in areas using any regulated TSCA chemical to assess exposure levels prior to any EPA mandated deadlines. This will include and specified 8-hour and 15-minute time weighted average

measurements.

5.19.1.2. Establish Regulated Areas

Areas where the regulated chemicals are in use or storage must be designated. These areas must have restricted access and be clearly marked.

5.19.1.3. Exposure Control Plan

PIs must implement control measures to reduce exposure below any specified exposure limits (8-hour-TW or 15-minute STEL). The PI must conduct a comprehensive assessment of the intended use of the regulated chemical. Specific criteria (e.g. type of PPE) and conditions may be stated by EPA. The plan must detail:

- Elimination/Substitution-All regulated chemicals must be reviewed to determine if less hazardous alternatives are available. The review process and outcome must be documented.
- Engineering controls (e.g., chemical fume hood, glovebox, gas cabinet) requirements.
- Administrative
    - Regulated areas & restricted access requirements
    - Reporting procedures for changes that could increase exposure.
- Personal Protective Equipment (PPE) & Respiratory Protection Requirements

5.19.1.4. Training

The PI must ensure that all personnel complete training prior to entering and/or working in areas where the regulated chemical is used or stored. The training must be documented and include:

- A review and understanding of the WCPP and associated conditions and requirements.
- Any laboratory specific information and/or training required by the PI.

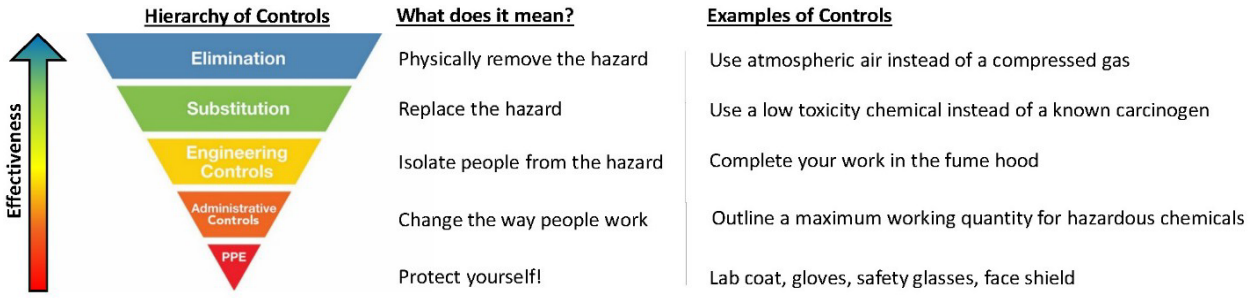
5.19.1.5. Periodic Monitoring

EHRS will conduct periodic air monitoring in regulated areas. If exposure levels are below any specified action level, re-monitoring will occur at the specified interval stated in the regulation. Higher concentrations may require more frequent monitoring.

6. CONTROLLING WORKPLACE HAZARDS

Hazardous chemicals require a carefully considered, multi-tiered approach to effectively manage associated health risks. Exposure prevention and control methods are defined by the Hierarchy of Controls as the elimination, substitution, engineering controls, administrative controls, and personal

protective equipment from most effective to the least effective.



Hierarchy of controls.

The primary methods for reducing researcher exposure to workplace hazards is to design the hazard out (elimination), substitute the hazard with something less toxic or hazardous, or isolate the hazard away from the researcher using engineering controls (e.g., ventilation or enclosing the operation). If such controls are not feasible or cannot alone reduce the potential exposure to acceptable levels (as is often the case), appropriate administrative controls and personal protective equipment (PPE) must be used to minimize exposures, preferably in conjunction with engineering controls. Applying the hierarchy of controls in a layered approach provides the most protection to exposures that cannot be eliminated or designed out.

6.1. Elimination & Substitution

Source controls are measures that prevent exposure to a hazardous chemical. Substitution, minimization and/or alteration of the chemical(s) or procedure (e.g., design out the hazard prior to the experiment) are examples of a source control. With chemical substitution, exposure to a high hazard chemical is controlled by utilizing a less hazardous chemical.

6.2. Engineering Controls

Engineering controls (*e.g.,* chemical fume hoods) minimize exposure to a chemical hazard in the work area of laboratory personnel.

6.2.1. General Laboratory Ventilation

The general ventilation system in laboratories must be well maintained with the laboratories operating under negative pressure. This negative pressure should be maintained in laboratories to ensure airflow into the laboratory from uncontaminated areas. General ventilation will not be relied upon to protect laboratory personnel from exposure. Chemical fume hoods and other local exhaust system devices must be used for these purposes.

6.2.1.1. Air Changes

Four to twelve (4-12) room changes per hour should be provided by general ventilation in laboratories where chemical fume hoods are used as the primary method of control. Storage areas used for flammables should have at least six (6) air changes per hour. Air should be 100% outside air (i.e., no re-circulation) in all active laboratories and chemical storage areas. Air removed from the laboratories through vents and ducts by general ventilation should be vented to the outside, not into the general facility circulation. Intake vents for the system should be far enough removed from the system's exit port to prevent cross- contamination. Ventilation from these areas is 100% exhaust.

6.2.2. Chemical Fume Hoods (Ducted)

An important safety device in the laboratory is a properly functioning chemical fume hood. The chemical fume hood protects users from inhaling chemicals by constantly pulling air into the hood and exhausting it out of the building. Chemical fume hoods also provide protection in the event of an explosion or fire. A chemical fume hood should be used when:

- Handling chemicals with inhalation hazards such as toxic gases, toxic chemical vapors, and respirable toxic powders.
- Conducting experimental procedures with strong exothermic reactions.
- Handling chemicals with significant vapor pressure.
- Chemical vapors generated could cause a fire hazard.
- Working with compounds that have an offensive odor.

GENERAL RULES FOR CHEMCIAL FUME HOOD USE

The following general rules must be followed when using chemical fume hoods:

1. Chemical Fume hoods should not be used for work involving hazardous chemicals unless they have a certification label that confirms certification has occurred within the past year.
2. Always keep hazardous chemicals >6 inches behind the plane of the sash.
3. Never put your head inside an operating chemical fume hood. The plane of the sash is the barrier between contaminated and uncontaminated air.
4. Work with the hood sash in the lowest practical position. The sash acts as a physical barrier in the event of an accident. Keep the sash closed when not conducting work in the hood.
5. Do not clutter your hood with unnecessary bottles or equipment. Keep it clean and clear. Only materials actively in use should be in the hood.
6. Do not use the hood to volatilize or evaporate chemicals or waste.
7. Do not make any modifications to hoods, duct work, or the exhaust system without first contacting EHRS at ehrschem@temple.edu
8. Do not use large equipment in chemical fume hoods unless the hood is dedicated for this purpose, as large obstructions can change the airflow patterns and render the hood unsafe.
9. To get re-certified, email ehrschemc@temple.edu with chemical fume hood location(s) and contact information.

All laboratory workers should review the guidelines for chemical fume hood use at least annually.

Perchloric acid should not be used in a standard chemical fume hood, due to its ability to form explosive perchlorate salts in the ductwork. Contact EHRS via ehrschecm@temple.edu prior to using any heated or concentrated perchloric acid in a chemical fume hood.

6.2.2.1. Performance Verification of Chemical Fume Hoods

Chemical fume hoods are evaluated and certified by EHRS on an annual basis. EHRS will contact Facilities Management to repair chemical fume hoods which are failing or restricted. In the event of a chemical fume hood failure, EHRS will also close the fume hood and post signage indicating that the hood should not be used until the flow rate can be certified. Chemical fume hoods are evaluated with the sash at 18 inches.

Each chemical fume hood will have a current inspection log (Testing Dates, Flow velocity (FPM) and last testing results (Pass/Marginal/Fail)) and a marker indicating the highest sash height to be used when working with hazardous chemicals.

Data on annual fume hood evaluations and associated documentation are maintained by EHRS in TU-EHSA for a minimum of 5 years.

Contact EHRS at ehrschem@temple.edu for a hood evaluation if chemical fume is past due for an evaluation and/or signage is missing.

Chemical fume hoods must be inspected and certified by an independent third-party vendor outside of the annual inspection process upon installation, renovation, when a deficiency is reported, or a change has been made to the operating characteristics of the hood.

6.2.3. Chemical Fume Hoods (Ductless)

Ductless chemical fume hoods are used when the requirements of the lab are such that a ducted hood is not required. The ductless chemical hoods make use of a filter bed that can filter such hazards as particulates, vapors, acids, and bases. The same performance standards apply for the use of these hoods as with ducted hoods with the one addition that the filter system must be changed as per manufacturer's directions if the filter bed is exhausted.

Contact EHRS at ehrschem@temple.edu prior to purchasing and/or using a ductless fume hood for an evaluation to determine if the hood is acceptable for the hazard.

Ductless fume hoods do not provide adequate protection for general chemical use and are designed for specific processes and procedures and must not to be used as a replacement for a vented or ducted fume hood.
Ductless chemical fume hoods are prohibited unless pre-approved by EHRS.

6.2.4.Glove Boxes

Glove boxes can be used for working with known carcinogens and highly toxic chemicals, or to provide an inert atmosphere when working with environmentally sensitive compounds. Glove boxes are effective in controlling hazards as they offer complete containment. Follow all maintenance and manufacturer instructions when working in a glove box.

6.2.5.Splash Shields

Splash shields provide low cost and effective personal protection against splashes when working in the laboratory. Splash shields are effective engineering control to minimize splash hazards for activities such as:

- Pipetting or pouring materials.
- Using hand-held equipment to mix or homogenize materials.
- Working with materials under pressure.
- Working in a hood above 18 inches.

6.2.6.Local Exhaust Snorkels

Snorkels capture hazardous dusts or vapors in small areas or by individual instruments. Snorkels are less effective than chemical fume hoods since their capture zone is only local to the placement of the device. Snorkels should never be used for hazardous atmospheres or as an alternative to a fume hood. EHRS can help ensure snorkels are working properly and that they are being used in the correct manner.

6.2.7.Gas Cabinets

Gas cabinets should be used to house hazardous gas cylinders, they allow for the removal of leaking hazardous gases before laboratory workers are exposed. A hazardous gas with an NFPA health rating of 3 or 4 in a cylinder larger than a lecture bottle should be stored and piped from a gas cabinet.

6.2.8.Other Sources of Ventilation

In addition to chemical fume hoods and gloveboxes, other sources of ventilation may be present in labs. Some of these provide local exhaust ventilation to remove hazardous fumes from the laboratory personnel's breathing zone, such as downdraft tables. There is also ventilation systems designed to protect samples or products from contamination, including biosafety cabinets and laminar flow benches (or "clean benches"). Biosafety cabinets are designed to protect the product, the worker, and the environment from contamination with particulates or biohazards, however they provide no protection from hazardous chemical fumes. Laminar flow benches protect only the product from contamination and are not to be used with hazardous materials.

6.3. Administrative Controls

Administrative controls are policies, work practices, and procedures designed to limit exposures to laboratory hazards. Administrative controls are often used in conjunction with engineering controls and personal protective equipment to provide a holistic exposure prevention program. Common examples of administrative controls include:

- Training
- Policies to limit risk of exposure.
- Standard operating procedures (SOPs)
- Good housekeeping
- Routine maintenance of equipment
- Signs and labels

Principal Investigators are required to implement additional administrative controls specific to their labs, beyond the guidelines outlined in the CHP. Lab-specific training and other lab-specific procedures must be conveyed to research personnel before they begin research.

6.3.1. Standard Operating Procedures (SOPs)

All laboratory personnel are required to follow the standard lab procedures listed in the CHP. Additional lab-specific policies or work practices required by the PI must also be followed by laboratory personnel.

6.3.1.1. Working Alone in the Laboratory

No work may be done alone in an immediately hazardous environment, which involves work with any material, activity, or circumstance that could cause an individual to become incapacitated and render them unable to seek assistance. Examples include work with poisons or toxic gases at a level approaching the threshold to be considered Immediately Dangerous to Life and Health (IDLH), or work with explosive or pyrophoric compounds. In this case, "alone" means that there is not another individual in visual or audible range that can provide assistance to the individual engaged in the hazardous research activity.

Principal Investigators are encouraged to define the types of procedures and/or equipment in their laboratories that cannot be used while researchers are alone in the laboratory and train their laboratory personnel on these lab-specific rules.

6.3.1.2. Operations Requiring Prior Approval

Principal Investigators are required to establish circumstances requiring prior approval for activities and chemical usage that involve an increased level of risk. Some examples of circumstances that may require prior approval include:

- Working alone in a laboratory.
- Unattended or overnight operations.
- Working with highly hazardous materials (e.g., pyrophorics, hydrofluoric acid, toxic gases, chemicals with a high degree of acutely toxicity/poisons, potentially explosive compounds).
- Modifying a procedure in such a way that it increases the overall hazard (e.g., reaction scale-up, change in reaction pressure or temperature, etc.).

PI approval and training is required prior to any use involving a Particularly Hazardous Substance (PHS) and/or a "High-Risk" chemical.

6.3.1.3. Smoking

Smoking and the use of tobacco products is prohibited. Temple University is a tobacco free university. Refer to Temple University Welcome to Tobacco Free for additional information.

6.3.1.4. Food/Beverages

Food/Beverage storage, preparation and/or consumption is prohibited in laboratories, stock rooms or any other location where laboratory type chemicals or hazardous substances are stored, managed, or used for research, educational, or any other purpose.

Glassware or any other apparatus used in laboratories must not be used for storage, preparation, and/or consumption of food. Likewise, refrigerators used for the storage of laboratory supplies must not be used to store foods unless such foods have been specifically identified for research purposes.

6.3.1.5. Cosmetics

Neither the application of cosmetics, nor the insertion of contact lenses, should be conducted in laboratories, storage rooms or any other facilities where chemicals or hazardous substances are stored, managed, or used for research, educational, or any other purpose.

6.3.1.6. Personnel Hygiene Practices

Wash areas of exposed skin promptly and thoroughly whenever contact with chemicals or hazardous substances is suspected. Remove clothing or personal protective equipment (PPE) if contamination is suspected or apparent. Decontaminate work clothing or PPE in accordance with an established schedule and procedure. At the end of all work procedures, wash hands thoroughly with soap and water.

Remove or change gloves before leaving the laboratory or answering phones. Leaving the laboratory while wearing contaminated PPE may contaminate non-lab locations.

6.3.1.7. Personnel Apparel

Do not wear loose fitting clothes or jewelry, which may become caught in moving mechanical parts, or clothing that may inadvertently dip into containers of chemicals and other materials. Wear clothing that provides maximum skin coverage. Do not wear light weave fabrics since rapid chemical penetration can occur. Sandals and several types of perforated or open-toe shoes are **PROHIBITED** in the lab area because of the limited protection they provide in case of a spill. No one should be permitted to enter or continue work in any laboratory while bare footed.

6.3.1.8. Exiting the Laboratory

Wash hands and areas of exposed skin before leaving the laboratory. Remove laboratory coats and gloves prior to leaving the laboratory.

6.3.1.9. Horseplay

Practical jokes or any other behavior, which may distract or potentially cause physical harm to others, must be avoided. Running, jumping, or rushing around must be avoided in laboratories or where chemicals or hazardous substances are being managed or stored.

6.3.1.10. Housekeeping

The work area and chemical fume hoods must be clean and uncluttered. Chemicals, hazardous substances, and equipment must be labeled. Glassware and other apparatus should be cleaned at the end of each work session and stored properly. Corridors and passageways must be maintained free of tripping hazards. Inappropriate storage of materials in hallways, exit routes, or in any such manner that emergency equipment may be obstructed, or emergency evacuation hampered, is prohibited.

Facilities Management will not accept any items that have not been sanitized and decommissioned by the user and approved by EHRS.

6.3.1.11. Mouth Suction & Pipetting

Do not use mouth suction for pipetting or stating a siphon. Use a squeeze bulb, house vacuum, or a Bernoulli device for these functions.

6.3.1.12. Unattended Operations

A thorough hazard analysis must be conducted for any experiment or project which is planned to operate unattended. Hazard analysis of unattended operations, which reveals an above

average degree of risk, should be avoided. When such operations are required, the following minimum precautions must be considered:

- Leave lights on
- Place an appropriate information at the door that includes:
    - name(s) and phone number(s) of personnel, including alternates, to be contacted in an emergency.
    - activity being performed,
- Provide for secondary containment of toxic substances in the event of failure.
- Consider the use of monitoring alarms, and
- Leave view panel unblocked with a clear view into the lab from outside.

All unattended operations require prior approval from the Principal Investigator (PI).

6.3.1.13. Children

Prudent laboratory safety practices prohibit the presence of children and infants in areas that have a potential for exposure to radioactive materials, toxic or hazardous chemicals, and infectious agents. University policy prohibits the presence of minors in research laboratories unless approved by Temple University Ethics & Compliance, Human Resources, and EHRS. Refer to Protecting Minors on Campus for more information

6.3.1.14. Mobile Devices

Avoid managing personal mobile devices while wearing gloves. Avoid setting any mobile device, especially a cell phone, down on any surface in the lab which may be contaminated with chemicals. Mobile devices can function as an ignition source. Do not use them while managing flammable materials.

6.3.2. EHRS SOPS & Chemical Hazard Guidelines

EHRS provides standard operating procedures, factsheets, and chemical hazard guidelines to summarize general guidance for safe handling and management of chemicals in a specific hazard class, specific chemical and/or a specific procedure involving a hazardous chemical. In some cases, these documents will provide enough information for labs to work safely with all chemicals in that class or chemical. In other cases, (chemicals categorized as a particular hazardous substance (PHS) or a high-rick chemical), additional lab-specific written procedures are required as a separate document.

The most recent version of the TUCHP and associated documents can be found on the Temple University Chemical Hygiene Program webpage.

6.3.3. Laboratory-Specific Standard Operating Procedures

Laboratory-specific Standard Operating Procedures (SOPs) are detailed documents that describe the hazards associated with a chemical, class of chemicals, or process and the appropriate safety controls required for working with the hazard. While general guidance regarding laboratory work is provided in the TUCHP, Principal Investigators are required to develop and implement laboratory-specific SOPs for hazardous chemicals that are used in the laboratory.

A laboratory-specific SOP is required when:

- A laboratory engages in an activity or procedure not covered elsewhere in the Chemical Hygiene Plan.
- Laboratory work involves the use of certain types of "High-Risk" chemicals (example: pyrophoric or reactive chemicals, changing pyrophoric gas cylinder.)
- Laboratory work involves chemicals classified as Particularly Hazardous Substances. PHS include:
    - Select carcinogen.
    - Acutely toxic chemicals, and
    - Reproductive toxins.
- Identified by the University Chemical Hygiene Officer (CHO) as a PHS and/or a "High-Risk" chemical or process.

Each laboratory-specific SOP must provide enough detail so that individuals with limited experience can conduct the procedure or process safely. Each laboratory-specific SOP must include the following elements, at a minimum:

Required Lab-Specific SOP Elements	
1	Hazard Overview
2	Engineering/Ventilation Controls
3	Administrative Controls
4	Personal Protective Equipment
5	Spill and emergency Procedures
6	Waste Management
7	Decontamination
8	Designated Area
9	Detailed Protocol(s)
10	Training Requirements
11	Approval and signature
SOP must identify and conditions that require prior approval.	

EHRS has developed a Chemical Standard Operating Procedure Template to aid in the generation of laboratory-specific Sops.

All laboratory personnel who conduct work requiring a laboratory specific SOP are required to document that they have read and understand all SOPs relevant to their research. New laboratory

personnel must be given direct training for hazardous operations which should include all relevant SOPs.

The SOPs are required to be reviewed by qualified personnel and must be amended and subject to additional review and approval by the Principal Investigator where changes or variations in conditions, methodologies, equipment, or use of the chemical occur.

6.3.4. Particularly Hazardous Substances (PHS)

The OSHA laboratory standard requires that laboratory personnel take particular care and caution while working with Particularly Hazardous Substances (i.e., carcinogens, reproductive toxins, and chemicals with a high degree of acute toxicity). Laboratory-specific Standard Operating Procedures (SOPs) for these materials are required to prevent exposure to Laboratory Personnel, and must include the following provisions:

- Establishment of a designated area,
- Use of containment decides such as chemical fume hoods or gloveboxes,
- Procedures for safe removal of contaminated waste, and
- Decontamination procedures.

Principal Investigators overseeing lab personnel using carcinogens, reproductive toxins, and acutely toxic chemicals are responsible for lab personnel training, providing appropriate personal protective equipment, and approval of procedures using Particularly Hazardous Substances in their laboratories. Laboratory Personnel are responsible for following all laboratory-specific procedures designed for the safe use of Particularly Hazardous Substances.

6.3.5. Laboratory Chemical Safety Audits (LCSA)

The Laboratory Chemical Safety Audit (LCSA) program is designed to provide staff and students with a safe working environment, address environmental protections, and ensure compliance with federal and state regulations covering work in laboratories.

LCSA are conducted at least annually for basic laboratory safety, covering general safety and health hazards as well as the proper handling and disposal of hazardous materials. Additional audits may occur if your laboratory uses materials that represent an elevated risk to workers or to the environment.

It is the responsibility of the principal investigator or responsible party assigned to each space to respond to lab audit findings in a timely manner. If findings are not addressed in a timely manner, EHRS reserves the right to bring this to the attention of university management.

Failure to respond to LCS in a timely manner increases liability to the university and PI (s) by not correcting safety hazards and/or environmental problems.

6.3.6. Exposure Monitoring

Personal and/or environmental monitoring may be necessary when lab personnel exhibit signs or symptoms of a chemical exposure or when performing experiments using hazardous chemicals without adequate ventilation.

Principal Investigators and laboratory personnel are responsible for contacting EHRS when research activities have or could lead to an actual or potential overexposure. In these cases, EHRS will perform an exposure assessment and may conduct quantitative exposure monitoring. Any monitoring results will be sent to the Principal Investigator and the affected individuals. EHRS will maintain records of all monitoring activities.

6.4. Personal Protective Equipment (PPE)

Personal protective equipment (PPE) is laboratory personnel's last line of defense against chemical exposures. Choose PPE and clothing based on the types of chemicals managed, the degree of protection required, and the areas of the body which may become contaminated. All clothing and equipment must, at a minimum, meet standards set by the American National Standards Institute (ANSI). Every effort must be made to evaluate the effectiveness of equipment and make improvements where possible. PIs and/or departments are responsible for purchasing appropriate PPE and other safety equipment for laboratory personnel.

At a minimum, long pants (covered legs) and closed toe/closed heel shoes (covered feet) are required to enter a laboratory where hazardous chemicals are used or stored. While working with or adjacent to hazardous chemicals, protective gloves, a laboratory coat, and protective eyewear should be worn.

Careful consideration must be made to fit and comfort; uncomfortable or ill-fitting PPE often does not provide adequate protection and is less likely to be worn.

In all cases the use of personal protective equipment must be consistent with manufacturer's recommendations, industry practice, proper hygiene, and specific task safety considerations.

6.4.1. PPE Risk Assessment

The use of personal protective equipment is required whenever the determination by the PI has been made that the implementation of engineering and/or administrative controls is neither possible nor adequate to protect the individuals from injury and/or illness. A review of chemical use and associated hazards is required to be conducted by the PI to assess and administrate the level of PPE required in their area.

6.4.2. Eye & Face Protection

Safety eyewear should always be worn in the laboratory, since the dynamic environment of the laboratory makes it hard to define where accidents won't happen.

6.4.2.1. Eye & Face Protection Standards

All eyewear must meet ANSI's "Practice for Occupational and Educational Eye and Face Protection," Z87.1 – 1989. Prior to use, personnel will verify that the equipment has been approved for the procedure (*e.g.,* ANSI certified for chemical splashes but not for impact).

For labs, ANSI standards required a minimum lens thickness of 3mm impact resistance, passage of flammability test, and lens retaining frames.

Prescription glasses are not sufficient for eye protection unless they meet the ANSI Z87.1 standard and have compliant side shields.

6.4.2.2. Eye & Face Protection Selection

A face shield should be paired with either safety glasses or goggles, depending on the situation.

The following table should be consulted in choosing eye & face protection:

EYE & FACE PROTECTION TYPES	
TYPE	**USE EXAMPLES**
Safety Glasses	Impact resistance, small incidental splashes
Safety Goggles	Procedures where splashes are foreseeable, generating aerosols, working with corrosive liquids, or liquids over 60°C (140°F)
Laser Safety Eyewear	Working around Class 3B or 4 lasers
Face Shield	Work with large volumes of corrosive chemicals or liquids.
A face shield should be paired with either safety glasses or goggles, depending on the situation.	

6.4.2.3. Contact Lens Use

Contact lens' may be worn in a laboratory setting in accordance with the Centers for Disease Control (CDC) and NIOSH publication *Contact Lens Use in a Chemical Environment*, https://www.cdc.gov/niosh/docs/2005-139/default.html.

In the event of a chemical exposure, begin eye irrigation immediately and remove contact lenses as soon as practical. Do not delay irrigation while waiting for contact lens removal. Contact lenses should be removed only in a clean environment after the workers have thoroughly washed their hands. Direct handling application or removal of contact lenses while in a chemical laboratory is prohibited. Standard eye protection requirements (*e.g.,* safety goggles, glasses, or face shield) still apply.

6.4.3. Gloves

Gloves should be always worn in the lab whenever there is a chance for hand contact with chemicals and/or other potentially contaminated laboratory materials. At a minimum, disposable latex gloves should be worn.

6.4.3.1. Glove Selection

Selecting appropriate gloves for research is both chemical and activity specific. No one type of glove will protect against all chemical hazards, and a combination of gloves may be needed to confer resistance to all chemicals used in a specific experiment. The length of contact time (incidental vs. immersion) must also be considered when selecting gloves for a specific task. Polyvinyl chloride and latex gloves provide poor chemical protection and should not be used.

TYPES OF CHEMCIALLY RESISTANT GLOVES			
TYPE	**ADVANTAGES**	**DISADVATANGES**	**USE WITH**
Butyl Rubber	Extended contact possible	Poor vs. hydrocarbons, chlorinated solvents	Polar organics (e.g., glycol, ethers, ketones, esters)
Neoprene	Extended contact possible, medium chemical resistance, medium physical properties, does not support combustion	Poor of halogenated and aromatic hydrocarbons	Good for acids, bases, alcohols, fuels, peroxides, hydrocarbons, and phenols
Nitrile	Excellent physical properties, dexterity	Incidental contact only, poor vs. benzene, methylene chloride, many ketones	Oils, greases, petroleum products and some acids and bases, fair vs. toluene
Polyvinyl alcohol (PVA)	Resists a broad range of organics, good physical properties, specific-use glove	Cannot be used with water or water-based solutions, poor vs. light alcohols (e.g., methanol, ethanol)	Aliphatics, aromatics, chlorinated solvents, ketones (except acetone) esters, ethers
Fluorelastomer (Viton)	Extended contact possible, organic solvents, good resistance to cuts and abrasions.	Poor physical properties, poor vs. some ketones, esters, amines	Aromatics, chlorinated solvents, also aliphatics and alcohols
Norfoil	Extended contact possible, excellent chemical resistance	Poor fit, easily punctures, poor grip, stiff	Good for most hazardous chemicals
Refer to SDS and manufacturers glove charts which provides information for the selection of diverse types of gloves and the chemicals for which they provide protection against.			

6.4.3.2. Glove Use

- Inspect gloves prior to use.
- No glove completely resists degradation or permeation. Replace gloves periodically depending on how often they are used and based on the concentration of chemicals being used and duration of use.
- Disposable latex or nitrile gloves are not intended to provide protection from prolonged or repeated contact with chemicals. Remove and replace disposable latex and nitrile gloves if there is any sign of damage or if they have any chemical contamination.
- Wear gloves with long cuffs or sleeve covers when there is skin exposed between the glove and your lab coat.
- Wash hands thoroughly after removing gloves.
- Wash reusable gloves before removal, except those that are permeable to water.
- Double-gloving and frequent glove changes should be considered when working with high-hazard materials (e.g., hydrofluoric acid) or with materials where the glove compatibility properties are poor or unknown.
- If the need for gloves arises when walking through public spaces, keep one hand gloved and the other hand gloveless for opening doors and pressing elevator buttons. Do not touch door handles and elevator buttons with a gloved hand to prevent the spread of cross-contamination.

6.4.4. Laboratory Coats & Other Protective Clothing

The choice of protective clothing depends upon the degree of protection required for the lab or the work being conducted. Protective and appropriate clothing is required when a potential exists for chemical splashes, exposure to hazardous dusts, fire, extreme heat or cold, excessive moisture or radiation. Protective clothing which should be readily available depending on chemical hazards used in the laboratory includes:

TYPES OF BODY PROTECTION	
TYPE	**USE EXAMPLES**
Standard Lab Coat	General laboratory work not involving risk of fire
Flame-resistant Lab Coat	Working with chemicals where risk of fire is present (e.g., flammable liquids with open flame or ignition sources, pyrophorics)
Chemically resistant apron, vests, or sleeves	Working with chemicals that re corrosive and/or toxic by skin contact/absorption where splashes are foreseeable.
Slip resistant shoes	Working in areas with wet floors

Instruct laboratory personnel to consider the following characteristics in protective clothing selection and purchase:

- Ability to resist fire, heat and chemicals used.
- Comfort, permitting easy execution of tasks when worn.
- Chemical impermeability when needed.
- Ease of cleaning (unless disposable)
- Ability to be removed during an emergency or chemical splash.

Laboratory coats should be removed before exiting the laboratory and entering the rest room or any public area.

6.4.5. Respiratory Protection

Respirators may be used when engineering controls such as general ventilation or a fume hood are not feasible or do not reduce exposure to acceptable levels. Since the use of a respirator is regulated by OSHA's Respiratory Protection Standard, respirator use at Temple University is subject to prior review by EHRS.

Any PI and/or laboratory personnel who believes that respiratory protection is needed must notify EHRS to request an evaluation of the hazard and enrollment in the Respiratory Protection Program. This program involves procedures for hazard evaluation, respirator selection, medical clearance, employee training, fit testing, respirator inspection, maintenance, and recordkeeping.

Respirator use requires enrollment in the Temple University Respiratory Protection Program . For more information, visit the Occupational Safety Program-Respiratory Protection Webpage or contact EHRS via Ehrsocc@temple.edu.

6.4.6. Usage & Maintenance of PPE

Personal protective equipment (PPE) should be kept clean and stored in an area where it will not become contaminated. PPE should be inspected prior to use to ensure it is in good condition. It must fit and be worn properly. PPE that becomes contaminated or damaged should be cleaned/repaired or discarded and replaced. Many gloves are a one-time use PPE and should be discarded in the solid hazardous waste container in the laboratory. Only gloves that are 100% free of contamination should be discarded in the trash.

6.4.7. Contaminated Clothing/PPE

Clothing or PPE that has become contaminated with hazardous chemicals must immediately be removed and placed in a clear, water-soluble bag to prevent release of the chemical. Heavily contaminated clothing/PPE resulting from an accidental spill must be placed in a yellow plastic bag and disposed of as laboratory waste. Laboratory personnel must never take contaminated items home for cleaning or laundering. Persons or companies hired to clean contaminated items should be informed of potentially harmful effects of exposure to hazardous chemicals and should

be provided with information to protect themselves.

7. CHEMICAL MANAGEMENT

7.1. Chemical Procurement & Receiving

7.1.1. Chemical Procurement

Chemicals must be procured through TU Marketplace or through TU Purchasing Services.

The following guidelines are recommended:

- Obtain any necessary permits, licenses, or registration prior to ordering.
- Review the laboratory chemical inventory in TU-EHSA to determine if the chemicals are already present.
- Evaluate the need for the chemical and determine if a less hazardous substitute is available.
- Determine the minimum quantity required to satisfy your specific demand.
- Determine the specific safety procedure and design elements required to assure protection of personnel and property (e.g., storage cabinets, respiratory protection, control ventilation).
- Check to determine if unused quantities can be returned to the manufacturer.
- Determine if environmental or air monitoring is required for the substance.
- Determine if the required personal protective equipment necessary to safely manage the material is available and in good condition. If the personal protective equipment is not available, make sure it is ordered, and the delivery date is prior to the arrival of the chemical.
- Order materials in the smallest quantity necessary for the laboratory needs. Excess amounts of a chemical invariably must be disposed of as waste; this imposes an unnecessary expense on the University and contributes to overall degradation of the environment.
- Request Safety Data Sheets (SDS) and safety specifications for all materials ordered.
- Conduct a "dry run" for particularly hazardous materials.

The procurement of hazardous chemicals is not permitted on the P-card.

7.1.2. Pre-Authorization/Notification Requirements

Most chemical products can be purchased without restriction from suppliers through TU Marketplace or through TU Purchasing Services. However, some chemicals may require notification and/or authorization to purchase, use and store.

Special authorization may be required to purchase, possess, and use the following materials:

- Chemicals of Interest - The Department of Homeland Security monitors chemicals of interest as they relate to the possibility of theft, release, or sabotage/contamination. See the Chemical Security program for additional information.

- DEA Controlled Substances-This category includes any drug, or materials regulated by the United States Drug Enforcement Agency. Refer to the TU Controlled Substances Program for Research (CSPR) for additional information.
- Explosives- these items are regulated by the United States Department of Transportation and the Federal Bureau of Alcohol, Tobacco, and Firearms.
- Tax Free Ethanol- This category includes alcohol used for education and scientific purposes and is regulated by both the Federal Bureau of Alcohol, Tobacco and Firearms and the Pennsylvania Liquor Control Board. Refer to CHE026-Procuremnet & Use of Tax-Free Alcohol for Research for more information.
- Compressed Gas Cylinders-Gas cylinders should only be purchased through suppliers that have a cylinder return or return authorization program.
- "High-Risk" Chemicals-Materials that are extremely hazardous to property, health, or the environment (e.g., pyrophoric, highly water-reactive chemicals, and highly toxic gases, etc.) may not be procured until the necessary administrative, engineering, and environmental controls are in place.
- EPA chemicals regulated under TSCA-Chemicals listed below require approval from EHRS prior to ordering. Contact EHRS via ehrschem@temple.edu for guidance.
    - Methylene Chloride

The use and possession of radioactive materials and certain toxins and biological materials (e.g., CDC select agents) require prior approval from EHRS. Contact EHRS via ehrs@temple.edu for information.

7.1.3. Receiving Chemicals

Inspect all received chemicals prior to unpacking. It should be noted if there appears to be any leakage on the outside of the box or on the packaging material. If contents are damaged, contact EHRS and the company from whom the chemical was ordered. All damaged chemical containers must be considered as spilled material and disposed of as chemical waste.

Additionally, ensure the following:

- TU-EHSA chemical inventory is updated to include the chemical received.
- SDS is available and updated in TU-EHSA. Ensure employees are aware of how to find it.
- Chemical label is legible and secure on the container of the chemical. If the container label has been defaced, it should be properly relabeled.

7.2. Chemical Inventory

All laboratories are required to maintain an up-to-date complete inventory of all hazardous materials including both chemicals and compressed gases as well as the quantity of these materials. Chemical inventories are used to ensure compliance with storage limits and other regulations and can be used in an emergency to identify potential hazards for emergency response.

All chemicals at TU must be inventoried electronically in TU-EHSA. All chemicals in laboratory or area where chemicals are stored must be entered into the inventory system upon receipt. Chemicals that have been used up or are disposed of must be removed from the inventory database. Care should be taken to consult the inventory system to ensure duplicate or excess chemicals are not ordered.

7.2.1. Chemical Inventory Annual Review & Verification

All hazardous chemicals must be physically inspected and evaluated at least annually to check for:

- Shelf Life/Expiration Date
- Inappropriate storage
- Damaged or missing labels
- Damaged or leaking containers

TU-EHSA must be reviewed, verified, and updated at least annually or whenever a meaningful change in the inventory occurs. This review must be acknowledged and documented in TU-EHSA.

7.3. Chemical Labeling Requirements

All chemicals and non-empty containers in the laboratory must be labeled, regardless of whether the chemical is hazardous. Chemical labels that have degraded, been removed, or that have fallen off must be replaced. Hazardous chemicals must have their containers properly labeled with the hazards associated with a chemical.

7.3.1. Manufacturer Labeling Requirements

All chemical containers must be properly labeled. Incoming, original containers from chemical manufacturers are required under the Federal OSHA Hazard Communication Standard to provide the following information:

- Common name of chemical
- Chemical manufacturer's name, address, and emergency telephone number
- Health and safety hazard warnings (*e.g.*, flammable, corrosive, etc.)

7.3.2. Laboratory Labeling Requirements

Laboratory personnel are responsible for ensuring all secondary (workplace) chemical containers (ex. squirt bottle, flask, vial) produced in the laboratory are properly labeled as follows:

- Legible and easy to read in English, no chemical structures.
- Hazards associated with the chemical, if applicable. Hazards may be expressed as:
    - A written word (e.g., "Toxic" or "Carcinogen"), or

    - With the corresponding Globally Harmonized System (GHS) pictogram.
- Chemicals in containers over 2 liters must be labeled with their full name, no abbreviations.
- If abbreviations are used for chemicals under 2 liters in size, an abbreviation cross- reference sheet must be posted near the entrance(s) to the laboratory (*e.g.,* EtBr = Ethidium Bromide).
- If the chemical is a byproduct whose composition is not known, it must be assumed that the substance is hazardous.

Secondary (workplace) containers do not need to be labeled if the container is under direct control of the individual who initially transferred the material, and it will be all used during the same shift.

7.3.3. Date Labeling Requirements for Specific Chemicals

Dates of receipt and date of opening should be noted on the bottle for each of the following groups. Chemicals should not be held past their recommended expiration date or in the specified amount of time from the date of their receipt.

- Picric(s)
- Perchlorates
- Peroxides
- Peroxide forming materials (*e.g.,* aldehydes, ethers and compounds containing benzylic hydrogen atoms).
- Chemicals with polymerization hazards
- Other unstable or reactive chemicals

7.4. Laboratory Door Placards

Each laboratory must have a laboratory door placard on the exterior door(s) of the laboratory.

It is not only necessary to provide laboratory personnel with awareness of hazardous chemicals present in a laboratory, but this information must also be provided to first responders, such as fire fighters, police officers, paramedics and anyone entering the laboratories. These placards are also required by various firefighting organizations and hazard communication compliance. These placards must be reviewed annually and/or updated in the event of any change in the information.

Contact EHRS at ehrschem@temple.ed if placards need to be updated and/or obtained.

7.5. Chemical Storage Requirements

Chemical storage areas in the laboratory setting include chemical storerooms, laboratory work areas (shelves and bench cabinets), storage cabinets, refrigerators, and freezers.

7.5.1. Permitted Laboratories & Chemical Storage Rooms

Hazardous chemicals may only be used and/or stored in laboratories or chemical storage rooms which have been permitted by EHRS. Storage of hazardous materials in an office are prohibited, unless said office has been converted into a laboratory.

7.5.2. Chemical Storage Limits

Hazardous chemicals may only be used and/or stored in laboratories or chemical storage rooms which have been permitted by EHRS. Laboratories must comply with applicable building and fire codes which limits the amount of hazardous chemicals that can be used and stored in a laboratory or laboratory "suite." Contact the University Fire Marshal to review the storage and use limits for your laboratory or space.

7.5.3. General Storage Requirements

Establish and follow safe chemical storage & segregation procedures for your laboratory.

Refer to chemical hazard guidelines for additional requirements located on the Temple University Chemical Hygiene Program Webpage.

7.5.3.1. Storage Locations

- No storage within 18 inches of the ceiling.
- No storage of chemicals, excluding standard detergents, under sinks.
- Shelves should be secured firmly to walls.
- Provide anti-roll lip on all shelves that is about 1 inch in height.
- Avoid storing chemicals in alphabetical order due to the possibility of incompatibilities being stored near one another.
- Store acids and corrosives in dedicated cabinets, while keeping bases separate. Nitric acid can be stored with other acids if kept in a separate secondary container.
- Store flammables in a vented flammables cabinet when possible.
- Flammable liquids more than 10 gallons must be stored in a flammable storage cabinet.
- Store those chemicals with special storage requirements separately. Examples include, nitrates, perchlorates, perchloric acids, peroxides, peroxide formers, air, or water reactive materials (*e.g.*, sodium, lithium), pyrophoric materials, toxic gases, and strong oxidizers.
- Every chemical should have a storage location and should be returned to that location after use.
- Chemical storage on bench tops should be minimized to reduce the amounts of chemicals unprotected from a potential fire and to prevent them from being easily knocked over.
- Chemicals should not be stored above eye level. Store larger containers on lower levels, if possible.
- Chemical storage in hoods should be minimized to less than one third of the hood space. Avoid blocking rear baffles with any hood storage. Storing containers inside the hood

interferes with airflow, reduces, and clutters up the workspace and may involve the stored materials in a spill, fire, or explosion.
- Stored chemicals must not be exposed to direct sunlight or heat.
- Secondary containment should be used when storing chemicals close to a water source, segregating those chemicals that need secondary containment for incompatibility reasons, when storing acids on bare metal, highly toxic or hazardous materials, or storing chemicals in a refrigerator or freezer.
- Label chemical storage cabinets according to the type of chemical family or hazard classification found there (*e.g.,* acid storage).

7.5.4. Laboratory Refrigerators & Freezers

- Laboratory refrigerators or freezers cannot be used to store food.
- Utilize explosion proof or flammable-proof refrigerators/freezers when flammable liquids must be refrigerated. The use of standard refrigerators to store flammable liquids is prohibited.
- Label all refrigerators/freezers as to their intended use (*e.g.,* for research purposes only, no food and drink allowed).
- Frequently inventory materials stored in refrigerators/freezers and defrost occasionally to prevent chemicals from becoming trapped in ice formations.

7.5.5. Water-Reactive Chemicals

Water-reactive chemicals must be stored in a manner to prevent direct contact from water and fire sprinkler systems. Label the storage area for water-reactive chemicals (*e.g.,* "Water-Reactive Chemicals").

7.5.6. Compressed Gasses

- The name of the gas must be marked on the cylinder.
- Flammable gas cylinders should be stored in a separate area from oxidizing compressed gases. A minimum of 20 feet must be maintained between oxidizers and flammable gases and other combustible materials, such as oil and grease. A firewall (partition) with a half-hour rating can be substituted.
- Cylinders of incompatible gases must be segregated by distance. Group cylinders by the type of gas (*e.g.,* toxic, corrosive, etc.).
- Empty cylinders should be separated from full cylinders and labeled as "Empty" or "MT."
- Never use a valve wrench that is not specifically meant for gas cylinders.
- All compressed gases must be stored away from direct or localized heat (including radiators, steam pipes, or boilers) in well-ventilated and dry areas, and away from areas where heavy items may strike them (*e.g.,* service corridors or near forklift traffic).
- All compressed gases, including empty cylinders, must be secured in an upright position with a chain, strap, or stand and must be capped when stored or moved.
- Use a hand truck when transporting gas cylinders to and from storage location. Never drag, slide, or lift a cylinder by the cap. Only transport with the valve cover in place.

- Gas cylinders must be hydrostatically tested by the vendor every 5 to 10 years. The last testing date is embossed in the metal near the head of the cylinder.
- Highly toxic or corrosive gas cylinders (including lecture bottle size) should be stored upright and inside a vented cabinet or fume hood.
- Inert gases or gases that deplete oxygen in the room may require oxygen sensors nearby to ensure the atmosphere does not deplete oxygen. EHRS can help evaluate if this is necessary for your laboratory.

7.5.7. Segregation of Incompatible Chemicals

A chemical segregation strategy must be employed that ensures incompatible chemicals are not stored together.

- Do not arrange chemicals alphabetically or haphazardly either in stockrooms or in the laboratory work areas.
- Segregate chemicals to prevent mixing of incompatible chemical vapors of liquids if containers break or leak.
- Review a chemical's SDS for incompatible materials. Contact EHRS if you are uncertain of incompatibles of your chemicals.

7.6. Chemical Transportation

7.6.1. On-Campus Transport

Precautions must be taken when transporting hazardous chemicals throughout a building or across campus to a different location. The following precautions must be taken to prevent spills or breakage:

- Secondary containment must be used during transport.
    - Containment must be large enough to contain the contents of the bottle(s) being transported should the container(s) break or rupture.
    - Secondary containers must be durable and leak resistant.
- Chemicals must be tightly sealed prior to transport. NEVER transport a container without a properly fitted lid.
- Do not leave chemicals unattended during transport.
- Sturdy carts and secondary containment must be used when transporting multiple, heavy, and/or large containers.
- Use elevators (preferably freight elevators) for chemical transport. Avoid transporting chemicals on the stairs.
- Contact EHRS prior to moving large quantities of chemicals to ensure compliance with local, state, and federal regulations.
- When transporting compressed gas cylinders, always secure the cylinder to a suitable hand truck with a strap or chain. A safety cap must be used for transport to protect the cylinder valve. Never transport a cylinder with the regulator attached. Never transport a cylinder horizontally. To prevent tipping, always push (never pull) a cylinder on a dolly or a dewar.

It is against DOT regulations for university personnel to transport gas cylinders across city roads or streets.

7.6.2. Off-Campus Transport or Shipment

Transportation of hazardous chemicals and compressed gases over public roads or by air is governed by international, federal, and state regulatory agencies. These agencies include the U.S. Department of Transportation (DOT) and the International Air Transport Association (IATA). Any shipment of hazardous materials must ensure compliance with all pertinent regulations.

Laboratory personnel who wish to ship or transport hazardous chemicals or compressed gases off-campus, even when using TU or personal vehicles, should contact EHRS at ehrsocc@temple.edu or the EHRS at 215-707-2520 for assistance.

7.7. Chemical Security

Recently regulatory agencies have been implementing rules to ensure chemical security. While many of these rules are for large manufacturing facilities, it is critical that chemicals be secured to prevent theft from campus laboratories especially the ones regulated the Drug Enforcement Agency and Department of Homeland Security.

It is each laboratory's responsibility to prevent and report any theft of chemicals from their laboratory. Access to hazardous chemicals should be always restricted and must be stored in laboratories and storerooms that are locked when laboratory personal are not present.

Labs can increase their security by simply keeping lab doors closed and locked when unoccupied, maintaining a current and accurate chemical inventory, training personnel on security procedures, and controlling access to keys. Labs should report any suspicious activity to TU Public Safety at 1-1234 and TU EHRS at 215-707-2520.

8. CHEMICAL WASTE MANAGEMENT

Management of hazardous chemical waste is a critical health, safety, and compliance responsibility of the laboratory. The Hazardous Waste Program encourages the recycling of chemicals, if appropriate, and ensures that hazardous chemical wastes are properly collected, packaged, shipped, and disposed.

Refer to the Temple University Chemical Waste Management Program Temple University Chemical Waste Management Program for more details regarding the management and disposal hazardous chemicals at Temple University.

8.1. Chemical Waste Management Guidelines

The responsibility for chemical waste identification, labeling, and packaging rests with the principal investigator. The principal investigator is required to follow all the procedures as provided in the Chemical Waste Management Program and must ensure proper training to all laboratory personnel under their supervision.

Hazardous waste training is available online through TU-EHSA training module. For detailed information of available courses, please visit the EHRS Training Webpage,

Under no circumstance must chemical waste be left in corridors or general access areas to await pick up.

8.2. Chemical Waste Disposal

Chemical waste picked up from the generating laboratories is transported by EHRS personnel to designated campus Central Accumulation Areas (CAAs). Chemicals are kept at the designated CAA until removed by a permitted hazardous waste disposal firm contracted by TU-EHRS.

Please visit the Temple University Chemical Waste Management Program for additional details and how to request waste pick-ups.

8.3. Waste Minimization & Pollution Prevention

TU is responsible for making efforts to reduce hazardous waste through source reduction, recycling, and other means. Source reduction includes ordering only the amount of chemical needed (e.g. not purchasing far more of a reagent than will be used because the larger volume was cheaper), retiring old equipment that contains hazardous materials (e.g. mercury), substituting less toxic or hazardous chemicals when possible, and improving work practices to reduce waste creation. Recycling includes reusing or recovering materials either on-site or offsite to reclaim value and/or reuse the material. Improved maintenance, training, and better inventory control are also effective means to minimize waste and prevent pollution.

Please visit the Temple University Chemical Waste Minimization & Pollution Prevention Program for additional information.

9. EMERGENCIES

An emergency is an incident that poses an actual or potential threat to people or the environment. Examples include, but are not limited to, equipment failure, explosions, fire, spills, rupture of containers, or failure of control equipment that results in an uncontrolled release to the laboratory or environment. Temple University Public Safety (1-1234) is the designated first responder and incident coordinator in an emergency since they are most familiar with our campus buildings and layout. All emergencies must be reported to the Principal Investigator and EHRS

9.1. Equipment

All laboratory personnel must be instructed in the location of fire extinguishers, emergency eyewashes and showers, and other safety equipment before they begin work in the laboratory. This training is considered part of the laboratory specific training that all laboratory personnel must complete.

Contact EHRS via ehrschem@temple.edu if you have any questions concerning the usage, placement, and/or installation of any laboratory safety equipment.

9.1.1. Emergency Eyewash

It is the responsibility of each laboratory personnel to identify and learn the location of and the route to the eyewash station in their work area so that they will be able to use these in an emergency.

Every laboratory personnel should learn the location of emergency eyewash stations so that it can be found with eyes closed, if necessary.

Emergency eyewashes are required if substances in use present corrosive hazards to the eye, or in research or instructional laboratories where hazardous chemicals may be encountered. Emergency eyewashes should provide a soft stream or spray of aerated water for an extended period, at least 15 minutes.

9.1.2. Emergency Showers

It is the responsibility of each laboratory personnel to identify and familiarize themselves with the location of, and the route to the emergency shower in their work area. Each laboratory person should learn the location of safety showers so that it can be found with eyes closed, if necessary.

Showers can provide a thorough drenching. They are equipped with a quick-opening valve to provide continuous water flow.

Safety showers are provided in areas where chemicals are managed and where the potential for an exposure to hazardous materials may require immediate first aid treatment.

9.1.3. Fire Extinguishers

Fire extinguishers are distributed as per code requirements and although fire extinguishers are accessible from a reasonable travel distance, not all laboratories contain a fire extinguisher inside the laboratory.

Laboratories are provided with ABC fire extinguishers unless specific laboratory conditions require another type. Fire extinguishers are strategically located in laboratory hallways and other locations throughout the University, in accordance with National Fire Protection Association

(NFPA) guidelines.

Any time a fire extinguisher is discharged, no matter for how brief a period, the laboratory workers present at the time of the incident, must immediately report to TU Public Safety by calling 1-2344. Any unintentional fire, no matter the size, must also be reported by calling 1-1234.

Contact the University Fire Marshal if you have any questions concerning the usage, placement, and/or installation of any fire extinguisher.

9.1.4. Fire Alarms

Fire alarms, pull stations, horn and strobes are in hallways and other locations throughout the University. Do not block access to, or visibility of fire alarm pull stations. All occupants must be advised when and how to activate alarms.

9.1.5. Performance Verification of Equipment

Laboratory safety equipment must always function properly to protect the health and safety of laboratory personnel. All performance verification and testing information (date, tester initials, results, etc.) must be documented and available for review upon request.

TABLE X: PERFORMANCE VERIFCATION FREQUENCY & RESPONSIBILITIES		
EQUIPMENT	**TESTING FREQUENCY**	**RESPONSIBLE PARTY**
Emergency Eyewash	Weekly	Laboratory
	Annual	Facilities Management-Plumbing
Emergency Shower	Weekly	Laboratory
	Annual	Facilities Management-Plumbing
Fire Extinguishers	Monthly & Annual	Facilities Management-Fire Marshal
Fire Alarms	As required by Fire Marshal	Facilities Management-Fire Marshal
Any units which do not have an inspection date within one year should be reported immediately to ehrschem@temple.edu		
Emergency eyewash and shower test kits are available via laboratory safety equipment vendors.		

9.1.6. Maintenance & Repairs of Equipment

Routine maintenance and repairs of laboratory safety equipment are conducted by Facilities Management. Laboratory personnel may route requests for hood repair directly to the Facilities Dispatch Office

- Mian Campus-1-1385
- HSC-2-4702

Make sure to indicate that the request has been "generated as a result of a health and safety

deficiency" and mark it "urgent" to expedite processing. EHRS does not initiate maintenance but may coordinate with Facilities Management to ensure that it is completed.

9.2. Chemical Spills

Chemical spills refer to the release of chemicals, wastes, oils, or other potentially hazardous materials into the air, water, or laboratory.

9.2.1. Incidental (Minor) Spills

Most chemical spills likely to occur in TU laboratories can be considered incidental, or minor - involving small quantities of materials, and not extremely hazardous substances. It is up to each PI to determine what will be considered an incidental vs. emergency spill, and to ensure all laboratory personnel are aware of the distinction and procedures for handling both. Laboratory personnel are permitted to manage incidental spills if they have the necessary knowledge, supplies, and training.

Contact EHRS at 2-2520 if you require assistance and/or guidance with any incidental chemical spill.

9.2.2. Emergency Spills

Large spills, spills released into the environment (near a drain, waterway, or on grass or dirt), or spills of highly hazardous chemicals (e.g., strong acid) may require special cleanup procedures such as special PPE or spill cleanup materials. Laboratory personnel should not attempt to manage any spills of an emergency nature and should never place themselves or others at risk by attempting to do so.

In the event of an emergency spill (or any other emergency involving hazardous materials), all laboratory personnel must immediately vacate the area and call TU Public Safety at 1-1234. The Philadelphia Fire Department has a Hazardous Materials Unit that is equipped to manage all such emergencies.

9.3. Spill Kits

All laboratories must contain an appropriate spill kit that is readily accessible and kept stocked. It is the PIs responsibility to provide and maintain spill kits and to ensure that laboratory personnel are trained on containing any incidental spills they may encounter. It is acceptable to use premade spill kits or assemble your own. Basic items to include:

- Spill absorbent/neutralizing material for the classes of chemicals used (acid/base/toxic/flammable/etc.)
- Container for collected spill material (Ziploc bags, sturdy plastic container)
- Absorbent mat squares

- Paper towels
- Broom and dustpan
- Instructions for safely cleaning up a spill (what PPE to wear, when a spill is too large to handle, and TU Public Safety should be called.

9.4. Chemical Exposures

Chemical exposure can occur through the following routes: absorption (via skin or eye contact), inhalation, ingestion, or injection. This section provides general guidance for properly responding to such exposures.

Some specific chemicals have very particular procedures, such as hydrofluoric acid and phenol. Always consult the Safety Data Sheet for first aid response instructions before using a chemical.

Immediately seek medical attention (TU-Public Safety 1-1234) if needed or desired. Immediately report all exposures or suspected exposure to the PI, and EHRS (ehrschem@temple.edu).

If you are unsure how to respond, you may always call Poison Control for free and confidential assistance. They are qualified to provide first aid instructions for any potentially hazardous exposures.
Poison Control: 1-800-222-1222

In general, the following procedures detail how to respond to a chemical exposure in the laboratory:

9.5. Absorption (Skin)

- Immediately drench the skin with copious amounts of water for at least 15 minutes.
- While rinsing, remove any contaminated clothing and/or jewelry.
- Use caution when removing contaminated pullover shirts or sweaters to prevent contamination of the eyes.
- Discard contaminated clothing or launder them separately from other clothing. Leather garments or accessories that cannot be decontaminated should be discarded.
- Consult the SDS for guidance on appropriate action and whether any delayed effects should be expected. It is important to determine all the chemicals, including any intermediaries or mixtures, which the person may have come in contact with. The victim should be encouraged to seek medical attention regardless of the assumed severity of the injury/exposure.
- Do not use solvents to wash skin. Solvents remove the natural protective oils from the skin, and can cause irritation and inflammation, and in some cases, may facilitate absorption of a toxic chemical.

9.6. Absorption (Eyes)

- Immediately flush eye(s) with copious amounts of water for at least 15 minutes.
- The use of an eyewash station is desirable, so hands are free to hold the eyes open.

- If an eyewash station is not available, pour water on the eye, rinsing from the nose outward to avoid contamination of the unaffected eye.
- Remove contact lenses while rinsing. Do not lose time removing contact lenses before rinsing. Do not attempt to rinse and reinsert contact lenses.

9.7. Inhalation

- Move affected person to fresh air and close containers, open windows or otherwise increase ventilation if necessary.
- Review the SDS to determine what health effects are expected, including delayed effects.

9.8. Ingestion

- Do not induce vomiting unless directed to do so by a healthcare provider.

9.9. Injection

- Wash the area with soap and water.

10. MEDICAL EVLAUATION & CONSULTATION

10.1. Medical Services

Principal Investigators and laboratory personnel working in laboratories at TU must be afforded medical attention, including follow-up examinations as deemed necessary by the examining physician, under the following circumstances:

- Whenever an employee develops signs and symptoms associated with a hazardous chemical exposure.
- Where exposure monitoring reveals an exposure level above the action level (or in the absence of

the action level, the permissible exposure limit) for a Cal/OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements.
- Whenever an accident such as a spill, leak, fire, explosion, or other occurrence results in the likelihood of a hazardous exposure; or
- At the request of the University Chemical Hygiene Officer.

All medical examinations must be performed by or under the direction of a licensed medical physician. Medical exams or consultations must be conducted within a reasonable time from the date that the incident occurred and must be provided without cost to the employee.

The consulting/treating physician must be provided with the following information as applicable:

- A description of the signs and symptoms of exposure.
- A description of the conditions under which the exposure occurred (e.g., chemical mixtures, amounts, fume hood use, etc.).
- The identity of the hazardous chemical(s) to which the exposure occurred, including any known byproducts of chemical mixtures that may have occurred. SDSs should be provided to the physician.

10.2. Reporting Requirements

Whenever someone experiences a medical emergency at the university, laboratory personnel must immediately inform PI and call or have someone else call Campus Safety at 215-204-1234. If you are off campus, call 911. Or go directly to Temple Hospital's Emergency Room or the nearest emergency room for treatment.

All accidents or injuries that occur on University property, regardless of severity, must be promptly reported to TU Public Safety so that a report can be issued. Minor chemical spills only need to be reported to TU Public Safety if someone is injured or the situation poses danger to people or property. See Section 9 for more information on minor (incidental) spills.

EHRS should be notified within 72 hours of all laboratory incidents involving hazardous chemicals, including incidental spills.

Refer to Temple University-Human Resources Department for additional information on what to do if you are injured at work.

If an incident occurs related to an Institutional Animal Care and Use Committee (IACUC), Institutional Biosafety Committee (IBC) or Institutional Review Board (IRB) protocol, please refer. to those committees' policies and the Office of Vice President for Research for additional reporting responsibilities.

11. RECORDKEEPING

EHRS maintains records on file for the following:

- EHRS provided trainings.
- Chemical incident investigations & reports
- Chemical exposure monitoring & monitoring equipment calibration records
- Safety Data Sheets (SDS)
- Chemical Fume Hood Records
- Chemical Waste records
- Regulatory Agency inspections/correspondence

All EHRS records will be maintained for a minimum of three years or as required by regulation.

Departments and/or laboratories are responsible for maintaining records for specific activities, including lab-specific training, not directly managed by EHRS.

12.REFERENCES

The following resources served as substantive references to this document:

- OSHA-Occupational Exposure to Hazardous Chemicals in Laboratories (Lab Standard)-29 CFR 1910.1450
- OSHA-Hazard Communication Standard (HazCom)-29 CFR 1910.1200
- OSHA-Table Z-1 Limits for Air Contaminants-29-CFR 1910.1000
- EPA-Resource Conservation and Recovery Acr-40 CFR 239 through 282
- National Research Council. Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards, Updated Edition (2011). National Academies Press, Washington, DC

13.APPENDICIES

13.1. Glossary/List of Acronyms

- Action Level- A concentration designated in the OSHA (29 CFR) part 1910 (or in the absence of an action level, the PEL) for which a specific substance, calculated as an eight- hour time-weight average, which initiates certain required activities such as exposure monitoring and medical surveillance.

- ANSI- American National Standard Institute

- CAS- Chemical Abstract Service

- CDC- Center for Disease Control and Prevention

- Chemical Hygiene Officer- The Chemical Hygiene Officer is an employee who is designed by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the Chemical Hygiene Plan.

- Designated Area- An area that may be used for work with “select carcinogens,” reproductive toxins, or substances that have a high degree of toxicity. A designated area may be the entire laboratory, an area of a laboratory, or a device such as a chemical fume hood.

- DOT- Department of Transportation

- EPA- Environmental Protection Agency

- Flash Point- the lowest temperature at which a flammable liquid gives off sufficient vapor to form an ignitable mixture with air near its surface or within a vessel.

- GHS- Globally Harmonized System

- Hazard Communication (HazCom)- HazCom is an OSHA standard for classifying chemicals to provide information on safe handling, storage, and use of hazardous chemicals, and communicating information on labels and ion safety data sheets.

- Hazardous Chemical- Any chemicals which is classified as a physical hazard or a health hazard.

- Health Hazard- Any chemical that is classified as posing one of the following hazardous effects: acute toxicity (any route of exposure), skin corrosion or irritation, serious eye damage or eye irritation, respiratory or skin sensitization, germ cell mutagenicity, carcinogenicity, reproductive toxicity, specific target organ toxicity (single or repeated exposure), aspiration hazard or simple asphyxiant.

- HEPA- High Efficiency Particulate Air

- HMIS- Hazardous Material Information System

- Laboratory- OSHA defines a laboratory as "a workplace where relatively small quantities ofhazardous chemicals are used on a non-production basis."

- Laboratory personnel-Anyone whose work within a laboratory setting requires the handling of a hazardous chemical. This includes employees whose work promotes a research PI or faculty member, teaching assistants in instructional laboratories, volunteers, and students.

- Laboratory Use of Hazardous Chemicals- the handling or use of such chemicals in which all the following conditions are met:

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

- Lethal Concentration 50 (LC_{50}): The concentration of a material in air which, based on laboratory tests, is expected to kill 50 percent of a group of test animals when administered as a single exposure (usually 1 to 4 hours).

- Lethal Dose 50 (LD_{50}): A single dose of a material expected to kill 50 percent of a group of test

animals. The dose is expressed as the amount per unit of body weight, the most common expression being milligrams of material per kilogram of body weight (mg/kg of body weight). Usually refers to oral or skin exposure.

- Lower Explosive Limit (LEL) and Upper Explosive Limit (UEL) values-The minimum and maximum concentrations of a flammable gas or vapor between which ignition can occur. Concentrations below the LEL are too lean to burn, while concentrations above the UEL are too rich. All concentrations between LEL and UEL are in the flammable range, and special precautions are needed to prevent ignition or explosion.

- NFPA- National Fire Protection Association

- NIOSH- National Institute for Occupational Safety and Health

- OSHA- Occupational Safety and Health Administration

- Permissible Exposure Limit (PEL)- PELs are the regulatory limit or maximum concentration of a substance in the air that personnel can be exposed to without personal protective equipment or engineering controls (such as a chemical fume hood). These chemicals may also have a "skin designation" that prohibits skin contact.

- Physical Hazard- Any chemical which is classified as posing one of the following hazardous effects: explosives, flammable (gases, aerosols, liquids, or solids), oxidizers (liquid, solid, or gas), self-reactive, pyrophoric (gas, liquid, or solid), self-heating, organic peroxides, chemicals corrosive to metal, gases under pressure, water reactives that emit flammable gases, or combustible solids.

- Principal Investigator (PI)- A Principal Investigator (PI) is faculty member responsible for research in their assigned laboratory(s) or assigned as the director and/or supervisor of a specific laboratory space.

- PPE- Personal Protective Equipment

- SDS(s)- Safety Data Sheet(s)

- SOP(s)- Standard Operating Procedure (s)

- Flammable Storage Cabinet- cabinet for the storage of flammable liquid which is designed and constructed in accordance with "OSHA General Industry Standards - Flammable and Combustible Liquids."

- Storage Room: A room where chemicals or gases are stored and not otherwise used or reacted.

- Threshold Limit Values (TLVs): Guidelines prepared by the American Conference of Governmental Industrial Hygienists, Inc (ACGIH) to assist industrial hygienists in making

decisions regarding safe levels of exposure to various hazards found in the workplace.

- TLV-TWA: The allowable Time Weighted Average concentration for a normal 8-hour workday (40-hour work week).

- TLV-STEL: The short-term exposure limit or maximum concentration for a continuous 15-minute exposure period (maximum of four such periods per day, with at least 60 minutes between exposure periods) and provided the TLV-TWA is not exceeded.

- TLV-C: The ceiling exposure limit is the concentration that should never be exceeded, even instantaneously.

- UL- Underwriters Laboratories

- UV- Ultraviolet

13.2. Chemical Toxicology & Routes of Exposure

Chemicals enter the body through three primary routes and two lesser routes of entry. Chemicals may affect the route of entry organ, or they may travel and target specific organs where they will do damage:

- Respiration – primary target lungs (asbestos, osmium tetroxide, phosgene), and other target organs (carbon monoxide – blood, methylmercury – brain)
- Ingestion – primary target gastrointestinal tract (acids), other target organs (lead – bones)
- Dermal Absorption – primary target skin, including mucous membranes, and other target organs (solvents, phenol – Central Nervous System)
- Ocular – primary target eyes (acids, bases), targets other organs (solvents)
- Subcutaneous – injected into the blood, transferred to target organ.

13.2.1. Acute Exposure

Short term, high exposure which results in an acute effect, including:

- Allergic reaction
- Coughing
- Shortness of breath
- Skin rash
- Burning eyes

13.2.2. Chronic Exposure

Long term, low exposure which may result in chronic effect, including:

- Asbestosis (asbestos)
- Central nervous system disorders (organic mercury, metallic mercury) Various cancers including lung, kidney, bladder, and liver (carcinogens)

14.DOCUMENT REVIEW & AMMENDMENTS LOG

Revision Number	Revision Date	Nature of Revision	Initials
N/A	Jan. 2025	Completely revised CHP	DM