CHEMICAL HYGIENE PLAN

SCHOOL OF PURE AND APPLIED SCIENCES

FLORIDA SOUTHWESTERN STATE COLLEGE

Document developed directly in compliance with Laboratory Safety Guidance (OSHA 3404-11R 2011) by the Occupational Safety and Health Administration.

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Introduction

Purpose

Florida SouthWestern State College (FSW) is committed to providing a healthy and safe working environment for the campus community, free from recognized hazards in accordance with FSW policy. The Chemical Hygiene Plan establishes a formal written program of safe practices and protocols for maintaining safe environment for students, faculty, staff, workers and visitors. This plan is based on the following federal and state regulations:

- 29 CFR 1910.1450 "Occupational Exposures to Hazardous Chemicals in Laboratories"
- 29 CFR 1910.1200 "Hazard Communication"
- 40 CFR 260.xx "General Hazardous Waste Management"
- National Fire Protection Association Requirements

The CHP provides prudent practices and procedures for the use of chemicals in the laboratory by establishing procedures, equipment, PPE and work practices capable of protecting workers from the health hazards presented by chemicals used in the laboratory. These processes are defined in the CHP:

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

Control Measures: Implementation of various measures to reduce worker exposure to hazardous chemicals including engineering controls, the use of personal protective equipment (PPE) and hygiene practices.

Information and Training: Required information and training to ensure that laboratory users are apprised of the hazards of chemicals in the areas and related information.

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

The appendices at the end of this document also contain the essential information for laboratory personnel. CHP should be reviewed annually, at a minimum, by the Chemical Safety Committee and updated accordingly.

Scope

The CHP applies to personnel within a laboratory where hazardous chemicals are used or stored, or those whose work activities are research-related and involve hazardous chemicals. Storage of the hazardous chemicals must be consistent with "laboratory use" to be covered by the CHP. Laboratory use means that:

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

- Multiple chemicals or chemical procedures are used.
- Activities are not part of or simulating a production process.
- Protective laboratory practices and equipment are available and in common use.

At a minimum, this definition includes employees who use chemicals in teaching and research laboratories, and in practice this protection is afforded to everyone working in a laboratory setting at FSW.

Rights and Responsibilities

Employees and other personnel who work in laboratories have the right to be informed about the potential health hazards of the chemicals in their work areas and to be properly trained to work safely with these substances. This includes custodial staff and other personnel who work to clean and maintain the laboratories.

Employees have the right to fila a complaint with FL/OSHA if they feel they are being exposed to unsafe or unhealthy work conditions and cannot be discharged, suspended, or otherwise disciplined by their employer for filing a complaint or exercising these rights.

Responsibilities for the health and safety of the campus community extend to the highest administrative levels at FSW. The President, Vice Presidents, Provost, and Public Safety are all responsible for the implementation of FSW's Environmental Health and Safety Policy at all facilities and properties under campus control. Deans and Associate Deans are responsible for establishing and maintaining programs in their areas for providing a safe and healthy work environment.

The day-to-day responsibility for the management of laboratory safety and adherence to safe laboratory practices rests with the PI/Laboratory Supervisor within individual laboratory units associated departments. All personnel, including PIs/Laboratory Supervisors, employees and students, have a duty to fulfill their obligations with respect to maintaining a safe work environment. Safety is everyone's responsibility.

All employees and other personnel working with potentially hazardous chemicals have the responsibility to conscientiously participate in training on general laboratory safety and review and be familiar with the contents of the CHP. Those working with chemicals are responsible for staying informed about the chemicals in their work areas, safe work practices and proper personal protective equipment (PPE) required for the safe performance of their job. Failure to comply with these requirements may result in temporary suspension of laboratory activities until corrective action is implemented.

Responsibilities of Principal Investigator (PI)/ Laboratory Manager

The PI/Laboratory Manager has responsibility for the health and safety of all personnel working in their laboratory who handle hazardous chemicals. The PI/Laboratory Manager may delegate safety duties but remains responsible for ensuring that delegated safety duties are adequately performed. The PI/Laboratory Manager has the primary responsibility for establishing a strong safety culture within the laboratory they supervise. The PI/Laboratory Manager is responsible for:

1. Knowing all applicable health and safety rules and regulations, training and reporting requirements and standard operating procedures associated with chemical safety for regulated substances;
2. Identifying hazardous conditions or operations in the laboratory or other facility containing hazardous chemicals and determining safe procedures and controls; and implementing and enforcing standard safety procedures;
3. Establishing standard operating procedures (general and protocol specific) and performing literature searches relevant to health and safety for laboratory-specific work;
4. Provide prior approval for the use of hazardous chemicals in their laboratory or other facility with hazardous chemicals;
5. Maintain an up-to-date and accurate chemical inventory for the laboratory or facility;
6. Ensuring laboratory or other personnel under their supervision have access to and are familiar with the appropriate Safety Data Sheets;
7. Training all laboratory or other personnel they supervise to work safely with hazardous materials and maintain written records of all training (including laboratory-specific or other specialized training).
8. Promptly notifying Risk Management and/or Facilities Management should they become aware that workplace engineering controls (e.g. fume hoods) and safety equipment (e.g. emergency showers/eyewashes, fire extinguishers, etc.) become non-operational;
9. Ensuring the availability of all appropriate personal protective equipment (PPE) (e.g. lab coats, gloves, eye protection, etc.) and ensuring the PPE is maintained and in good working order. Ensuring that all employees wear the appropriate PPE every time they enter the laboratory;
10. Promptly reporting all accidents and injuries to Risk Management. Any explosions, unintended fires, or use of a fire extinguisher must be reported to Risk Management and Public Safety. It is imperative that any used fire extinguisher must be taken out of service and returned to public safety for replacement;
11. Informing facilities personnel, other non-laboratory personnel, and any outside contractors of potential laboratory-related hazards when they are required to work in the laboratory environment;
12. Identifying and minimizing potential hazards to provide a safe environment for repairs and renovations.

Responsibilities of All Personnel Who Handle Potentially Hazardous Chemicals

All personnel working in the laboratories that use, handle or store potentially hazardous chemicals are responsible for:

1. Reviewing and following the requirements of the Chemical Hygiene Plan and all appropriate safety precautions and policies;
2. Following all verbal and written laboratory safety rules, regulations and standard operating procedures required for the tasks assigned;
3. Develop good personal chemical hygiene habits, including but not limited to, keeping the work areas safe and uncluttered;
4. Properly identifying/labeling, storing, handling, and disposing of hazardous waste;
5. Utilizing appropriate measures to control identified hazards, including consistent and proper use of engineering controls, PPE, and administrative controls;
6. Understanding the capabilities and limitations of PPE issued to them;
7. Gaining prior approval from the PI/Laboratory Manager for the use of restricted chemicals and other materials;
8. Consulting with PI/Lab Manager before using any hazardous materials or conducting any higher risk experimental procedures;
9. Immediately reporting all accidents, unsafe conditions, and near-misses to the PI/Lab Manager.
10. Completing all required health, safety and environmental training and providing written documentation to their PI/Lab Manager.
11. When working autonomously or performing independent research work:
    - Reviewing the plan and scope of work for their proposed research with the PI/Lab Manager;
    - Notifying in writing and consulting with the PI/Lab Manager, in advance, if they intend to significantly deviate from previously reviewed procedures;
    - Preparing SOPs and performing literature searches relevant to the safety and health that are appropriate for the work;

Hazard Communication

FSW is responsible for providing information about the hazardous substances in our workplace, the associated hazards, and the control of these hazards, through a comprehensive hazard communication program that complies with 29CFR 1910.1200, the OSHA Hazard Communication Standard. The Hazard Communication Standard is designed to protect against injuries and illnesses caused by the chemical source. The goal is to provide employers and workers with sufficient information to recognize, evaluate, and control chemical hazards and take appropriate protective measures. The requirements of the Hazard Communication Program apply to the laboratory environments at FSW due to the potential for use of hazardous chemicals in preparation and execution of lab experiments.

List of Hazardous Substances

An up-to-date chemical inventory must be kept on file and made available to Risk Management or Public Safety upon request. For each hazardous substance in inventory, specific information on any associated health hazards must be made readily available to all laboratory personnel.

Hazard Determination

It is the responsibility of the PI/Laboratory Manager to verify if any items in their inventory are subject to the requirements of the hazard communication regulation.

The term "hazardous substance" refers to any chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed individuals. Hazardous substances include, but are not limited to, those chemicals listed in the following:

- "The Hazardous Substance List", commonly known as the Directors List of Hazardous Substances, 8 CCR 339 (http://www.dir.ca.gov/title8/339.html);
- "Consolidated lists of Chemicals subject to the Emergency Planning and Community Right-to-Know Act (EPCRA), Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and Section 112(r) of the Clean Air Act (https://portal.floridadisaster.org/SERC/External/EPCRA/Attachment%20A%20EPA%20List%20of%20Lists%202019.pdf);
- "Fourteenth Annual Report on Carcinogens", NTP, 2016 (https://ntp.niehs.nih.gov/ntp/roc/content/listed_substances_508.pdf; https://ntp.niehs.nih.gov/pubhealth/roc/index-1.html);
- "Monographs", IARC, WHO (https://monographs.iarc.fr/agents-classified-by-the-iarc/ *and* https://monographs.iarc.fr/wp-content/uploads/2019/07/Classifications_by_cancer_site.pdf);
- SDSs for reproductive toxins and cancer-causing substances: • (\\Lee-NAS-2/Math And Science/Lab Managers/SDS)

Any novel chemical produced should be presumed hazardous. Chemicals derivatives of known materials should be assumed at least as hazardous as their known parent compound. Novel compounds should be treated with extreme caution to prevent exposure.

Inventory items found on the above lists are subject to the requirements outlined below.

Safety Data Sheets (SDS)

A Safety Data Sheet (SDS), formerly known as Material Safety Data Sheets (MSDS) provides comprehensive information that is imperative for the safe handling of hazardous chemicals. Laboratory personnel should use the SDS as a resource to obtain information about the hazards and safety precautions of chemicals in the workplace. PIs/Laboratory Managers are responsible for keeping SDS current and making them available to all laboratory personnel throughout the workday. SDS are kept in a central location that can be accessed in the event of an emergency. Electronic copies are kept on the lab managers group drive.

A Globally Harmonized System (GHS) of the classification and labeling of chemicals was developed by the UN, and adopted by OSHA in 2012, to ensure the safe production, transport, handling, use and disposal of hazardous materials. This standardized the content of SDS to contain detailed information under each heading illustrated in the table below:

1	**Identification of the substance or mixture and of supplier**	**9**	**Physical and Chemical Properties**
2	**Hazards Identification**	**10**	**Stability and Reactivity**
3	**Composition/ Information on ingredients**	**11**	**Toxicological Information**
4	**First Aid Measures**	**12**	**Ecological Information**
5	**Firefighting Measures**	**13**	**Disposal Considerations**
6	**Accidental Release Measures**	**14**	**Transport Considerations**
7	**Handling and Storage**	**15**	**Regulatory Information**
8	**Exposure Controls/ Personal Protection**	**16**	**Other Information (dates of preparation or last revision)**

Labels and Other Forms of Warning

Every chemical in the laboratory (including nonhazardous materials, e.g., water) must be labeled properly. Labeling requirements for all hazardous substances are summarized as follows:

- All containers of purchased hazardous materials or materials intended for distribution must be labeled with the identity of the hazardous substance;
- The label must contain all applicable hazard warning statements;
- The name and address of the chemical manufacturer, generator, or other responsible party must be present;

- Manufacturer's product labels must remain on all containers and must not be defaced in any way. Appropriate hazard warning statements and Proposition 65 warnings must be present, if not that information must be added;
    - If a container is going to be reused ensure that all the material has been removed (you should not be able to pour or scrap any material from the container), then soak the label off before reusing the container. Never put a new label over an old label.
- Labels must be legible, in English, and prominently displayed;
- Symbols and/or other languages are required for non-English speaking employees;
- Signal words such as "Danger" (for more severe hazards) or "Warning" (for less severe hazards are used to emphasize hazards and indicate the relative level of severity of the hazard;
- Working containers (such as spray bottles) must be labeled with the identity of the substance and appropriate hazard warnings;
- Prepared mixtures and/or buffers must be labeled with the appropriate hazard warnings based on the knowledge of the chemical and physical properties of that substance;

The GHS also standardizes the hazard pictograms that are to be used on all hazard labels and SDSs. There are 9 pictograms that represent several defined hazards, and include the harmonized hazard symbols which are intended to convey specific information about each hazard. Figure below illustrates these GHS hazard pictograms.

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

Notice Boards & Signs

Laboratories, chemical storage areas and other potentially hazardous work areas shall have a notice board at all entrances into the workspace. These notice boards shall have stickers identifying the categories of potentially hazardous materials found in the lab and be considered a warning of the potential hazards. An emergency contact information sticker shall also be attached and completed to identify at least 2 individuals to contact in case of emergency. This Emergency Call List shall provide the names and after-hours phone numbers of those individuals who will know the chemicals, gases and other hazards that may be affected by an emergency in the laboratory.

Training

Effective training is essential to a successful laboratory safety program. PIs/laboratory Managers must actively participate in the training process to ensure all lab employees are effectively trained before working with any hazardous materials. Although the minimum training requirements are listed here, it should be noted that depending on the type of work conducted and associated hazards there may be additional training requirements not detailed in this section.

CHP Training

All employees (PIs, instructors, Lab Managers, Lab Technicians, Student assistants) must receive documented CHP training before any work with hazardous materials occurs. The Laboratory Manager is responsible for providing CHP training. Initial CHP training should include the following:

- Review the lab-specific CHP in its entirety
- Review lab-specific hazard assessments
- Review lab-specific SOPs
- Review any other lab-specific protocol or requirements

Refer to Appendix A for the CHP Lab-Specific Training Certification Form, which can be used to document review of the CHP. After receiving the initial documented CHP training, all lab employees must receive annual CHP training as well. This annual refresher is a condensed version of the initial CHP training, and includes the following elements:

- Review of lab-specific hazards and required PPE
- Review lab-specific SOPs
- Review any additional lab-specific rules and requirements
- Review chemical spill and emergency procedures

Laboratory Safety Training

Every person working in the lab must complete Laboratory Safety Training which include the following basic safety practices:

- Review of general safety practices in a laboratory
- Awareness of the reference materials such as Safety Data Sheets (SDS) and Chemical Hygiene Plan (CHP) available.
- Proper handling of the hazardous chemicals and wastes
- Proper operation of the Autoclaves
- Proper use of PPE and Engineering Controls
- Locations of emergency equipment such as eyewash stations, showers, and exit routes

The Laboratory manager is responsible for providing this training, which currently resides as a course in Canvas and can be accessed here:

https://fsw.instructure.com/courses/1084530

Lab employees that must use autoclaves in their work also must complete the autoclave training form located in the autoclave log binder near the autoclave.

PPE Training

Lab Managers must ensure that all lab employees receive documented PPE training before any work with hazardous materials occurs. Document PPE training using the Personal Protective Equipment Certificate of Training. Each lab employee must be trained to know at least the following:

- When PPE is necessary
- What PPE is necessary
- How to properly don, doff, adjust and wear PPE
- The limitations of the PPE
- The proper care, maintenance, and useful life of PPE

Each affected employee must demonstrate and understanding of the training provided and the ability to use PPE properly before performing any work requiring PPE.

Biomedical Waste Training/ Biosafety

Biosafety is the application of safety precautions that reduce a person's risk of exposure to a potentially infectious microbe and limit contamination of the work environment and ultimately the community around us. All persons that work in areas where red bins are kept must complete annual Biomedical Safety Training as a requirement by Florida Department of Health. The PIs/Lab Managers/Lab Instructors will conduct this training and complete the Biomedical Waste Training Form for each section/lab. This includes students enrolled in labs that contain biomedical waste bins.

Laboratory Hazard Assessment and Classes

Chemicals can be divided into several different hazard classes. The hazard class provides information to help determine how a chemical can be safely stored and handled. Each chemical container, whether supplied by a chemical manufacturer or produced in the laboratory, must have a label that clearly identifies the chemical constituents. In addition to a specific chemical label, more comprehensive hazard information can be found by referencing the SDS for that chemical. The OSHA Laboratory Standard defines a hazardous chemical as any element, chemical compound, or mixture of elements and/or compounds which is a physical or health hazard. This definition of a hazardous chemical and the GHS primary classes of chemicals are briefly discussed below.

Physical Hazards

A chemical is a physical hazard if there is scientifically valid evidence that it is flammable, combustible, water reactive, explosive, organic peroxide, oxidizer, pyrophoric, self-heating, self-reactive, or a compressed gas. Each physical hazard is briefly defined below. Refer to Appendix B (section B.1) for detailed information on each physical hazard.

- **Explosives:** A liquid or solid which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings.
- **Flammable Liquids:** Materials which under standard conditions can generate sufficient vapor to cause a fire in the presence of an ignition source and have a flash point no greater than 93 °C (200 °F).
- **Flammable Solid:** A solid which is readily combustible, or may cause or contribute to a fire through friction.
- **Gases under Pressure:** Gases which are contained in a receptacle at a pressure not less than 280 kPA at 20 °C or as a refrigerated liquid.
- **Organic Peroxide:** A liquid or solid which contains the bivalent -0-0- structure and may be considered a derivative of hydrogen peroxide, where one or both of the hydrogen atoms have been replaced by organic radicals.
- **Oxidizer:** A liquid or solid, while in itself is not necessarily combustible, may generally by yielding oxygen, cause or contribute to the combustion of other material.
- **Pyrophoric Substance (also called Spontaneously Combustible):** A liquid or solid that even in small quantities and without an external ignition source can ignite after coming in contact with the air.
- **Self-Heating Substance:** A liquid or solid, other than a pyrophoric substance, which, by reaction with air and without energy supply, is liable to self-heat.
- **Self-Reactive Substance:** A liquid or solid that is liable to undergo strong exothermic thermal decomposition even without participation of oxygen (air).

- **Water-Reactive Substance:** A liquid or solid that reacts violently with water to produce a flammable or toxic gas, or other hazardous conditions.

Health Hazards

A chemical is a health hazard if there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. Each health hazard is briefly defined below. Refer to Appendix B (section B.2) for detailed information on each health hazard.

- **Carcinogens:** Substances that cause cancer. Generally, they are chronically toxic substances; that is, they cause damage after repeated or long-duration exposure, and their effects may only become evident after a long latency period. Carcinogens are separated into two classes: select carcinogens and regulated carcinogens.
- **Corrosives:** Substances that cause destruction of living tissue by chemical corrosion at the site of contact and can be either acidic or caustic (basic).
- **Hazardous Substances with Toxic Effects on Specific Organs:** Substances that pose adverse health effects to specific organs such as the liver, kidneys, lungs, etc.
- **High Acute Toxicity Substances:** Substances that may be fatal or cause damage to target organs as the result of a single exposure or exposures of short duration. Acute toxins are quantified by a substance's lethal dose-50 (LD50) or lethal concentration-50 (LC50), which is the lethal dose of a compound to 50% of a laboratory tested animal population (e.g., rats, rabbits) over a specified time period.
- **Irritant:** Substances that cause reversible inflammatory effects on living tissue by chemical action at the site of contact.
- **Reproductive Toxins:** Substances that may affect the reproductive capabilities, including chromosomal damage (mutations) and effects on fetuses (teratogens).
- **Sensitizer (also called allergen):** A substance that causes exposed individuals to develop an allergic reaction in normal tissue after repeated exposure to the substance.

Biological Hazards

Definition of biological hazards is contained within the Biomedical Waste Operating Plan. There is one specific to each campus. Most are on Teams and the shared drive. Within this plan, biological hazards are defined as any solid or liquid that may present a threat of infection to humans. PIs must confer with Laboratory Managers prior to starting any work with biological hazards to ensure proper containment and control measures are in place.

PIs/Lab Managers are responsible for designation of the Biosafety Level (BSL) status in the lab. The levels of containment range from the lowest of BSL1 to the highest of BSL4. Each BSL level has its own specific controls for containment of microbes and biological agents.

Each BSL builds on the controls of the level before it. Every microbiology laboratory, regardless of biosafety level, follows standard microbiological practices.

Most of our microbiological work is designated as BSL-1. The microbes there are not known to consistently cause disease in healthy adults and present minimal potential hazard to employees and the environment. Specific considerations for a BSL-1 Laboratory include:

- Standard microbiological practices are followed.
- Work can be performed on an open lab bench or table.
- Lab coats, gloves, and eye protection are worn as needed.
- A sink must be available for handwashing.
- The lab should have doors to separate the working space from the rest of the facility.

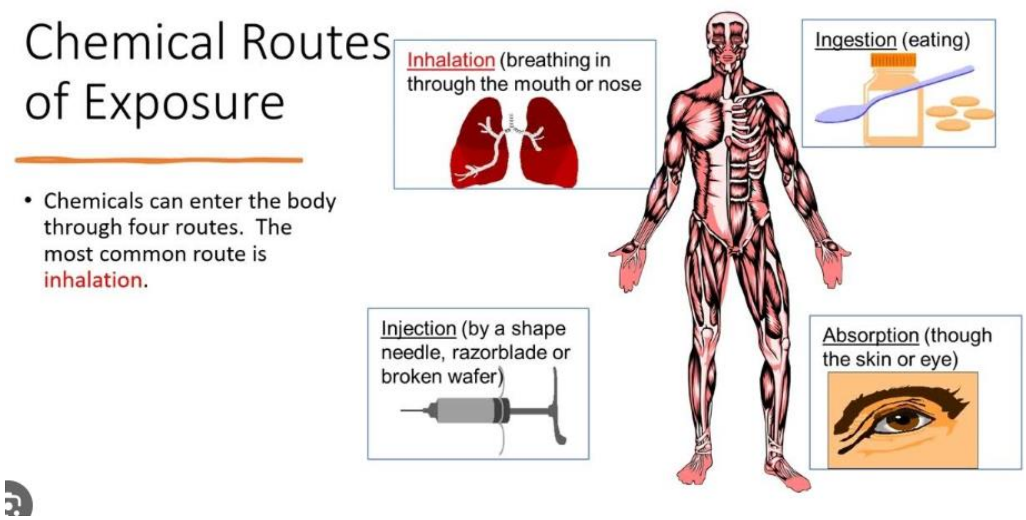
BSL-2 builds on BSL-1. The microbes there pose moderate hazards to employees and the environment. In addition to BSL-1 considerations, BSL-2 Laboratories have the following containment requirements:

- Access to the laboratory is restricted when work is being conducted.
- Appropriate PPE is worn, including lab coats and gloves. Eye protection and face shields can also be worn as needed.
- All procedures that can cause infection from aerosols or splashes are performed within a Biological Safety Cabinet (BSC).
- The laboratory has self-closing doors.
- A sink and eyewash are readily available.

There is no work permitted at FSW in BSL-3 or BSL-4, as our labs are not constructed to meet the containment requirements of the levels. Regulation of biomedical wastes can be found in the Biomedical Waste Operating Plan.

Reducing Exposure to Hazardous Chemicals

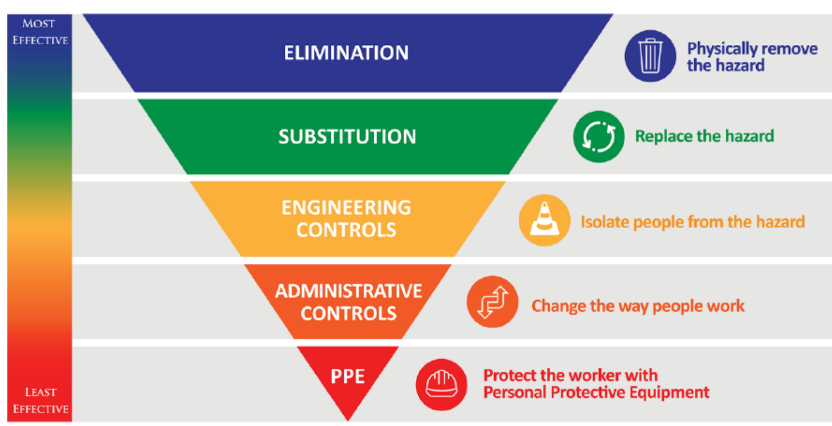
Hazardous chemicals require a carefully considered, multi-tiered approach to ensure safety. There are four primary routes of exposure for chemicals which have associated health hazards: inhalation, absorption, ingestion, and injection. Of these, the most likely routes of exposure in the laboratory are by inhalation or skin absorption. Many hazardous chemicals may affect people through more than one of these exposure modes, so it is critical that protective measures are in place for each of these exposure routes.



Safety Controls

Safety Controls are divided into five main classifications:

1. Elimination (most effective)
2. Substitution
3. Engineering Controls
4. Administrative Controls
5. Personal Protective Equipment (least effective)



Elements of these five classes are used in a layered approach to create a safe working environment.

Elimination/Substitution of Hazards

When planning research or educational laboratory activities, consider the hazards of the chemicals. Elimination and substitution are the most effective methods for mitigating hazards. Elimination is the most effective, however where elimination is not possible, substitution to a less hazardous material is the next most effective method. For instance, replacing mercury thermometers with alcohol thermometers or replacing hexane with heptane are great substitution measures. In addition, limit the quantity of chemicals used when possible- small scale or pilot experiments are preferred.

Lab Managers must employ procurement controls by making chemical purchasing decisions that enhance workplace safety. For example, labs shall:

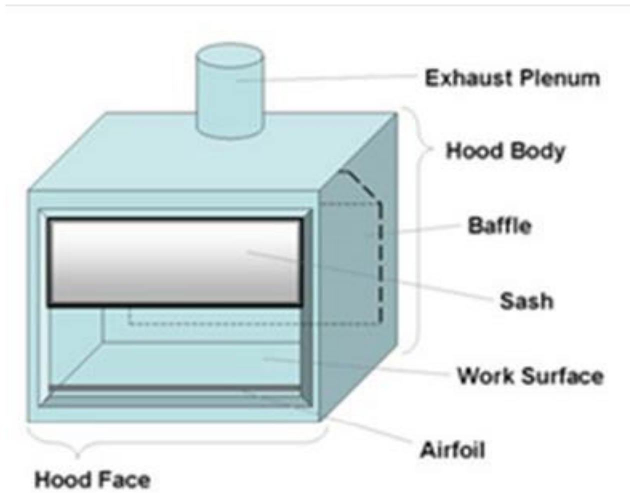
- Order ONLY needed amounts- order an amount that will be used in the foreseeable future and avoid ordering larger quantities merely for the bulk discount! Having a larger amount on hand increases the risk to health, the environment, or property in the event of an incident.
- Order a less hazardous form of the same chemical- work with the instructor/PI to help chose the least hazardous form that will work for the needed application.
    - Dilute solutions are generally safer than more concentrated solutions.
    - Aqueous solutions are generally safer to handle than powders requiring reconstitution.
    - Pellets, tablets, granules, or flakes are generally safer to handle than powders.
- Purchase the chemical in a safer container- order chemicals in shatter resistant containers or other containers that enhance workplace safety.
- Check existing inventory before ordering. Maintain up to date inventory in Quartzy. Determine the max usage in a term and keep only that on hand, even if it means several researchers or departments are all using from the same container (divide). Work together to eliminate excess inventory.

Engineering Controls

Devices or systems which remove the hazard from the workplace or place physical barriers between the staff member and the hazard, known as engineering controls, will be employed to minimize or eliminate potential hazards in all labs. These may include fume hoods, biological safety cabinets, glove boxes, shields, increased ventilation, etc. Laboratories have proper ventilation in place to prevent the spreading of fumes and contaminating agents from the laboratory to outside areas when doors are closed. Doors should not be routinely propped open to “air out” the lab. This defeats the purpose of this engineering control.

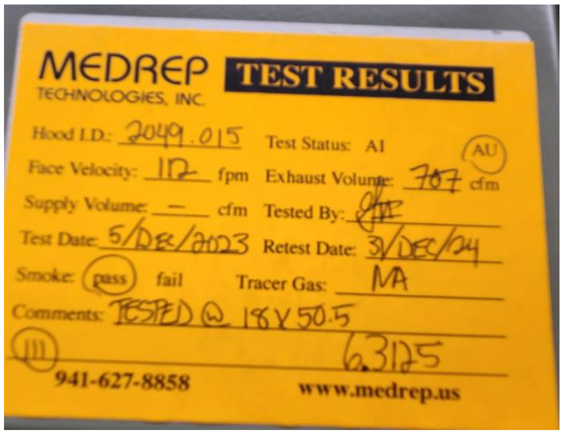
Chemical Fume Hoods

Fume hoods are the most commonly used local exhaust system on campus. Other methods include vented enclosures for large pieces of equipment or chemical storage, and portable exhaust systems for capturing contaminants near the point of release. Some systems are equipped with air cleaning devices (HEPA filters or carbon absorbers). Exhaust from fume hoods are designed to terminate at least ten feet above the roof deck or two feet above the top of any parapet wall, whichever is higher. The figure below illustrates the common parts of a fume hood.



It is advisable to use a laboratory hood when working with hazardous substances. In addition, a laboratory fume hood or other suitable containment device must be used for all work with "particularly hazardous substances." A properly operating and correctly used laboratory fume hood can reduce or eliminate volatile liquids, dusts and mists. Follows is an image of one of the fume hoods in H 212 on the Lee Campus.

Fume hoods are evaluated for operation and certified by MedRep inc. on an annual basis. Certification is coordinated through Lab Managers that contract with MedRep, schedule service if needed, and handle payments. These annual evaluations check the fume hood air flow velocity to ensure that the unit will contain hazardous vapors. Data on annual fume hood monitoring will be maintained by SPAS. A complete report of fume hood monitoring data must be kept for one year; summary data must be maintained for 5 years. Typical certification sticker can be found on the face of the hood above the sash usually near the controller.



Each fume hood should have a current calibration sticker and a marker indicating the highest sash height to be used when working with hazardous materials. Medrep certifies this height and in some circumstances may lower the recommended sash height based on conditions at testing. (typical working height is ~18 inches from the base of the fume hood). Always keep the sash at this established mark posted on the hood or lower when working with chemicals.

Air flow for fume hood ventilation is measured at nine points. The average of the nine readings must be at least 100 linear feet per minute (fpm) with a minimum of 70 fpm for any measurement. The average face velocity should not exceed 160 fpm.

Each fume hood must be equipped with at least one type of continuous quantitative monitoring device designed to provide the user with current information on the operational status of the hood.

When hazardous materials are in a fume hood, but it is not under active use (e.g., during an unattended reaction or experiment), the sash should be closed. NEVER store hazardous materials in a fume hood. Some particularly hazardous chemicals or corrosive substances will corrode the fume hood and the duct work (e.g., acid).

It is the responsibility of the lab manager to conduct routine maintenance either by contacting facilities or contracting with a 3rd party.

General Rules for Fume Hood Use

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

1. Fume hoods must not be used for work involving hazardous substances unless they have a certification label that confirms certification has occurred within the past year.
2. Always keep hazardous chemicals more than 6 inches behind the plane of the sash.
3. Never put your head inside an operating laboratory 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 that can block air circulation. Keep it clean and clear. Only materials actively in use should be in the hood.
6. Do not make any modifications to hoods, duct work, or the exhaust system. If there is a problem with your hood, contact facilities.
7. Do not use large equipment in laboratory hoods unless the hood is dedicated for this purpose, as large obstructions can change the airflow patterns and render the hood unsafe.
8. Shut your sash! For energy efficiency, make sure to shut your sash when the hood is not in use.

Laboratory fume hoods are one of the most important pieces of equipment used to protect laboratory and other workers from exposure to hazardous chemicals. Chemical fume hoods should be inspected upon installation, renovation, when a deficiency is reported, or a change has been made to the operating characteristics of the hood, contact a lab manager to schedule an inspection. Periodically, the lab manager will be checking for:

- Improper storage of materials inside the fume hood
- Use of proper materials
- General hood cleanliness
- Physical damages to the fume hood such as broken sash
- Fully functioning lighting, fume hood indicator, airflow monitor, and alarm, etc.

Biological Safety Cabinets

Biological safety cabinet (BSC) is required for safe manipulation of moderate and high-risk infectious agents such as Biosafety Level 2 (BSL 2) agents. BSCs protect laboratory workers and the immediate environment from infectious aerosols generated within the cabinet.

Laminar Flow Hoods

A laminar flow clean bench, as shown below, is an enclosed bench designed to prevent contamination of media, samples, or any particle sensitive device. Air is drawn through a filter on the top of the unit and blown in a very smooth, laminar flow towards the user. Therefore, it is critical that absolutely no hazardous chemicals, infectious and/or radioactive materials ever be used in a laminar flow clean bench, as the vapors are blown directly towards the user. Applications that involve the use of chemicals should be conducted in chemical fume hoods.

Safety Showers and Eyewash Stations

All laboratories using hazardous chemicals must have immediate access to safety showers and eye wash stations. Safety showers must have a minimum clearance of 24 inches from the centerline of the spray pattern in all directions at all times. Identify the safety station with a highly visible sign and maintain an unobstructed path to it. All lab personnel must be aware of the location and know how to properly use the safety shower and eyewash stations.

If lab personnel are exposed to a hazardous chemical, they should dial 911 (or someone else in the lab that is not exposed should dial 911) and use the safety shower and/or eye wash unit for 15 minutes or until emergency response have personnel arrive and begin treatment. If an uninjured individual is present, this person should assist with the decontamination of the affected individual.

All eyewash stations must be flushed by laboratory personnel on a weekly basis to ensure proper working order. This will keep the system free of sediment and prevent bacterial growth from reducing performance. Inspect the system when flushing. Any deficiencies are repaired by Facilities maintenance staff. If the safety shower or eye wash unit becomes inoperable, notify Facilities immediately.

Fire Extinguishers

All fire extinguishers should be mounted on a wall in an area free of clutter. Each fire extinguisher on campus is inspected every month by Public Safety. All laboratory personnel should be familiar with the location, use, and classification of the extinguishers in their laboratory. In the hands of a trained person, portable fire extinguishers are great tools to protect people and property from fire during early stages. Ensure that the fire extinguisher being used is appropriate for the type of material on fire before attempting to extinguish any fire. The table which follows illustrates the fire classification system, which should be used to determine the most suitable fire extinguisher for a particular area.

Classification	Fire type
Class A	Ordinary combustibles- wood, paper, cloth, rubber, and many plastics
Class B	Flammable liquids, combustible liquids, greases, tars, oils, solvents, alcohols and flammable gases.
Class C	Electrical equipment
Class D	Combustible metals, such as magnesium, titanium, zirconium, sodium, lithium, and potassium
Class K	Cooking appliances that involve combustible cooking media (oils and fats)

Laboratory personnel are not required to extinguish fires that occur in their work areas and should not attempt to do so unless:

- It is a small, contained fire that can be quickly and safely extinguished (e.g., small trash can sized fire);
- Appropriate training has been received and the individual feels the fire can be safely extinguished; and
- It is necessary to extinguish a fire in order to safely exit an area (e.g., fire is blocking an exit).

If a fire occurs in the laboratory and is extinguished by lab personnel, FSW Public Safety must still be contacted immediately by dialing 911. It is common for fires to reignite so it is critical that the Fire Department still be contacted.

Fire Blankets

Most labs and lab prep areas have fire blankets installed on the walls near the fire extinguisher and/or the eye wash and shower. The fire blanket consists of a piece of fire- resistant fabric (usually woven glass fiber). It cuts off the supply of oxygen smothering completely or reducing the size of a fire. Due to it simplicity, a fire blanket may be more helpful for personnel who are inexperienced with fire extinguishers. These are the steps of what should be done if there is a small fire:

1. Pull down sharply on the tab of the package on the wall to release the fire blanket
2. Hold it in front of you, with the fabric rolled back at the edges to protect your hands
3. Place (do not throw or fan) fire blanket over the fire, keeping hands and face protected behind it
4. Turn off any supplied heat source, ad leave the blanket over the fire area for at least 15 minutes or until the heat has dissipated.

✔
Dos

- Wait until a fire blanket is room temperature to the touch before disposing of it
- Just to be safe, it might not be a bad idea to douse the fire blanket in water before disposal
- Replace a fire blanket as soon as possible

✖
Don'ts

- Fire Blanket is not to be used on live electrical equipment especially where high voltage is involved
- Never reuse a fire blanket if it's already been used. They should be disposed of and replaced.

Flammable Storage Area

Chemicals with a flash point below 93.3 °C (200 °F) should be considered fire hazard chemicals and must be stored in a proper flammable storage cabinet. Flammable chemicals are ones with flash point below 37.8 °C (100 °F) and chemicals with flash point between 100 °F – 200 °F are defined as combustible. No more than 10 gallons of flammable chemicals may be outside and approved flammable storage cabinet for any length of time. No more than 60 gallons of flammable liquids, nor more than 120 gallons of combustible liquids may be stored in a flammable storage cabinet. For certain flammable chemicals that need refrigeration, the refrigerator used must be approved for flammable storage.

Secondary Containment of Corrosives

Secondary containment must be provided for corrosive and reactive materials and is strongly recommended for all other hazardous chemicals. Secondary containment should be made of chemically resistant materials and should be sufficient to hold 100% of the largest container's volume or 10% of the aggregate volumes of all containers whichever is greater.

Spill Kits

Spill kits are located in every laboratory for specific hazards of the chemicals used in the laboratory. Amorphous silica spill absorbents may be used for all types of spills, except hydrofluoric acid spills. Hydrofluoric acid can be neutralized with sodium bicarbonate or use clay absorbent.

Administrative Controls

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

Each laboratory has safety procedures, which include safety practices, for any work that involves hazardous materials. These safety procedures should be laboratory specific and communicated via lab specific trainings, Standard Operating Procedures, or Job Safety Analyses and properly documented. Administrative controls include but are not limited to the following:

- Ensuring that employees are provided adequate documented training for safe work with hazardous materials
- Careful planning of experiments and procedures with safety in mind; planning includes the development of written SOPs and hazard assessments for safe performance of the work
- Discussing safety on a regular basis (e.g., during lab meetings) and creating an atmosphere where people feel comfortable talking about safety
- Restricting access to areas where hazardous materials are used
- Using safety signs or placards to identify hazardous areas (designated areas)
- Labeling all chemicals
- Substitution of toxic materials with less toxic materials, when possible
- Good housekeeping and good personal hygiene such as routine hand washing and regular decontamination of areas that are possibly chemically contaminated such as bench-tops

and fume hoods

- Prohibiting eating and drinking where chemicals are used or stored

Developing Standard Operating Procedures (SOPs)

SOPs are written instructions that detail the steps that will be performed during a given procedure and include information about potential hazards and how these hazards will be mitigated. SOPs must be prepared by laboratory personnel who are the most knowledgeable and involved with the experimental process. However, the Laboratory Manager is ultimately responsible for approving SOPs regardless of who prepares them. The OSHA Lab Standard requires SOPs to be developed for all hazardous tasks that are performed in the lab. This would include work with hazardous chemicals (e.g., flammable liquids, compressed gases, etc.) and also work with hazardous equipment/operations (e.g., solvent distillation, hydrogenation, centrifuge, etc.). An individual SOP is not required for every hazardous task performed or chemical used in the lab; SOPs can be written in a comprehensive manner that encompasses many similar hazards. For example, if a procedure in the lab requires the use of acetone and ethyl acetate, both of which are flammable liquids, one SOP on flammable liquids can be created rather than a separate SOP for both acetone and ethyl acetate.

Personal Protective Equipment (PPE)

Personal protective equipment (PPE) should be used to supplement engineering controls. However, PPE should never be used as a substitute for engineering controls when engineering controls are required. PPE must be worn at all times in the laboratory when handling hazardous chemicals. Employees will be trained in properly using PPE (see Appendix C). Proper PPE selection can be determined in the following ways:

- Ask the Laboratory Supervisor about proper PPE selection.
- Review the SOP and associated hazard assessment for the task to be performed.
- Review Section 8, "Exposure Controls/Personal Protection" of the SDS for the chemical(s) being used. This will provide basic information on the PPE recommended for use with the particular chemical. The SDS addresses "worst case" conditions; therefore, all the equipment described may not always be necessary for a specific task. In addition, the SDS may not provide sufficient information concerning a specific respirator or type of glove appropriate for the chemical.

PPE serves as an employee's last line of defense against chemical exposures and is required by everyone entering a laboratory containing hazardous chemicals. Minimum requirements for PPE use for chemical operations include but are not limited to:

- Full length pants and closed-toed shoes or equivalent. Confine any loose clothing and long hair. Loose and jewelry that dangles below the neckline should be confined.
- Protective gloves, lab coats, and eye protection should be worn when suggested by section 8 in the SDS for the chemical being used.
- Avoid the use of contact lenses in the laboratory unless necessary. If they are used,

inform the lab manager so special precautions can be taken. If researchers do wear contact lenses they should be aware that fumes from concentrated acids and solvents can cause eye irritation and damage to lenses. If eye irritation does occur immediately remove contact lenses and rinse eyes with clean water.

- Use any other protective and emergency equipment as appropriate. Be aware of the locations of first aid kits, showers and eyewashes.
- While working with UV lamp or UV-transilluminator, a UV blocking goggles should be used to prevent damage to the eyes.
- Do NOT wear gloves when touching common surfaces such as cellphones, computers, and door knobs.
- Do NOT wear gloves outside of the lab (or wear on only one hand). When transporting hazardous materials between the labs, use secondary containers that can be carried without gloves.
- Do NOT wear lab coats outside of the laboratory except when transporting hazardous materials from one place to another.
- Do NOT launder lab coats with other clothing.
- Change gloves often
- Never touch your gloves to any surface that should not be contaminated (e.g., your face, your phone, your computer). Always remove your gloves before touching a surface that should not be contaminated.
- Keep your lab coat buttoned when working in the laboratory;
- Remove your laboratory coat when leaving the laboratory and wash your hands with soap and water. Laboratory coats should never be worn outside of the laboratory and never within the clean areas in the laboratory;
- Never wear or store your laboratory coat in a non-laboratory area, or a clean-area in the laboratory. Never sit at your desk in a clean-area with your laboratory coat on.

The primary goal of basic PPE is to mitigate, at a minimum, the hazard associated with exposure to hazardous substances. In some cases, additional, or more protective, equipment must be used.

Eye and Face Protection

Each affected employee must use appropriate eye and face protection equipment when exposed to hazards from chemical splash, flying debris, or other exposures that may occur in the laboratory.

- If a project involves a chemical splash hazard, chemical goggles are required; face shields may also be required when working with chemicals that may cause immediate skin damage (safety glasses must be worn under a face shield).
- Safety goggles differ from safety glasses in that they form a seal with the face, which completely isolates the eyes from the hazard. If a significant splash hazard exists, heavy gloves, protective aprons and sleeves may also be needed.
- All eye protection equipment must be American National Standards Institute (ANSI) approved and appropriate for the work being done.

- Eye and face protection may not be required in the lab if the employee is sitting at a workstation or desk that is away from chemical processes (e.g., working at a desktop computer, having a lab meeting at a table not adjacent to hazardous operations).

Hand Protection

Each affected employee must wear appropriate hand protection when the hands may be exposed to skin contact of hazardous chemicals, cuts, abrasions, punctures, or harmful temperature extremes. Chemical-resistant gloves must be worn while handling any hazardous chemical container; regardless of whether the container is open or closed (it should be assumed that all chemical containers are contaminated). Gloves should only be used under the specific condition for which they are designed, as no glove is impervious to all chemicals. Always consult the SDS and manufacturer's glove permeation chart (see example on next sheet). It is also important to note that gloves degrade over time, so they should be replaced frequently to ensure adequate protection and inspected for discoloration, cracks, stiffening, swelling, or softening of the gloves. Never reuse disposable gloves and never touch your gloves to any surface that should not be contaminated (e.g., your phone, your skin, non-laboratory work surfaces).

8th EDITION Permeation/Degradation Resistance Guide for Ansell Gloves

The first square in each column for each glove type is color coded to provide an overall rating for both Degradation and Permeation. The letter in each colored square is for Degradation alone.

GREEN: The glove is very well suited for application with that chemical.

YELLOW: The glove is suitable for that application under careful control of its use.

RED: Avoid use of the glove with this chemical.

SPECIAL NOTE: The chemicals in this guide highlighted in BLUE are experimental carcinogens, according to the ninth edition of Sax' *Dangerous Properties of Industrial Materials*. Chemicals highlighted in GRAY are listed as suspected carcinogens, experimental carcinogens at extremely high dosages, and other materials which pose a lesser risk of cancer.

	LAMINATE FILM BARRIER™			NITRILE SOL-VEX®			UNSUPPORTED NEOPRENE 29-SERIES			SUPPORTED POLYVINYL ALCOHOL PVA™			POLYVINYL CHLORIDE (Vinyl) SNORKEL®			NATURAL RUBBER *CANNERS AND HANDLERS™			NEOPRENE/ NATURAL RUBBER BLEND *CHEMI-PRO®			BUTYL UNSUPPORTED CHEMTEK™ BUTYL			VITON/BUTYL UNSUPPORTED CHEMTEK™ VITON/BUTYL		
CHEMICAL	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate
1. Acetaldehyde	■	380	E	P	—	—	E	10	F	NR	—	—	NR	—	—	E	13	F	E	10	F	—	—	—	—	—	—
2. Acetic Acid, Glacial, 99.7%	■	150	—	G	158	—	E	390	—	NR	—	—	F	45	G	E	110	—	E	263	—	E	>480	—	DD	>480	—
3. Acetone	▲	>480	E	NR	—	—	G	10	F	P	143	G	NR	<5	—	E	10	F	G	12	G	E	>480	E	DD	93	VG
4. Acetonitrile	▲	>480	E	F	30	F	E	20	VG	■	150	G	NR	—	—	E	4	VG	E	13	VG	E	>480	E	DD	70	E
5. Acrylic Acid	—	—	—	G	120	—	E	305	—	NR	—	—	NR	—	—	E	80	—	E	67	—	—	—	—	—	—	—
6. Acrylonitrile	▲	>480	E	—	—	—	—	—	—	▲	>480	—	—	—	—	E	5	F	—	—	—	E	>480	—	E	>480	—
7. Allyl Alcohol	▲	>480	E	F	140	F	E	140	VG	P	—	—	P	60	G	E	10	VG	E	20	VG	E	>480	—	E	>180	—
8. Ammonia Gas	■	19	E	▲	>480	E	▲	>480	—	—	—	—	—	—	—	—	—	—	■	27	E	—	—	—	—	—	—
9. Ammonium Fluoride, 40%	▲	>480	E	E	>360	—	E	>480	—	NR	—	—	E	>360	—	E	>360	—	E	>360	—	—	—	—	—	—	—
10. Ammonium Hydroxide, Conc. (28-30% Ammonia)	E	30	—	E	>360	—	E	250	—	NR	—	—	E	240	—	E	90	—	E	247	—	E	>480	—	E	>480	—
11. n-Amyl Acetate	▲	470	E	E	198	G	NR	—	—	G	>360	E	P	—	—	NR	—	—	P	—	—	E	128	G	F	<10	F
12. Amyl Alcohol	▲	>480	E	E	>480	E	E	348	VG	G	180	G	G	12	E	E	25	VG	E	52	VG	E	>480	E	E	>480	E
13. Aniline	▲	>480	E	NR	—	—	E	145	F	F	>360	E	F	62	G	E	25	VG	E	82	G	E	>480	E	E	>480	E
14. Aqua Regia	—	—	—	F	>360	—	G	>480	—	NR	—	—	G	120	—	NR	—	—	G	193	—	E	>480	—	E	>480	—
15. Benzaldehyde	▲	>480	E	NR	—	—	NR	—	—	G	>360	E	NR	—	—	G	10	VG	G	27	F	E	>480	E	E	100	E
16. Benzene (Benzol)	▲	>480	E	P	—	—	NR	—	—	E	>360	E	NR	—	—	NR	—	—	NR	—	—	E	20	F	E	253	VG
17. Benzotrichloride	▲	>480	E	E	>480	E	NR	—	—	—	—	—	G	—	—	NR	—	—	NR	—	—	—	—	—	—	—	—
18. Benzotrifluoride	▲	>480	E	E	170	G	—	—	—	—	—	—	G	<10	F	P	50	G	P	—	—	—	—	—	—	—	—
19. Bromine Water	—	—	—	E	>480	E	E	>480	E	NR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20. 1-Bromopropane (Propyl Bromide)	▲	>480	E	▼	23	F	▼	<10	P	▲	>480	E	▼	<10	F	▼	<10	P	▼	<10	P	▼	10	P	■	182	VG
21. 2-Bromopropionic Acid	▲	>480	—	F	120	—	E	460	—	—	—	—	G	180	—	E	190	—	G	190	—	—	—	—	—	—	—
22. n-Butyl Acetate	▲	>480	E	F	75	F	NR	—	—	G	>360	E	NR	—	—	NR	—	—	P	—	—	E	80	G	DD	<10	F
23. n-Butyl Alcohol	▲	>480	E	E	>360	E	E	270	E	F	75	G	G	180	VG	E	35	VG	E	75	VG	E	>480	E	E	>480	E
24. Butyl Carbitol	—	—	—	E	>323	E	G	188	F	E	>480	E	E	397	VG	E	44	G	E	148	G	—	—	—	—	—	—
25. Butyl Cellosolve	▲	>480	E	E	470	VG	E	180	G	■	120	G	P	60	G	E	45	G	E	48	G	E	>480	—	E	>480	—
26. gamma-Butyrolactone	▲	>480	E	NR	—	—	E	245	G	E	120	VG	NR	—	—	E	60	G	E	104	F	E	>480	E	E	>480	E
27. Carbon Disulfide	▲	>480	E	G	30	F	NR	—	—	E	>360	E	NR	<5	—	NR	—	—	NR	—	—	▼	7	G	■	138	E
28. Carbon Tetrachloride	—	—	—	G	150	G	NR	—	—	E	>360	E	F	25	F	NR	—	—	NR	—	—	F	53	P	—	—	—
29. Cellosolve® (Ethyl Glycol Ether, 2-Ethoxyethanol)	E	>480	E	G	293	G	E	128	G	■	75	G	P	38	G	E	25	VG	E	25	VG	E	>480	E	E	465	E
30. Cellosolve Acetate® (2-Ethoxyethyl Acetate, EGEAA)	▲	>480	E	F	90	G	G	40	F	■	>360	E	NR	—	—	E	10	G	E	23	G	E	>480	E	DD	105	VG

[Fisher Scientific Permeation and Degradation Data, Ansell Chemical Resistant gloves]

DO NOT Purchase gloves from a manufacturer that does not provide and adequate gloved degradation chart. It is recommended that each lab purchase a general-purpose disposable nitrile glove (nitrile gloves are typically more versatile and provide resistance to a wider range of chemicals than latex do) with a minimum of a 4 mil thickness that is suitable for general chemical handling. When handling chemicals or equipment with harmful temperature extremes such as liquid nitrogen or autoclaves, appropriate protection such as cryogenic gloves or heat-resistant gloves or mitts must be worn.

The volume of hazardous chemical being handled should be considered as well. For example, if working with a small volume of a sodium hydroxide solution, disposable chemical-resistant gloves provide adequate protection. But if working with a large volume of sodium hydroxide as with a base bath for instance, a more-durable and thick glove such as a butyl rubber should be selected to provide adequate protection.

Chemical-resistant gloves must not be worn outside of the laboratory (e.g., hallways, elevators, offices) to avoid contamination of public areas. Gloves should also be removed prior to handling any equipment that could likely result in cross-contamination (e.g., water fountains, phones, computer work stations). Disposable gloves must never be reused!

Body Protection

A garment and fully enclosed shoes covering all skin beneath the waist must be worn at all times by all individuals that are occupying the laboratory area; shorts are not permitted. Lab coats, coveralls, aprons, or protective suits are required to be worn while working on, in the vicinity of, or adjacent to, all procedures using hazardous chemicals (using means that the hazardous chemical bottle is open and the chemical is being poured, transferred, pipetted, etc.). Lab coats must be appropriately sized for the individual and be fastened (snap buttons are recommended) to their full length. Lab coat sleeves must be of a sufficient length to prevent skin exposure while wearing gloves. Flame resistant lab coats must be worn when using any quantity of pyrophoric materials or more than 1 liter of flammable liquids. It is also recommended that 100% cotton (or other non-synthetic material) clothing be worn underneath the flame-resistant lab coat to minimize injury in the case of a fire emergency.

Lab coats should not be worn outside of the lab unless the individual is traveling directly to an adjacent lab work area. Lab coats should not be worn in common areas such as break rooms, offices, or restrooms. Each department is responsible for providing laundry services as needed to maintain the hygiene of laboratory coats. They may not be cleaned by staff members at private residences or public laundry facilities. Alternatives to laundering lab coats include routinely purchasing new lab coats for employees to replace contaminated lab coats, hiring a professional garment laundering service, or using disposable lab coats.

Foot Protection

To protect against spills or dropped chemicals, fully enclosed shoes must be worn at all times when in the laboratory; open toe (toe, top, or heel) shoes and/or sandals are not permitted in any circumstance. Each affected employee must wear protective footwear when working in areas where there is a high-risk of objects falling on or rolling across the foot, piercing the sole, and where the feet are exposed to electrical or chemical hazards. If there is a high risk of chemical contamination to the foot (e.g., cleaning up a chemical spill on the floor), then chemical-resistant booties may need to worn as well.

How to Use and Maintain PPE

Personal protective equipment should be kept clean and stored in an area where it will not become contaminated. Personal protective equipment should be inspected prior to use to ensure it is in good condition. It should fit properly and be worn properly. If it becomes contaminated or damaged, it should be cleaned or repaired when possible, or discarded and replaced. Lab coats and gloves should never be worn outside of the lab area.

Contaminated Clothing/PPE

In cases where spills or splashes of hazardous chemicals on clothing or PPE occur, the clothing/PPE should immediately be removed and placed in a closed container that prevents release of the chemical. Heavily contaminated clothing/PPE resulting from an accidental spill and PPE contaminated with particularly hazardous substances should be disposed of as hazardous waste. Non-heavily contaminated laboratory coats should be cleaned and properly laundered, as appropriate. Laboratory personnel should never take contaminated items home for cleaning or laundering. Persons or companies hired to clean contaminated items must be informed of potentially harmful effects of exposure to hazardous chemicals and must be provided with information to protect themselves.

Handling of Hazardous Materials

By OSHA's definition, a hazardous material is anything that presents a physical hazard or health hazard. The examples that pose physical hazards are combustible and flammable materials, oxidizers, pyrophoric materials, compressed gases, and operating certain equipment. Health hazards include carcinogens, toxic agents, irritant or corrosive chemicals, and certain biological agents that can cause diseases.

Handling chemicals must be done only by trained personnel. SDS and label information should be read before using a chemical for the first time. It must be ensured that proper engineering controls and PPE are in place for handling of any hazardous chemicals.

Chemical Procurement

- It is the responsibility of the PI/laboratory Manager to know Information on proper handling, storage, and disposal prior to purchasing the chemical.
- Proper protective equipment and handling and storage procedures should be in place before receiving a shipment.
- Only the minimum amount of the chemical needed to perform the planned work should be ordered.
- Only containers with adequate labels should be accepted.
- Chemical shipments should be dated upon receipt.

Chemical Handling

- Use the smallest amount of chemical needed for the experiment. Only use the amount of chemical that is appropriate for the available ventilation system.
- Any apparatus that may contain or discharge toxic chemicals (pumps, distillation systems, solvent traps) must exhaust into local exhaust systems (e.g., fume hood) not into the laboratory.
- Properly label and store all chemicals. Always read all labels and warning signs.
- Use secondary containment at all times.
- Deposit chemical waste in appropriately labeled receptacles and follow all other waste disposal procedures of the Chemical Hygiene Plan.
- Do not allow release of toxic substances or fumes into rooms that re-circulate the atmosphere (e.g., cold or warm rooms).
- Do not smell or taste chemicals.
- Never use mouth suction for pipetting or starting a siphon.
- Do not dispose of any hazardous chemicals through the sewer system. These substances might interfere with the biological activity of wastewater treatment plants, create fire or explosion hazards, cause structural damage or obstruct flow.
- Be prepared for an accident or spill and refer to the emergency response procedures for the specific material. Procedures should be readily available to all personnel. Information on minor chemical spill mitigation may also be referenced in Appendix I Spill Clean-up Procedures.

- For general guidance, the following situations should be addressed:

    - Eye Contact: Promptly flush eyes with water for a prolonged period (15 minutes) and seek medical attention
    - Skin Contact: Promptly flush the affected area with soap and water (15 minutes) and remove any contaminated clothing. If symptoms persist after washing, seek medical attention

General Chemical Storage

- Chemicals should be stored according to the hazard category and compatibility.
- SDS and information on label should be followed for storage requirements.
- Maintain the existing labels on every container. If it was defaced, it must be replaced immediately with a new label containing chemical identification and appropriate hazard warnings.
- Peroxide formers should be dated upon receipt, again dated upon opening, and stored away from heat and light with tightfitting, nonmetal lids.
- Oxidizers, reducing agents, and fuels should be stored separately to prevent contact.
- Chemicals should not be stored in the chemical hood, on the floor, in areas of egress, on the benchtop, or in areas near heat or in direct sunlight.

- Store acids in a dedicated acid cabinet. Nitric acid may be stored there also BUT only if it is kept isolated from all other acids (such as in a containment box).
- Laboratory-grade, flammable-rated refrigerators and freezers should be used to store sealed chemical containers of flammable liquids that require cool storage. Do not store food or beverages in the laboratory refrigerator.
- Highly hazardous chemicals should be stored in a well-ventilated and secure area designated for that purpose.
- Flammable chemicals should be stored in a spark-free environment and in approved flammable-liquid containers and storage cabinets.
- Chemical storage and handling rooms should be controlled-access areas. They should have proper ventilation, appropriate signage, diked floors, and fire suppression systems.

Chemical Segregation

All chemicals must be stored according to chemical compatibility. Once segregated by chemical compatibility, they can then be stored alphabetically. Information regarding chemical compatibility can be found in the SDS, primarily in Section 7, "Handling and Storage" and Section 10, "Stability and Reactivity". If unsure of proper segregation procedures, contact the Laboratory manager or PI for assistance. Chemical segregation can be achieved by either isolation (e.g., organic solvents stored in a flammable cabinet), physical distance (e.g., acids and bases are stored on opposite sides of a chemical storage room), or secondary containment (e.g., placing oxidizing acids such as nitric acid into a secondary containment to segregate from organic acids such as formic acid). In the most general terms, proper segregation can be achieved by:

- Storing acids away from bases and toxics;
- Storing oxidizers away from organic chemicals; and
- Storing reactive and acutely toxic materials away from all other chemicals

The following table illustrates a more detailed chemical compatibility logic that can be used for chemical storage. Hazard classes marked by an X need to be segregated from each other (e.g., Acid, inorganic must be segregated from Base, inorganic).

Compatibility chart for chemical storage

	Acid, Inorganic	Acid, organic	Acid, oxidizer	Base, inorganic	Base, organic	Oxidizer	Toxic, Inorganic	Toxic, organic	Reactive	Organic Solvent
Acid, Inorganic				X	X		X	X	X	
Acid, organic				X	X	X	X	X	X	
Acid, oxidizer		X		X	X		X	X	X	X
Base, inorganic	X	X	X						X	
Base, organic	X	X	X			X			X	
Oxidizer		X			X			X	X	X
Toxic, Inorganic	X	X	X						X	
Toxic, organic	X	X	X			X			X	
Reactive	X	X	X	X	X	X	X	X		X
Organic Solvent			X			X			X	

Equipment Storage and Handling

- Use equipment only for its intended/designed purpose.
- Store laboratory glassware with care to avoid damage. Use extra care with Dewar flasks and other evacuated glass apparatuses. Evacuated glass apparatuses including Dewar flasks should be shielded or wrapped to contain chemicals and fragments should implosion occur. This type of wrapping can include a plastic casing or a strong layer of tape.
- Use certified fume hoods, or other ventilation devices for operations which might result in release of toxic chemical vapors or dust. Preventing the escape of these types of materials into the working atmosphere is one of the best ways to prevent exposure.
- Balances for these materials should also be in a certified fume hood, glove boxes, or other ventilation device.
- Keep hood sash closed when you are not working in the hood.
- Do not use damaged glassware or other equipment.
- Do not use uncertified fume hoods or glove boxes for hazardous chemical handling.
- Avoid storing materials in hoods.

- Do not allow the vents or air flow to be blocked.
- All electrical equipment should be grounded and kept in good condition

Transporting Chemicals Between Labs or Buildings

- Chemicals must be transported between stockrooms and laboratories in break-resistant, secondary containers such as commercially available bottle carriers made of rubber, metal, or plastic, which include carrying handle(s) and which are large enough to hold the contents of the chemical container in the event of breakage.
- In the case of big quantities or more than one chemical being transported the appropriate cart with build-in secondary containment should be utilized and high traffic areas need to be avoided.
- Never use a secondary container that will react with or is incompatible with the chemical that is being transported.
- Do not attempt to move large volumes or greater than 5 gallons of chemicals across campus by foot. If a large amount must be moved (such as an entire lab) do in multiple trips and adhere to segregation requirements.
- During the move of chemicals on campus via foot travel, PPE may not be needed or even appropriate (eg. employees should not where chemical resistant gloves in public areas). However appropriate PPE and spill containment equipment should be brought along in the event of a spill or accident.
- Laboratory carts used to transport chemicals from one area to another must be stable and in good working condition. Transport only the quantity that can be handled easily. Plan the route ahead of time to avoid busy areas, stairs, and steps.
- Preference should be given to freight elevators before passenger elevators. The employee transporting the chemicals should be the only person in the elevator and operates alone. Do not get on an elevator with someone transporting hazardous chemicals.

Flammable Liquids Storage

Flammable liquids include any liquid with a flash point no greater than 93^{O}C (200 ^{O}F). The following guidelines for storing flammable liquids must be followed in all science laboratories at FSW:

- Flammable and combustible liquids should be stored in flammable storage cabinets, as shown below, whenever possible. No more than 10 gallons of flammable liquid is permitted to be stored outside of a flammable storage cabinet unless it is stored in a flammable safety can equipped with a spring-loaded lid and an internal screen as shown in example below.

- Domestic refrigerators or freezers must never be used to store flammable liquids. Flammable liquids can only be stored in refrigerators or freezers that are designed for flammable materials (Note: most refrigerators and freezers are not intended for flammable storage).
- Flammable liquids must be stored in well-ventilated areas free from ignition sources.
- Some organic solvents (e.g., diethyl ether, tetrahydrofuran) have a shelf-life and can form organic peroxides over time while in storage. These “peroxide formers” must be dated when received from the chemical manufacturer and disposed of once expired. If any time-sensitive chemicals are found to be past the manufacturer’s expiration date, they must be submitted to REM for hazardous waste disposal immediately. See **Appendix D** for a list of commonly found organic solvents that potentially form organic peroxides.

Refrigerators and Freezers Chemical Storage

A number of general precautions need to be taken when storing chemicals in refrigerators and/or freezers in the laboratories on campus. When working with refrigerators or freezers, the following procedures should be followed:

- Domestic refrigerators or freezers must never be used to store flammable materials. Flammable materials may only be stored in refrigerators or freezers specifically designed to store such items. Most refrigerators on FSW campuses are not designed for storing flammables.
- Laboratory refrigerators or freezers must never be used to store food or drink for human consumption. Lab refrigerators and freezers should be labeled “No Food or Drink.”
- All chemicals in a refrigerator or freezer must be appropriately labeled.
- Ensure that all chemicals stored in a refrigerator or freezer adhere to the chemical segregation policy outlined in this document. Shelves should have suitable trays and compartments for secondary containment.
- All chemicals must be safely capped, sealed and secured. Never keep open beakers in a refrigerator.
- If a room temperature chemical is going into the refrigerator, loosely cap and and allow it to cool completely before completely sealing to reduce vacuum pressure on the storage vessel.
- Remember that power outages or tripping of circuits can cause internal temperatures to rise, which can impact chemical contents. Be aware of any unusual vapors or odors when opening the door.
- An inventory of the refrigerator should be posted on the refrigerator or freezer door.
- Refrigerators or freezers containing hazardous chemicals should be located at least 20 feet from exits.
- Refrigerators and freezers should be cleaned out regularly and manually defrosted on regular maintenance schedule or as necessary.

- When defrosting a refrigerator or freezer storing chemicals, care should be taken regarding handling the potentially contaminated water that comes off the unit.

Equipment, Glassware and Sharps Safety

Autoclave and Sterilizers

Steam sterilization is heating in an autoclave utilizing steam under a pressure of 15 psi to achieve a chamber temperature of at least 121 °C (250 °F) for a minimum of 15 minutes. Proper training must be obtained before operating autoclave. Users must be aware of the conditions for appropriate decontamination such as longer run time for large, dense loads. More information can be found in the Standard Operating Procedure developed specific to the autoclave on site.

Centrifuges

Without proper handling, centrifuges operate under high speed and high volume can pose dangerous threats. The problems may arise from unbalanced rotors and operator error. An operator must have knowledge of the manufacturer's recommended instructions and the hazards associated with the centrifuge.

Before Centrifugation:

- Centrifuges must be installed properly and operated only by trained employees.
- Centrifuges cannot be placed in hallways or main walkways. The must remain inside the laboratory.
- The PI/Laboratory Manager has the responsibility to train each operator on proper operational procedures and review the user manual.
- Use only rotors compatible with the unit. Check for an expiration date.
- Make sure the rotor, tubes, and spindle are dry and clean.
- Examine o-rings and replace if worn, cracked or missing.
- Never exceed ¾ full in any tube.
- Always cap tubes.
- Place the centrifuge in a fume hood or safety cabinet if aerosols are anticipated or suspected. Use centrifuge safety cups when dealing with infectious organisms.
- Be sure to balance the tubes against each other and within the rotor when loading the centrifuge. For example, when spinning only two tubes, place them on opposite sides of the rotor. Do not place them next to each other. Also, be sure the densities of the materials in the tubes are similar.
- Check that the rotor is seated on the drive correctly, close the lid and secure it.

During Centrifugation:

- Keep the lid closed at all times- never open a centrifuge until the rotor has completely stopped.
- Do not exceed safe and recommended rotor speed.
- The operator should not leave the centrifuge until full operating speed is attained and the machine appears to be running safely without vibration.
- Stop the centrifuge immediately if any unusual condition arises such as odd noises or vibration.

After Centrifugation:

- Allow the centrifuge to come to a complete stop before opening.
- Check inside the centrifuge for possible spills and leaks. Clean the centrifuge and rotor thoroughly if necessary.
- Wash hands after removing gloves.

Compressed Gases

Although the gas itself may not be flammable, reactive or toxic, compressed gases can be extremely dangerous due to the high pressure and potential explosion.

- Compressed gases must be handled by trained personnel only.
- Personnel must use appropriate PPE, including eye protection.
- Regulators must be used to safely reduce pressure using an appropriate pressure regulator, and must include two gauges indicating cylinder pressure and outlet pressure.
- Cylinders must always be stored in the upright position and secured from tipping over.

Cryogens and Dry Ice

Cryogenic use involves ultralow temperature liquid or solid of materials that are normally gases at room temperature. A few examples include liquid nitrogen, liquid helium, and dry ice. Even brief contact with small amounts of cryogenic material may result frostbite and destroy skin or eye tissue permanently. Cryogens will rapidly boil and get converted to a gas which will displace oxygen. Asphyxiation may occur when cryogenic materials are stored or handled without adequate ventilation.

- When using cryogens indoors, the room must be well ventilated. Oxygen monitor is suggested if more than a few liters of cryogenic materials is used or stored.
- Immediately evacuate the area if the oxygen reading indicates below 19.5% oxygen.
- Always wear protective gloves that are well insulated.
- Always wear safety glasses to protect your eyes.
- Wear loose, long sleeves and pants, and close-toed shoes.
- Remove watches and other jewelry on the hands and wrists before working on cryogens.
- Never make direct contact with cryogenic liquids or cryogenic pipes.
- Use containers that are made specifically for ultralow temperatures, such as Dewar flasks.

- Fill containers slowly to minimize thermal shock to the container, and do not overfill.
- Cover Dewar flasks when the liquid is not being transferred, but do not tightly plug, as warming cryogens will expand and increase the pressure inside the container, which could result in explosion.
- Keep the Dewar upright. Do not bump or drop.

Stirrers and Mixers

Stirring and mixing devices commonly found in laboratories include stirring motors, magnetic stirrers, shakers and vortexers. Only spark-free induction motors should be used in power stirring and mixing devices or any other rotating equipment used for laboratory operations. Because stirring and mixing devices, especially stirring motors and magnetic stirrers, are often operated for fairly long periods without constant attention, the consequences of stirrer failure, electrical overload or blockage of the motion of the stirring impeller should be considered.

Heating Devices

Laboratories commonly use heating devices such as ovens, hot plates, heating mantles, oil baths, salt baths, sand baths, air baths, hot-tube furnaces, hot-air guns, and microwave ovens. Steam heated devices are generally preferred whenever temperatures of 100 °C or less are required because they do not present shock or spark risks and can be left unattended with assurance that their temperature will never exceed 100 °C. Ensure the supply of water for steam generation is sufficient prior to leaving the reaction for any extended period of time.

A number of general precautions need to be taken when working with heating devices in the laboratory. When working with heating devices, consider the following:

- The actual heating element in any laboratory heating device should be enclosed in such a way as to prevent a laboratory worker or any metallic conductor from accidentally touching the wire carrying the electric current.
- If a heating device becomes so worn or damaged that its heating element is exposed, the device should be either discarded or repaired before it is used again.
- If the electrical cord becomes damaged to the point the wires are exposed, the cord must be replaced with the exact conductive rating and gauge as initially installed if possible.
- The external cases of all variable autotransformers have perforations for cooling by ventilation and, therefore, should be located where water and other chemicals cannot be spilled onto them and where they will not be exposed to flammable liquids or vapors.
- Fail-safe devices can prevent fires or explosions that may arise if the temperature of a reaction increases significantly because of a change in line voltage, the accidental loss of reaction solvent, or loss of cooling. Some devices will turn off the electric power if the temperature of the heating device exceeds some preset limit or if the flow of cooling water through a condenser is stopped owing to the loss of water pressure or loosening of the water supply hose to a condenser.

Distillation and Solvent Purification

The process of thermal solvent distillation is inherently dangerous. If not handled properly, fire, explosion, and/or personnel exposure can result. A few common chemicals distilled in laboratories include diethyl ether, toluene, benzene, and hexanes. The guidelines below should be followed while thermal distillation of organic solvents is conducted in the lab:

- The thermal solvent distillation system should be installed inside of a chemical fume hood if possible.
- Ensure that all heat generating equipment has a shutoff device installed.
- Ensure that all water connections on the condenser are clamped securely.
- Inspect all glassware for defects before setting them up in the experiment.
- Keep all air and water-sensitive drying agents under inert atmosphere. Make consistent efforts to not store or use other flammable or hazardous chemicals inside the fume hood where distillation is taking place.

Laboratory Glassware

Broken laboratory glassware is dangerous. Glassware-related injuries ranging from small cuts to multiple stitches and eye damage are common to lab workers. In order to reduce the risk of accidents, the following guidelines should be followed:

- Temperature changes can shatter any laboratory glassware. Never flash-cool glassware with cold water, especially after autoclaving or exposure to any high temperatures.
- Only round-bottomed or thick-walled (e.g., Pyrex) evacuated reaction vessels specifically designed for operations at reduced pressure should be used.
- Inspect glassware for any small imperfections before using. Sometimes a hairline crack may be present. Tap the glassware with a pen and listen to the tone to tell if there is a defect. A ringing tone indicates the glassware is fine, while a dull "thud" indicates there is a flaw present.
- Do not keep cracked glassware. If the bottom of a graduated cylinder is chipped or broken, properly dispose of it to reduce the risk of accidents.
- Always wear appropriate PPE when working with glassware and varying temperatures. Always wear safety glasses when working with glassware.

Laboratory Electrical Safety

Laboratory employees, Instructors, and PIs all will use portable electronic equipment from time to time. The following requirements apply to the sue of cord and plug connected equipment and flexible cord sets (extension cords):

- Extension cords may only be used to provide temporary power and must be used with Ground Fault Circuit Interrupter (GFCI) protection during maintenance and construction activities and in damp or wet locations.
- Portable cord and plug connected equipment and extension cords must be visually inspected before use for external defects such as loose parts, deformed and missing pins, or damage to outer jacket or insulation, and for possible internal damage such as

pinched or crushed outer jacket. Any defective cord or cord-and-plug-connected equipment must be removed from service and no person may use it until it is repaired and tested to ensure it is safe for use.

- Extension cords must be of the three-wire type. Extension cords and flexible cords must be designed for hard or extra hard usage. The rating or approval must be visible.
- Portable equipment must be handled in a manner that will not cause damage. Flexible electric cords connected to equipment may not be used for raising or lowering the equipment.
- Extension cords must be protected from damage. Sharp corners and projections must be avoided. Flexible cords may not be run through windows or doors unless protected from damage, and then only on a temporary basis. Flexible cords may not be run above ceilings or inside or through walls, ceilings or floors, and may not be fastened with staples or otherwise hung in such a fashion as to damage the outer jacket or insulation.
- Extension cords used with grounding type equipment must contain an equipment-grounding conductor; the cord must accept a three-prong, or grounded, plug. Operating equipment with extension cords without a grounding plug is prohibited.
- Attachment plugs and receptacles may not be connected or altered in any way that would interrupt the continuity of the equipment grounding conductor.
- Additionally, these devices may not be altered to allow the grounding pole to be inserted into current connector slots. Clipping the grounding prong from an electrical plug is prohibited.
- Flexible cords may only be plugged into grounded receptacles. Adapters that interrupt the continuity of the equipment grounding connection may not be used.
- All portable electric equipment and flexible cords used in highly conductive work locations, such as those with water or other conductive liquids, or in places where employees are likely to contact water or conductive liquids, must be approved for those locations.
- Employee's hands must be dry when plugging and unplugging flexible cords and cord and plug connected equipment if energized equipment is involved.
- If the connection could provide a conducting path to the employee's hands (e.g. if a cord connector is wet from being immersed in water), the energized plug and receptacle connections must be handled only with insulating protective equipment.
- Lamps for general illumination must be protected from breakage, and metal shell sockets must be grounded.
- Temporary lights must not be suspended by their cords unless they have been designed for this purpose.

Hazardous Waste Management

Hazardous chemical waste is defined as any unwanted or unusable chemical that exhibits any of four hazardous characteristics (ignitability, corrosivity, reactivity, and toxicity). These pose potential hazards to individuals, environment, or public health. Some examples include:

- Chemicals from laboratory experiments
- Opened surplus chemicals
- Expired chemicals
- Carcinogens and cytotoxic agents
- Prescription drugs and controlled substances
- Thermometers and other items containing mercury
- Spill clean-up materials, contaminated rags and absorbents
- Used oil – motor, vacuum pump, lubricating
- Used solvents
- Batteries
- Heavy metal containing waste or products (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver)

Wastes and other contaminated materials from experiments should be collected and disposed of regularly. Chemicals may be accumulated in a labeled and defined satellite accumulation area provided that the area meets the storage needs of the composition of the waste- for instance if waste is flammable it must be in a flammable cabinet.

- Each waste type should be stored in a compatible container in good condition pending transfer or disposal. Never store chemicals or solutions in homemade bottles such as peanut butter jars or soda bottles.
- Waste containers should be clearly labeled with words that describe the contents and the words "Hazardous Waste" and kept sealed when not in use. Incompatible waste types should be kept separate to ensure that heat generation, gas evolution, or another reaction does not occur.
- The waste storage volume should never exceed 55 gallons in the Satellite Accumulation Area per 40CFR 262.15 of the code of Federal Regulations.
- Waste containers should be stored in a designated location that does not interfere with normal laboratory operations.
- Ventilated storage and secondary containment may be appropriate for certain waste types.
- In order to prevent waste accumulation in the working areas, laboratory managers should collect the wastes from satellite accumulation areas regularly for appropriate disposal.

Identification

Wastes classes must be identified during the collection and separated based on their identity.

- Solid wastes must be kept separately from the solvent wastes and organic solvents wastes must be isolated from the aqueous wastes.
- When collecting organic solvents, separate halogenated wastes from non-halogenated wastes.
- Carcinogens such as ethidium bromide waste must be collected and appropriately labeled with warning sign.

Labeling

Waste containers must be appropriately labeled with the identity of the chemical(s) in the container, writing full names - do not abbreviate, from the moment the first drop of waste enters the waste container. Labels should include the accumulation start date and hazard warnings as appropriate. Surplus chemical to be discarded must be in the original container with "HAZARDOUS WASTE" printed in large, easily recognizable letters. If a chemical is found in the laboratory and the composition is unknown, it should be assumed to be hazardous waste and labeled as "Hazardous Waste – awaiting proper characterization." Biohazard wastes must be clearly labeled with the phrase and international biological hazard symbol. Use appropriate bags such as red or orange-red, puncture resistant, biohazard-labeled bags.

Disposal

Non-regulated wastes or non-hazardous wastes that are inert or innocuous may be disposed of in the trash. Determination on whether a material is inert or innocuous should be verified by consulting the material safety data sheet, container label, or reference manual. All hazardous wastes must be disposed of according to the regulations required by Florida Department of Environmental Protection. Please keep the following procedures and information in mind when disposing of empty containers:

- Triple rinse containers with a solvent capable of removing the original material.
- Collect the rinsate for disposal or neutralization as if it were hazardous.
- Identify triple-rinsed, dry, odorless, and empty containers by placing a "Safe for Disposal" label on the container.
- Remove any cap that may cause the container to become pressurized when compacting.
- Arrange removal of these containers with custodial services or take these to the designated area for disposal. No chemical containers should be placed in recycling.
- Under no circumstances, should a chemical be poured down the drain or discarded in the trash unless it is certain that doing so does not violate hazardous waste regulations or the wastewater treatment plant's discharge requirements for the municipality your campus resides in.

Biohazard Wastes: Biological wastes that may contain a human pathogen must be disposed of as biomedical waste. As defined by 64E-16 F.A.C., all biomedical waste must be disposed of within thirty days of generating the waste.

Sharps Disposal

Sharps are items capable of puncturing, cutting, or abrading the skin such as glass or plastic pipettes, broken glass, test tubes, petri dishes, razor blades, needles, and syringes with needles. Sharps waste contaminated with hazardous chemicals must be placed into puncture resistant containers (e.g., sharps container, plastic or metal container with lid) and properly labeled. All chemically contaminated waste should be inventoried on a Hazardous Materials Pickup Request Form and sent for proper disposal.

Clean uncontaminated broken glassware and plastic sharps should be placed in a corrugated cardboard box or other strong disposable container. Do not exceed 20 pounds. When ready for disposal, the box should be taped shut and prominently labeled as “Sharp Objects/Glass – Discard” and “Safe for Disposal”.

Biohazard Sharps

Needles, needle-syringe units, scalpels, and razor blades, contaminated with biological materials, are consider biohazard sharps. All biohazard sharps are considered biohazard waste and must be placed into a red, puncture resistant plastic needle box and discarded as biohazard waste. Broken or unbroken glassware used in microbiology such as Pasteur pipettes should be considered as biohazard sharps and disposed of accordingly. After decontamination, liquids may be poured down the sink with plenty of water. Do NOT pour melted agar into sink – allow it to cool and solidify for disposal as solid waste in regular trash.

Minimizing Waste

Hazardous waste management requires not only the above practices, but also requires efforts to minimizing waste. Below are some common waste minimization strategies.

- Reduce chemical purchases. Many hazardous wastes come from unused or expired chemicals. Careful considerations must be made when purchasing chemicals and purchase only the amount necessary. Many chemicals degrade over time so purchase the amount needed only for up to 2 years if purchasing the chemicals in bulk for lesser price.
- Do not accept donated chemicals or free samples unless they meet specific needs. These chemicals are usually of unknown age and unknown purity if the bottles are not sealed, and become a future waste problem. Since the cost of disposing can exceed ten to fifty times the cost of the chemical, it is more economical to buy a new one as needed.
- Substitute less hazardous chemicals and/or apply microscale approach whenever possible. This practice results not only in the safer procedures, but also reduces chemical wastes in need of disposal.
- Clearly mark the contents of all chemical containers to prevent the generation of unknowns.
- Neutralize, quench, or destroy hazardous by-products if possible after the experiments.

Inspections

It is the responsibility of every employee to report any safety discrepancies or issues to the lab manager or PI. If you see something, say something. PI/laboratory managers must ensure structured annual inspections occur. These can be done by multiple people. When deficiencies are noted during an inspection, the appropriate corrective actions shall be addressed by the lab manager.

Emergencies

All laboratory employees should be familiar with emergency plans and aware of the laboratory safety equipment such as eye wash stations, safety showers, fire blankets, fire extinguishers, fire alarm pull stations, and spill kits.

For all emergencies, call 911 or Public Safety 239-489-9203 (Ext. 11203 on campus phone).

Accidents

Laboratory supervisors are responsible for reporting all accidents and near misses to the Public Safety Department. Public Safety and/or risk management will direct the investigation of the accident. In the case of accidents, injured person must be sent to medical treatment facility and the medical personnel must be provided with copies of SDS(s) for the chemical(s) involved in the accident.

Fire Related Emergencies

If there is fire or smoke in the laboratory or in the building, immediately follow the instructions:

- Pull the fire alarm and call 911 or Public Safety number posted on the lab sign.
- If a person has been trained and is comfortable using portable fire extinguisher, the individual may try to contain the fire that is small.
- Shut off the equipment and evacuate the area.
- Close doors.
- Remain outside of the affected area to provide details to the emergency responders. Every person must evacuate the building when the fire alarm sounds. The Fire Department will determine when it is safe to return. Do not go back into the building until the alarm stops and Fire Department gives clearance to re-enter.

If someone's clothing catches on fire, use three words – stop, drop, and roll. A fire extinguisher may be used by another person to put out the fire. Report any burn injuries to the supervisor immediately and seek medical treatment.

Report to Public Safety Department every time a fire extinguisher is discharged and ask for a replacement.

Spills

Chemical and biological spills are the most common accidents in the laboratory. Laboratory instructors/research advisors must be familiar with handling the incidental spills and the hazards of the chemicals they normally handle. If the spill is too large or highly hazardous, call the Public Safety Department. Follow these procedures for the spills:

- Cease all activities immediately and evacuate the affected area. Make sure that all personnel in the area are aware of the spill and evacuate as well.
- Attend to any persons who may be contaminated. Contaminated clothing must be removed and go under safety shower for no less than 15 minutes. Eyewash should run for minimum of 15 minutes.
- Call 911 or public safety if the situation is or could become an emergency.
- Eliminate potential sources of ignition by turning off electrical equipment or any apparatus.
-

Cleaning up a minor spill

- Refer to the Safety Data Sheet for hazard information about the chemical. Acquire and don personal protective equipment appropriate to the hazards.
- Obtain spill kit and dike spill area to prevent spread.
- Spread spill control materials over the entire spill area, working from the outside to the center.
- Once the spill has been controlled, absorbed and neutralized, use a brush and consolidate the spill by sweeping inward. Scoop and collect in a suitable container.
- Label the container appropriately for waste disposal.

Weather Related Emergencies

During severe weather conditions, it is suggested that laboratory operations involving hazardous materials or processes are not performed. Power outages are likely during these conditions and the engineering controls such as chemical fume hood or biosafety cabinet will not be operational. If the power is interrupted:

- Immediately stop all laboratory work.
- Stabilize chemical reactions or other work taking place.
- Close all chemical containers.
- Shut-off and unplug equipment.
- Close chemical fume hood sashes.

Medical Consultations

All laboratory workers shall receive an appropriate medical consultation whenever an event takes place in the work area such as spill, leak, explosion, or other circumstances that may result in hazardous exposure. Employee must notify the accident and the case of exposure to hazardous conditions/chemicals to Public Safety Department as well as to the supervisor. Exposure assessment will be conducted by Public Safety **NOT** by Laboratory Personnel. All accidents should be fully documented and all consultations/examination should be conducted or supervised by a licensed physician. The employer will provide the following should the employee seeks to get medical attention:

- Consultation/examination at no cost
- Identity of the hazardous chemical(s) or condition(s)
- Description of the conditions under which the exposure occurred
- Description of signs and symptoms that an employee is experiencing

In event of any serious injury or exposure, immediately call 911 and seek medical treatment. Do NOT wait for an exposure assessment to be performed.

For any medical consultation/examination, the person responsible for the employee must ensure that the attending physician provides a written opinion which includes:

- Results of medical examination and tests
- Any recommendation for further medical treatment
- Any medical condition the employee had in prior to exposure which may increase the risk of exposure to hazardous chemical found in the incident
- A statement that the employee has been informed by the physician of the results and recommendations of the consultation/examination.
- The written opinions must not reveal specific findings or diagnoses that are unrelated to the incident

Document Revisions:

1st Draft	Feb 2016	N. Infantado
1st Revision	Feb 2020	N Infantado
2nd Revision	Oct 2024	J Vonderwell

Appendix Listing

A. CHP Lab-Specific Training Certification Form
B. OSHA Hazard Class Definitions
C. Personal Protective Equipment Certification of Training
D. Peroxide Forming Chemicals
E. Chemical Storage
F. Overnight Reaction/Incubation Form
G. Accident Reporting Instructions

Appendix A
Lab Specific CHP Training Form

Florida SouthWestern State College
School of Pure and Applied Sciences

Lab- Specific Training Certification

(Please Type or Print Legibly)

Lab Supervisor:____

Building:____

Rooms:____

After reading the Chemical Hygiene Plan, complete and return a copy of this form to your Laboratory Supervisor. By signing below you acknowledge that you understand your lab-specific Chemical Hygiene Plan and the policies and procedures applicable to the OSHA Occupational Exposure to Hazardous Chemicals in Laboratories Standard (29 CFR 1910.1450). Your Laboratory Supervisor will provide additional information and training as appropriate.

Name: ____ Cell Telephone: __________________

Email Address: ____

Department: ____

Job Title: ____

Employee Signature: ____ Date: ______________

Filing:
File each employee's completed Chemical Hygiene Plan Lab-Specific Training Certification Form in a central administrative location. These and all other safety training records should be organized in a way that allows original records for a single staff member or for an entire work group (as identified by the Laboratory Supervisor) to be retrieved quickly and efficiently on request by an inspector.

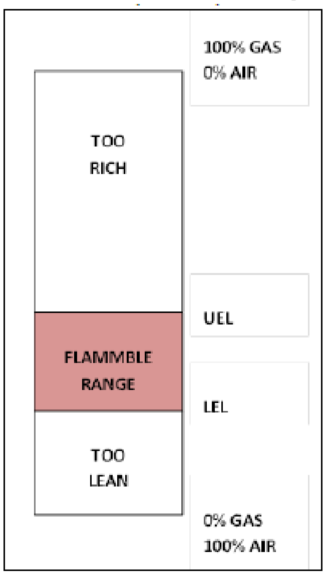
Appendix B:
OSHA Hazard Class Definitions

B.1 Physical Hazards

B.1.1 Flammable Liquids

Flammable hazards are materials which under standard conditions can generate sufficient vapor to cause a fire in the presence of an ignition source. Flammable liquids (e.g., hexane, ethyl acetate, and xylene) are more hazardous at elevated temperatures due to more rapid vaporization. The following definitions are important to understand when evaluating the hazards of flammable liquids:

- **Flammable Liquid** is a liquid having a flash point no greater than 93^{O}C (200^{O}F).



- **Flash point** is the minimum temperature at which the application of an ignition source causes the vapors of a liquid to ignite under specified test conditions.
- **Boiling point** is the temperature at which the vapor pressure of a liquid equals the atmospheric pressure and the liquid changes into a vapor.
- **Auto ignition temperature** is the minimum temperature at which self-sustained combustion will occur in the absence of an ignition source.
- **Lower explosive limit (LEL)** is the lowest concentration (percentage) of a gas or a vapor in air capable of producing a flash of fire in presence of an ignition source (arc, flame, heat).
- **Upper explosive limit (UEL)** is the highest concentration (percentage) of a gas or a vapor in air capable of producing a flash of fire in presence of an ignition source (arc, flame, heat).

Some organic solvents (e.g., diethyl ether) have the potential to form potentially shock-sensitive organic peroxides. See Appendix D for additional information regarding peroxide forming chemicals.

B.1.2 Flammable Solids

A flammable solid is a solid which is readily combustible, or may cause or contribute to a fire through friction. Readily combustible solids are powdered, granular, or pasty substances which are dangerous if they can be easily ignited by brief contact with an ignition source. Flammable solids are more hazardous when widely dispersed in a confined space (e.g., finely divided metal powders).

B.1.3 Gasses under Pressure

Gases under pressure are gases which are contained in a receptacle at a pressure not less than 280 kPA at 20 °C or as a refrigerated liquid. Gases under pressure include the following:

- **Compressed gas** is a gas which when packaged under pressure is entirely gaseous at -50 °C; including all gases with a critical temperature ≤ -50 °C.
- **Liquefied gas** is a gas which when packaged under pressure is partially liquid at temperatures above -50 °C.
- **Refrigerated liquefied gas** is a gas which when packaged is made partially liquid because of its low temperature.
- **Dissolved gas** is a gas which when packaged under pressure is dissolved in a liquid phase solvent.

All compressed gases are hazardous due to the fact they are stored in compressed cylinders, which can explode and act as a projectile if ruptured. Compressed gases also carry the hazards of the chemicals they contain such as asphyxiation (carbon dioxide), toxicity (nitric oxide), flammable (propane), and corrosive (hydrogen chloride).

B.1.4 Pyrophoric, Self-Heating, and Self-Reactive Materials

- **Pyrophoric material** (also called "spontaneously combustible") is a liquid or solid that even in small quantities and without an external ignition source can ignite after coming in contact with the air.
- **Self-heating material** is a solid or liquid, other than a pyrophoric substance, which, by reaction with air and without energy supply, is liable to self-heat. This endpoint differs from a pyrophoric substance in that it will ignite only when in large amounts (kilograms) and after long periods of time (hours or days).
- **Self-reactive material** is a thermally unstable liquid or solid liable to undergo a strongly exothermic thermal decomposition even without participation of oxygen (air).

B.1.5 Water Reactive Materials

A water-reactive material is a liquid or solid that reacts violently with water to produce a flammable or toxic gas, or other hazardous conditions. Alkali metals (e.g., sodium, potassium) and metal hydrides (e.g., calcium hydride) are common water-reactive materials found in laboratories.

B.1.6 Oxidizers

An oxidizing solid/liquid is a solid/liquid which, while in itself is not necessarily combustible, may generally by yielding oxygen, cause or contribute to the combustion of other material. Hydrogen peroxide, nitric acid, and nitrate solutions are examples of oxidizing liquids commonly found in a laboratory. Sodium nitrate, Sodium perchlorate, and Potassium permanganate are examples of oxidizing solids commonly found in a laboratory.

B.1.7 Organic Peroxides

An organic peroxide is an organic liquid or solid which contains the bivalent -0-0- structure and may be considered a derivative of hydrogen peroxide, where one or both of the hydrogen atoms have been replaced by organic radicals. The term also includes organic peroxide formulations (mixtures). Such substances and mixtures may:

- Be liable to explosive decomposition;
- Burn rapidly;
- Be sensitive to impact or friction; or
- React dangerously with other substances

B.1.8 Explosives

An explosive substance (or mixture) is a solid or liquid substance (or mixture of substances) which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed that can cause damage to the surroundings. Pyrotechnic substances are included even when they do not evolve gases. A pyrotechnic substance (or mixture) is designed to produce an effect by heat, light, sound, gas or smoke or a combination of these as the result of non-detonative, self-sustaining, exothermic chemical reactions. An explosive compound that is sometimes found in a laboratory setting is picric acid (2,4,6-trinitrophenol).

B.2 Health Hazards

A chemical is a health hazard if there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. Each health hazard is defined and briefly discussed below.

B.2.1 Irritants

Irritants are defined as chemicals that cause reversible inflammatory effects on living tissue by chemical action at the site of contact. A wide variety of organic and inorganic compounds, including many chemicals that are in a powder or crystalline form, are irritants. Symptoms of exposure can include reddening or discomfort of the skin and irritation to respiratory systems.

B.2.2 Sensitizers

A sensitizer (allergen) is a substance that causes exposed individuals to develop an allergic reaction in normal tissue after repeated exposure to the substance. Examples of sensitizers include diazomethane, chromium, nickel, formaldehyde, isocyanates, arylhydrazines, benzylic and allylic halides, and many phenol derivatives. Sensitizer exposure can lead to all of the symptoms associated with allergic reactions, or can increase an individual's existing allergies.

B.2.3 Corrosives

Corrosive substances cause destruction of living tissue by chemical corrosion at the site of
contact and can be either acidic or caustic (basic). Major classes of corrosive substances include:

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

B.2.4 Hazardous Substances with Toxic Affects

Substances with toxic effects on specific organs include:

- **Hepatotoxins**, which are substances that produce liver damage, such as nitrosamines and carbon tetrachloride.
- **Nephrotoxins**, which are substances that cause damage to the kidneys, such as certain halogenated hydrocarbons.
- **Neurotoxins**, which are substances that produce toxic effects on the nervous system, such as mercury, acrylamide, and carbon disulfide.
- Substances that act on the hematopoietic system (e.g., carbon monoxide and cyanides), which decrease hemoglobin function and deprive the body tissues of oxygen.
- Substances that damage lung tissue such as asbestos and silica.

B.2.5 Particularly Hazardous Substances

Substances that pose such significant threats to human health are classified as "particularly hazardous substances" (PHSs). The OSHA Laboratory Standard requires that special provisions be established to prevent the harmful exposure of researchers to PHSs, including the establishment of designated areas for their use. Particularly hazardous substances are divided into three primary types:

- Carcinogens
- Reproductive Toxins
- Substances with a High Acute Toxicity

B.2.5.1 Carcinogens

Carcinogens are chemical or physical agents that cause cancer. Generally they are chronically toxic substances; that is, they cause damage after repeated or long-duration exposure, and their effects may only become evident after a long latency period. Chronic toxins are particularly insidious because they may have no immediately apparent harmful effects. These materials are separated into two classes:

- **Select Carcinogens**: Select carcinogens are materials which have met certain criteria established by the National Toxicology Program or the International Agency for Research on Cancer regarding the risk of cancer via certain exposure routes. It is important to recognize that some substances involved in research laboratories are new compounds and have not been subjected to testing for carcinogenicity.
- **Regulated Carcinogens**: Regulated carcinogens are more hazardous and have extensive additional requirements associated with them. The use of these agents may require personal exposure sampling based on usage. When working with Regulated Carcinogens, it is particularly important to review and effectively apply engineering and administrative safety controls as the regulatory requirements for laboratories that may

exceed long term (8 hour) or short term (15 minutes) threshold values for these chemicals are very extensive.

B.2.5.2 Reproductive Toxins

Reproductive toxins include any chemical that may affect the reproductive capabilities, including chromosomal damage (mutations) and effects on fetuses (teratogens). Reproductive toxins can affect the reproductive health of both men and women if proper procedures and controls are not used. For women, exposure to reproductive toxins during pregnancy can cause adverse effects on the fetus; these effects include embryolethality (death of the fertilized egg, embryo or fetus), malformations (teratogenic effects), and postnatal functional defects. For men, exposure can lead to sterility. Examples of embryotoxins include thalidomide and certain antibiotics such as tetracycline. Women of childbearing potential should note that embryotoxins have the greatest impact during the first trimester of pregnancy. Because a woman often does not know that she is pregnant during this period of high susceptibility, special caution is advised when working with all chemicals, especially those rapidly absorbed through the skin (e.g., formamide).

B.2.5.3 Substances with a High Acute Toxicity

Substances that have a high degree of acute toxicity are materials that may be fatal or cause damage to target organs as the result of a single exposure or exposures of short duration. Acute toxins are quantified by a substance's lethal dose-50 (LD50) or lethal concentration-50 (LC50), which is the lethal dose of a compound to 50% of a laboratory tested animal population (e.g., rats, rabbits) over a specified time period. High acute toxicity includes any chemical that falls within any of the following OSHA-defined categories:

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

Appendix C

PPE Certification of Training

Florida SouthWestern State College

School of Pure and Applied Sciences

Florida SouthWestern State College provides personal protective equipment as a last resort to protect employees when handling hazardous chemicals. Training will be provided with this equipment by the PI/Lab Manager. At a minimum, training shall consist of:

- SDS and information on hazards where PPE are required
- Donning and doffing procedures
- Storage, cleaning and maintenance of PPE

This form certifies that the listed employee has been trained in the use of PPE.

(Please print clearly)

Trainer Name: ____

Trainee Name: ____

Department: ____

Campus: _____________________________Date: ________________

Trainer Signature ____

Trainee Signature ____

Appendix D

Peroxide Forming Chemicals

Autoxidation in common laboratory solvents can lead to unstable and potentially explosive peroxide formation. The reaction can be initiated by exposure to air, heat, light, or contaminants. Most of these solvents are available with inhibitors to slow the peroxide formation. Examples of inhibitors include BHT (2,6-di-tert-butyl-4-methyl phenol) and Hydroquinone. There are three categories of peroxide formers:

- **Group A** chemicals are those which form explosive levels of peroxides after prolonged storage, especially after exposure to air without concentration. Test these for peroxide formation before using and discard 3 months after opening.

Group A Chemicals	
Butadiene	Isopropyl ether
Chloroprene	Tetrafluoroethylene
Divinylacetylene	Vinylidine chloride

- **Group B** chemicals form peroxides that are hazardous only when concentrated by distillation or evaporation. Test these before distillation and discard after 12 months.

Group B Chemicals		
Acetal	Dicyclopentadiene	Methyl isobutyl ketone
Acetaldehyde	Diethyl ether	4-Methyl-2-pentanol
Benzyl Alcohol	Diethylene glycol dimethyl ether	2-Pentanol
2-Butanol	Dioxane	4-Penten-1-ol
Cumene	Ethylene glycol dimethyl ether	1-Phenylethanol
Cyclohexanol	4-Heptanol	2-Phenylethanol
2-Cyclohexen-1-ol	2-Hexanol	2-Propanol
Cyclohexene	3-Methyl-1-butanol	Tetrahydrofuran
Decahydronaphthalene	Methylacetylene	Tetrahydronaphthalene
Diacetylene	Methylcyclopentane	Vinyl ether

- **Group C** chemicals consist of monomers which form peroxides that can initiate explosive polymerization. Inhibited monomers should be tested before use and discarded after 12 months. Uninhibited monomers should be discarded 24 hours after opening.

Group C Chemicals	
Acrylic Acid	Tetrafluoroethelene
Acrylonitrile	Vinyl Acetate
Chloroprene	Vinyl Acetylene
Clorotrifluoroethelene	Vinyl Chloride
Methyl methacrylate	Vinyl Pyridine
Styrene	

Appendix E

Chemical Storage Guidelines

Adopted from http://www.ehso.com/ChemicalStorageGuidelines.htm

Primary storage information of chemicals can be found on Safety Data Sheets (SDS). Proper storage of chemicals requires segregating the chemicals based on the type and compatibility as well as using appropriate engineering controls.

Table 1. Basic Chemical Segregation

Hazard Class of Chemical	Recommended Storage Method	Examples	Incompatibilities
Corrosives - Acids	Store separately in acid storage cabinet. Segregate oxidizing acids (i.e., Chromic, nitric, sulfuric, and perchloric acids) from organic acids	Acetic acid Phenol Sulfuric acid Chromerge Nitric acid Perchloric acid Chromic acid Hydrochloric acid	Flammable liquids, flammable solids, bases, oxidizers
Corrosives - Bases	Store in separate corrosive storage cabinet. Store solutions of inorganic hydroxides in labeled polyethylene containers.	Ammonium hydroxide Sodium hydroxide Calcium hydroxide	Flammable liquids, oxidizers, poisons, and acids
Flammable Liquids	Store in flammable storage cabinet and away from sources of ignition. Store highly volatile flammable liquids in an explosion-proof refrigerator.	Acetone Benzene Diethyl ether Methanol Ethanol Toluene Glacial acetic acid	Acids, bases, oxidizers, and poisons
Flammable Solids	Store in a separate dry, cool area away from oxidizers, corrosives, flammable liquids	Phosphorus, yellow Calcium carbide Picric acid Benzoyl peroxide	Acids, bases, oxidizers, and poisons
General Chemicals - Non-reactive	Store on general laboratory benches or shelving preferably behind glass doors and below eye level.	Agar Sodium chloride Sodium bicarbonate Most non-reactive salts	See specific MSDS.

Oxidizers	Store in a spill tray inside a chemical storage cabinet. Separate from flammable and combustible materials.	Ammonium persulfate Ferric chloride Iodine Sodium hypochlorite Benzoyl peroxide Potassium permanganate Potassium dichromate Peroxides, perchlorates, chlorates, nitrates, bromates, superoxides.	Separate from reducing agents, flammables, and combustibles.
Poisons/Toxic Compounds	Store separately in vented, cool, dry area, in unbreakable chemically-resistant secondary containers and in accordance with the hazardous nature of the chemical.	Aniline Carbon tetrachloride Chloroform Cyanides Heavy metals compounds, i.e., cadmium, mercury, osmium Oxalic acid Phenol Formic acid	Flammable liquids, acids, bases, and oxidizers. See specific MSDS.
Water-Reactive Chemicals	Store in dry, cool location, protect from water fire sprinkler.	Sodium metal Potassium metal Lithium metal Lithium aluminum hydride	Separate from all aqueous solutions and oxidizers.
Carcinogens	Label all containers as "Cancer Suspect Agents". Store according to the hazardous nature of the chemical, using appropriate security when necessary.	Benzidine Beta-naphthylamine Benzene Methylene chloride Beta-propiolactone	See specific MSDS.
Teratogens	Label all containers as "Suspect Reproductive Hazard". Store according to the hazardous nature of the chemical, using appropriate security when necessary.	Lead and mercury compounds Benzene Aniline	See specific MSDS.
Peroxide-Forming Chemicals	Store in air-tight containers in a dark, cool, dry area. See Table 3 for recommended storage time limits.	Diethyl ether Acetaldehyde Acrylonitrile	See specific MSDS.
Strong Reducing Agents	Store in cool, dry, well-ventilated location. Water reactive. Segregate from all other chemicals.	Acetyl chloride Thionyl chloride Maleic anhydride Ferrous sulfide	See specific MSDS.

Table 2. Common Incompatible Chemicals

*Chemicals listed in **Column A** should not be stored with or used near items in **Column B**.*

Column A	***Column B***
Acetic acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetic anhydride	Hydroxyl-containing compounds such as ethylene glycol, perchloric acid
Acetone	Concentrated nitric and sulfuric acid mixtures, hydrogen peroxide
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Alkali and alkaline earth metals	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens
Ammonia (anhydrous)	Mercury, halogens, calcium hypochlorite,
hydrofluoric acid Ammonium nitrate	Acids, metal powders, flammable liquids,
chlorates, nitrites,	
	sulfur, finely divided organic or combustible materials
Aniline	Nitric acid, hydrogen peroxide
Arsenical materials	Any reducing agent
Azides	Acids, heavy metals and their salts, oxidizing agents
Calcium oxide	Water
Carbon, activated	All oxidizing agents, calcium hypochlorite
Carbon tetrachloride	Sodium
Chlorates	Ammonium salts, acids, metal powders, sulfur, finely divided organic or combustible material
Chlorine dioxide	Ammonia, methane, phosphine,
hydrogen sulfide Chromic acid and chromium trioxide	Acetic acid, alcohol,
camphor, glycerol, naphthalene,	
	flammable liquids in general
Copper	Acetylene, hydrogen peroxide
Cumene hydroperoxide	Acids (organic or inorganic)
Cyanides	Acids
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens, other oxidizing agents
Fluorine	All other chemicals
Hydrides	Water
Hydrocarbons	Fluorine, chlorine, bromine, chromic acid, peroxides

Hydrocyanic acid	Nitric acid, alkalis
Hydrofluoric acid (anhydrous)	Ammonia (aqueous or anhydrous)
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, any flammable liquid (i.e., alcohols, acetone), combustible materials, aniline, nitromethane
Hydrogen sulfide	Fuming nitric acid, oxidizing gases
Hypochlorites	Acids, activated carbon
Iodine hydrogen	Acetylene, ammonia (aqueous or anhydrous),
Mercury	Acetylene, fulminic acid, ammonia
Metal hydrides	Acids, water
Nitrates	Acids
Nitric acid (concentrated)	Acetic acid, acetone, alcohol, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, copper, brass, any heavy metals
Nitrites	Acids
Nitroparaffins	Inorganic bases, amines
Oxalic acid	Mercury and silver and their salts
Oxygen gases	Oils, grease, hydrogen; flammable liquids, solids, or
Perchloric acid grease, oils	Acetic anhydride, alcohol, bismuth, paper, wood,
Permanganates	Concentrated sulfuric acid, glycerol, ethylene glycol, benzaldehyde
Peroxides, organic	Acids (organic or mineral), avoid friction, store cold
Phosphorus, white	Air, oxygen, alkalis, reducing agents
Potassium	Carbon tetrachloride, carbon dioxide, water
Potassium chlorate	Sulfuric and other acids, ammonium salts, metal powders, sulfur, finely divided organics, combustibles
Potassium perchlorate	Sulfuric and other acids
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, sulfuric acid
Silver and silver salts compounds,	Acetylene, oxalic acid, tartaric acid, ammonium fulminic acid
Sodium	Carbon tetrachloride, carbon dioxide, other chlorinated hydrocarbons, water
Sodium nitrate	Ammonium nitrate and other ammonium salts

Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulfides	Acids
Sulfuric acid	Chlorates, perchlorates, permanganates

Appendix F

Unattended Overnight Experiment Notice

For unattended operations, laboratory lights should be left on (unless the operation is light sensitive) and signs should be posted to identify the nature of the experiment and hazard classification. Information should be clearly posted indicating who to contact in the event of an emergency. The following template may be used.

Experimenter's Name: ____

Phone Number: ____

Faculty Advisor: ____

Phone Number: ____

Date/Time Started: ____

Expected Date/Time to be completed: _______________________________

Hazard Information (Check all that apply)

- ☐ Flammability
- ☐ Air Sensitivity
- ☐ Water Sensitivity
- ☐ Biohazard
- ☐ Toxic
- ☐ Other (Explain) ____

Appendix G

Hazard or Accident Report

Employees should inform their supervisor if they identify a hazard in the workplace. Hazards may include unsafe conditions, damaged or improper equipment, inadequate procedures, missing safety equipment, and contaminant.

The employee's supervisor has the primary responsibility to investigate the reported hazard.

All accidents require the completion of accident reporting form, which will be provided by Public Safety. There may be additional forms required. It is important to document as many details as possible. Therefore, completing the form and submitting should take place immediately after the accident.

In the event an employee is injured, the supervisor must contact Human Resources for Workers' Compensation procedures.

Public Safety will provide procedures for reporting incidents. The switchboard for public safety is 239-489-9203. This dispatch will route all reports to your local team. The following are addresses for public safety at each campus.

Lee Campus
8099 College Parkway
Fort Myers, FL 33919
Building D Room 101

Collier Campus
7505 Grand Lely Drive
Naples, FL 34113
Building A Room 100

Charlotte Campus
26300 Airport Road
Punta Gorda, Florida 33950
Building N Room 105

Hendry Glades Campus
1092 E Cowboy Way
LaBelle, FL 33935
Building A Room 118