Victor Valley College

Chemical Hygiene Plan (CHP)

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Introduction

Victor Valley College (VVC) strives to be an institution that fosters a safe and professional work environment for all members of its community. Given that VVC is home to many laboratory classrooms, stockrooms, and vocational training facilities, it is our responsibility to outline a Chemical Hygiene Plan (CHP) that encompasses overall standards of cleanliness and safety. The Occupational Safety and Health Administration (OSHA) Laboratory Standard defines a CHP as "a written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices that are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace."(29 CFR 1910.1450(b)). It is the goal of this document to be a reference for handling, storing, and protecting from primarily workplace chemical hazards. It is the responsibility of every member of the VVC campus community to follow the Standard Operating Procedures listed in this document, and in their department, and to comply with workplace requirements as set by OSHA.

Chapter 1: Individual Chemical Hygiene Responsibilities

In order to create a safe working environment for all individuals, there must be a team effort in perpetuating safety. There are several roles in the workplace which must maintain their part in preventing accidents and improving the community's workspace.

1.1 Chemical Hygiene Officer (CHO)

- Maintains and reviews the Chemical Hygiene Plan
- Reviews and creates safety rules and regulation to ensure best and current policies
- Overlooks the procurement, plans for use, storage, and disposal policies of chemicals by conducting regular inspections of workplaces that handle chemicals
- Creates reports of inspections and discusses appropriate improvements with administration
- Keeps records of inspections, personnel training, inventories, and accident reports
- Assists departments with maintaining facility safety and hygiene
- Assists departments in the development of new training and safety policies as appropriate

1.2 Department Chairperson or Director

- Assumes responsibility for the safety and proper training of personnel that handle hazardous chemicals, including laboratory supervisors
- Works in conjunction with the CHO to ensure that CHP policies are understood and enforced among personnel
- Discusses and corrects any workplace violations by meeting with laboratory supervisors
- Ensures corrections comply with federal, state, college, local and departmental codes and regulations
- Approves and provides fiscal arrangements to correct violations in a timely manner that maintains health and safety in the workplace

1.3 Safety Committee

- Reviews accident reports and makes appropriate recommendations to the CHO regarding proposed changes in the laboratory procedures
- Reviews proposed changes to CHP by CHO and votes to amend the CHP in meetings
- Discusses concerns that may arise which challenge the CHP and provides suggestions on changing or maintaining the CHP

1.4 Laboratory Supervisor or Principal Investigator

- Assumes overall responsibility for chemical hygiene in the laboratory
- Ensure laboratory personnel comply with the CHP
- Ensures personnel do not operate equipment or handle hazardous chemicals without proper training and authorization
- Ensures personnel always wear personal protective equipment (PPE) that is appropriate for the hazard; implements PPE by always having PPE available to personnel and visitors
- Sets an example for personnel by following safety rules and hazard policies
- Reviews laboratory plans for potential safety problems before approving or assigning to other laboratory personnel
- Ensures that visitors follow the laboratory rules and assumes responsibility for laboratory visitors
- Provide regular, formal chemical hygiene and housekeeping inspections, including routine inspections of emergency equipment
- Monitor the facilities and chemical fume hoods to ensure that they are maintained and function properly. Contact the Maintenance & Operations department to report problems with the facilities or the chemical fume hoods

1.5 Laboratory Personnel (Aides)

- Read, understand, and follow all Standard Operating Procedures and Safety Data Sheets that apply to the work done in the area
- Conduct each activity that involves hazardous chemicals in accordance with the institutional chemical hygiene procedures
- Avoid dangerous behavior in areas of hazardous chemicals such as horseplay, running, eating, drinking, or smoking
- Maintain good housekeeping and hygiene practices in the work area
- Use PPE as directed and appropriate for each procedure that involves hazardous chemicals
- Consult with the Laboratory Supervisor about training if performing a new task or a task that involves new chemicals

1.6 Laboratory Instructors (Full-time & Part-time)

- Understand all the hazards that may occur during a planned activity; read chemical Safety Data Sheets (SDS) to know ahead of time what interactions may cause chemical reactivity, what kind of fire extinguisher is appropriate in case of fire, and what are the signs of/response to accidental chemical exposure
- Receive safety training about chemical hazards or physical hazards (machines, high voltage equipment, compressed gases, etc.) that are a part of the planned experiments

- Obtain information about emergency exit locations, protocol for medical, fire, and chemical emergencies, phone numbers for after-hours emergencies, locations of first aid kits and safety shower/eyewash
- Ensure laboratory teaching assistants receive safety training for the classroom and the stockrooms they may access
- Ensure students receive activity specific instructions on how to handle hazardous chemicals, waste, and/or equipment
- Supervise laboratory students and teaching assistants in the proper use of personal protective equipment
- Ensure students are performing experiments in accordance to safety rules and to minimize hazards

1.7 Laboratory Teaching Assistants

- Obtain safety information from laboratory supervisors about the hazardous chemical areas that they may access during work hours
- Obtain information about emergency exit locations, protocol for medical, fire, and chemical emergencies, phone numbers for after-hours emergencies, locations of first aid kits and safety shower/eyewash
- Ensure that the laboratory classroom is performing experiments safely, with the use of personal protective equipment, and to alert the instructor of any hazardous behaviors
- Ensure students are not engaging in dangerous behavior in areas of hazardous chemicals such as horseplay, running, eating, drinking, or smoking
- Ensure that laboratory students follow the arranged method for waste disposal
- Ensure that the laboratory classroom is clean, chemicals and equipment have been stored away at appropriate locations, and all ignition and electrical sources have been shut down before leaving classroom
- Departments may implement safety contracts for teaching assistants to certify that the TA has received, understands, and complies with their safety duties

1.8 Laboratory Students

- Read, understand, and prepare for upcoming laboratory activities
- Ask questions to instructor and/or teaching assistant if any procedure is unclear before performing the task
- Always wear personal protective equipment (PPE) in the laboratory, do not remove PPE until everyone has finished handling hazards
- Follow labels or signs that are on chemicals, equipment, and waste containers before using or disposing of materials
- Do not engage in dangerous behavior in areas of hazardous chemicals such as horseplay, running, eating, drinking, or smoking

- Do not engage in dangerous behavior when working in the fume hood, such as putting the upper body/head into the fume hood while experiments are being conducted
- Instructors may distribute student safety contracts with more detailed information and responsibilities that students should follow for the specific course

Chapter 2: General Lab Safety Principles & Protections

Victor Valley College has a variety of instructional, preparation, and experimental areas which come with potential hazards if the individuals participating in these areas do not follow safety procedures. This chapter explains general lab safety principles to keep in mind and protections that the work space must have in place for your safety.

2.1 Personal Guidelines for Safety – Before entering a hazardous workplace, it is important that one is prepared with the appropriate apparel and knowledge.

Workplace Apparel: In some areas, a uniform is required which has been assigned as appropriate and safe for the work. For example: mechanic attire or scrubs. When a uniform has not been assigned, it is practical to wear clothing which is not too loose and which does not expose large parts of the skin. Loose clothing, jewelry, and untied hair can get caught or become a fire hazard if flames are present. To protect your skin from direct splashes, cuts, or unforeseen temperatures, it is best to wear long pants and closed-toe shoes. If a protective layer such as a laboratory coat is available, use it to protect your arms. If a lab coat is not around, a chemical apron will also protect from splashes, but be sure to wear a long-sleeved shirt underneath. Wear a minimal amount, or preferably no makeup in the work area. Sweat and/or unsanitized eyewear can cause eye irritation when wearing makeup near chemicals. Do not wear contacts near chemical hazards.

Workplace Behavior: Areas where chemicals are used, and stored, generally forbid the presence and/or eating of food and drink. Even if the containers are sealed and labeled, there is a potential for contamination by workplace residue moving from the worker to the food/drink. Wash your hands before entering a workplace, when leaving home or to breaks, and during work hours as necessary. It is highly advised to maintain routine hygiene outside of the workplace as well, to avoid long-time exposure to hazards on the skin that were not removed by hand washing. It is also against personal safety to smoke in a laboratory area. Flammable chemicals, compressed gases, or equipment can quickly become a fire or explosion hazard. For personal safety avoid ingesting chemicals via accidental or intentional routes. Do not pipette chemicals with mouth suction, use a rubber bulb. Avoid chemical fumes by working in a well ventilated area, such as a fume hood. Never run or horseplay in the hazardous work area.

Workplace Habits: Be conscious of cross-contamination of commonly touched surfaces that should not be touched with gloves. Remove gloves that have touched chemical bottles and

materials before touching counters, computers, phones, doorknobs, furniture, etc. If other persons may touch these items with bare skin on a regular basis, do not contaminate these surfaces. Be sure to sanitize borrowed safety equipment before using. Wipe safety equipment (goggles, glasses, face shields) with warm, soapy water then dry. If there are chemical stains, use a small amount of ethanol on a paper towel to wipe them. Allow to air dry. Ethanol evaporates quickly and is generally a better sanitizer than water alone.

2.2 Engineering Control Measures – Every laboratory or workplace with known hazards has to include designs or modifications to plants, equipment, ventilation systems, and processes that ensure the minimization of the hazards. Engineering controls are the first line of defense against hazards.

Process Control – Steps in a procedure may be intentionally altered or equipment substituted for less harmful alternatives. Examples:

- Use wetting methods when cleaning up dust rather than sweeping alone; controls inhalation
- Use electric equipment rather than ones running with toxic chemicals
- Decrease the temperature of a process so that less hazardous vapor is released
- Try painting with methods that reduce the amount of paint aerosol in the air (dipping, brushing)

Enclosure & Isolation – Hazards may be minimized by enclosing the hazard from the worker or by moving the hazard further from the worker. An example of enclosing hazards is the use of a glovebox. The glovebox is a large, transparent box that can be used to house and handle chemicals from the outside. These storage boxes have a characteristic pair of thick neoprene gloves on the outside for inserting one's arms inside of the glovebox. Gloveboxes are best for compounds which are reactive in air or moisture. Thus, the environment inside of a glovebox may typically be nitrogen gas or argon inert gas. Enclosure equipment will require special maintenance to keep the hazards within and prevent leakage. Tests of leakage should be performed routinely to make sure that the mechanism is indeed working to keep hazards away from workers.

The isolation of chemical hazards may be done, for example, by placing chemical waste in one separate fume hood. Students may find this the most helpful for safety. Large quantities of waste would be isolated to one ventilated area versus spread across many fume hoods where spill risk is higher. Isolation of a hazard does not only apply to chemical hazards. Noise hazards in the workplace can be isolated from workers by soundproofing around the noise source.

Ventilation – A fume hood is purposely built into a laboratory to reduce the exposure of chemicals through additional ventilation.

Appropriate fume hoods feature:

- Materials that can withstand corrosive and flammable materials
- Alarms that alert unsafe changes in air flow
- Ease of decontamination

- Sturdy, laminated glass sashes that can protect workers from chemicals and be moved quickly in case of emergency

However, fume hoods should not be used as chemical storage locations. Overcrowding of the hood space affects air flow and becomes unsafe when bringing different types of chemicals together. To upkeep engineering controls, it is important to have routine inspection of ventilation stations so that any issue can be prevented. Routine inspections should be performed once a year unless an issue has been found before the next inspection. Fume hoods must be maintained by technicians that can restore ventilation to appropriate levels. Technicians will ensure that the fume hood has an average face velocity of at least 100 linear feet per minute (lfm). Records of fume hood maintenance should be maintained for reference by the laboratory and CHO for five years.

Proper use of fume hoods is crucial for avoiding unnecessary accidents. Do not insert your head and upper body, or allow others to do so, into a fume hood while working with hazards (chemicals, glassware, or equipment of high voltage, high pressure, moving mechanical parts, and/or ignition sources). Inexperienced workers, such as students, should be trained to only work inside of a fume hood at upper arm length. The glass sash should be maintained between the worker and the hazard; fume hoods have arrows along the sides of the sash to indicate the maximum height that the sash can be raised and still provide adequate hazard protection.

2.3 Administrative Control Measures - In addition to a well-engineered work space, supervisors should know the hazards which could present themselves in any project: chemical, physical, or psychological, and administrate their workers appropriately.

Work Practices - This control deals with the planning and boundaries of a workspace. Planning must be done with the intention to protect workers from hazards by decreasing their risk of exposure. If a project requires handling acids, for example, the supervisor could lessen the risk of exposure by *decreasing the amount* of chemical required or assigning an acid of a *decreased concentration*. In a classroom setting, the supervisor can have students *rotate tasks* so that each student is potentially exposed for less time. Boundaries, or rules, should also be set for protection. Restricting workers from specific areas or tasks depending on their level of training is an example of administrative control.

Education – The administration is responsible for maintaining an educated workplace so that hazardous practices are minimized. Requiring and enforcing new training is another example of administrative control. Administration is responsible for presenting workers with emergency preparedness information, safety fundamentals training, and personal hygiene practices.

Good Housekeeping – Supervising personnel of the workplace are to encourage and enforce the cleanliness of the workplace. Equipment and facilities must be maintained in clean and working order; this can be facilitated by cleaning schedules. Administration has the ability to post signs that remind employees to maintain personal hygiene (i.e. washing hands, no food or drink areas, no smoking) and to wear the appropriate personal protective equipment (googles, gloves,

temperature-resistant accessories, etc.). Designating a specific hazardous waste area also encourages workers to dispose of waste appropriately.

2.4 Personal Protective Equipment Controls – The last line of defense in a hazardous workplace is Personal Protective Equipment (PPE). Even with a great fume hood and small volume of chemicals, there is always a chance of directly coming in contact with danger. Thus, protective apparel is important for every hazardous workplace. Depending on the field of work, personal protective equipment (PPE) can include: laboratory coat, gloves, safety glasses or goggles, apron, heat-resistant or cryo-resistant gloves, mechanic uniform, scrubs, medical mask, dust mask, respirator, and more. Since our campus community hosts vocational/technical laboratories in addition to chemical laboratories, it is worth investigating PPE which will best accommodate the tasks of each department. One size of PPE does not fit all. The Occupational Safety and Health Administration (OSHA) regulates how employers should approach the fitting of their workers with safety gear. Employers must establish a Personal Protective Equipment (PPE) Program to comply with hazardous workplace laws.

2.4.1 Personal Protective Equipment Program

The Personal Protective Equipment (PPE) OSHA standard (29 CFR 1910.132): Employers are required to provide, pay for, and enforce the use of PPE in "hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants." PPE must protect when hazards are "encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation, or physical contact." (29 CFR 1910.132(a) and 1910.132(h)).

The Personal Protective Equipment Program are guidelines for approaching and implementing the requirement of safety equipment for workers. Below are the steps that employers must take when beginning a PPE Program:

- Employer must conduct an ***assessment of the hazards*** to which individuals will be exposed to in the workplace, 29 CFR 1910.132(d)(1)
- Employer will ***select appropriate PPE*** after the evaluation is complete, 29 CFR 1910.132 (d)(1)(i). PPE must be certified and compliant with OSHA regulations and standards.
- ***Communicate what PPE*** will be provided to the worker, 29 CFR 1910.132 (d)(1)(ii)
- Employer must ensure to ***provide PPE that fits each worker*** properly, 29 CFR 1910.132(d)(1)(iii).
- Arrange for ***workers to be trained*** on how to use, inspect, and maintain the PPE, and its limitations, 29 CFR 1910.132(f)

PPE Programs should be audited annually with input from workers to ensure that the selected equipment is effectively protecting from hazards. Any equipment that needs replacement should be identified during an audit or as necessary before the annual audit. When considering the change of one PPE to another, employers must perform safety tests to observe if the replacement will protect workers more effectively or not. An example of this would be in changing glove type for hot work conditions. The employer in charge could perform a trial with potential glove materials

to see which will protect the longest or at the highest temperatures before switching all workers to a new glove type. Since the hazards which are encountered in a workplace are dynamic, it is important for workers to self-audit and inspect PPE each workday.

Body Protection

As our campus has various vocational departments, the type of body PPE which faculty and students may wear for protection will change. Most departments have uniform requirements that fulfill the standard of protection for their field (i.e. nursing, fire technology, etc.). In departments where chemicals are more exclusively handled, body protection will differ compared to other vocations. It is imperative to wear a laboratory coat or chemical apron to protect the body from chemical contact. When selecting a laboratory coat keep the following in mind:

- ***Material*** – Fire-Resistant (FR) coats protect best when handling flammable or explosive chemicals versus a standard cotton lab coat. Cotton lab coats burn quickly if caught on fire
- ***Fit*** – When standing or sitting, lab coats sleeves should always cover the wrists completely. Lab coats should be completely buttoned at all times to ensure the chest area is protected. When sitting or standing, the coat should have enough room that the buttons remain closed at all times. The length of a proper lab coat should reach at least the knee and should not be longer than mid-calf. Ensure that no part of the coat is loose enough to get caught on a hazard. Also, ensure that the coat is not too tight around the arms as some distance from the skin is needed in case of chemical spills. Similarly, chemical aprons should not exceed mid-calf length and should cover up to shoulder length in chest protection.

Face / Eye Protection

The Eye and Face Protection standard (29 CFR 1910.133): Employers are required to provide PPE for the eyes and face when workers are subjected to environments that have "flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation" (29 CFR 1910.133(a)).
Selection of safety eyewear should be based on the type of flying hazards in the environment.

- ***Splashes*** – safety goggles (small to moderate liquid volumes), face shield (large liquid volumes).
- ***Particles*** – safety glasses (medium particle size and hardness) or goggles (small, dispersive dust, and large, hard particles)
- ***Vapors*** – safety goggles or face shield, may require a full-facepiece respirator depending on toxicity
- ***Light radiation*** – special safety glasses must be selected for the wavelength of light hazard, check manufacturer of light source for suggestions. Some work, such as welding, may require a face shield with light protection

Due to the potential for eye injury, it is critical not to wear contact lenses or makeup in the chemical work area. The proper fit of safety glasses and goggles must be ensured before beginning work around hazards. *Safety glasses* should cover vertically from the eyebrow to the cheekbone; horizontally, the glasses should sit on the nose and extend left and right to cover the boney area on

the sides of the eyes. When the head is tilted forward, the glasses should not slip forward. When the head is moved side to side, the glasses should remain in place. Safety glass side pieces should fit over the curve of the ear not too tightly or too loosely. Some safety glasses have adjustable length side pieces. Ensure that the sides of the safety glasses are not too tight around the temple area. Preferably choose safety glasses that have safety guards on the top, sides, and bottom for enhanced protection. *Safety goggles* are already made with safety guards for all-around splash protection. When fitting splash goggles over the face, adjust the elastic strap manually. If splash goggles begin to fog while working or leave an indentation on the face after removing them, the elastic strap has not been fitted properly. Splash goggles should fit comfortably but still be close to the face for protection. Experiment with the goggle fit before using in hazardous activity.

Face shields should cover the hairline at the top of the head and extend chin length. The shield design and thickness may differ between manufacturers. Select face shields with appropriately thick materials for the work. Face shields are adjustable to different head sizes; they can be minimized or enlarged by turning a dial at the back of the head rest. Ensure that the shield covers the entire front and sides of the face.

As adjustable eyewear is among the more commonly shared pieces of PPE, be sure to clean any shared eyewear before using. Be mindful to also clean eyewear after working, particularly when touching the item with contaminated gloves. Eyewear will last much longer if chemical contaminants are eliminated before they become stains. Discard any faulty or scratched PPE from the work area.

Hand Protection

The Hand Protection standard (29 CFR 1910.138): Employers are required to provide hand protection and ensure that workers use hand protection when exposed to hazards that can cause "severe cuts or lacerations; severe abrasions; punctures; chemical burns; skin absorption of harmful substances; thermal burns; and harmful temperature extremes," 29 CFR 1910.138(a).

When using gloves for a hazardous task, be sure that the glove fits the application before working. Check that the gloves are not torn or contaminated before using. Refresh gloves as necessary and when switching to chemicals that are not compatible. Wash reusable gloves if fabric allows. Follow the proper glove removal technique, "doffing", when using nitrile type laboratory gloves (below). Note that typical nitrile or latex gloves are not reusable. Disposable gloves should be discarded before touching doorknobs, phones, computer equipment and anything else that others may touch without gloves. Begin any work around chemicals and glassware with the application of gloves. Surfaces in areas of chemical storage contain hazards that are transferred in air, dust, and unseen solid particles. Thus, take care not to touch hair, skin, or street clothes while wearing gloves. The table below describes applications of gloves by glove type.

Glove Type	Applications
Rubber, Plastic, or Synthetic Rubber Gloves (Neoprene & Nitrile)	Chemical protection: oils, greases, solvents, acids and caustics. This type of glove can be applied to cleaning tasks and biohazard applications.
Leather	Resists sparks, moderate heat, cuts, and abrasions. Applicable to welding activities.
Cotton & Fabric	Protect against dirt, chafing, and abrasions. May not be strong enough to endure rough, sharp, or heavy materials.
Coated Fabric	Provides protection for moderately concentrated chemicals. Not applicable to all chemical types, depends on the chemical.
Aluminized	Provides reflective and insulated protection. Can be used in welding, furnace, and foundry work.
Kevlar	Provides protection against hot and cold. This type of glove can be used in a wide variety of industrial applications.

How to safely remove disposable gloves – "Doffing"

Footwear Protection

The standard rule for any hazardous workplace is to wear closed-toe shoes. Depending on the specific hazards, special footwear protection may be required. In workplaces that handle or store heavy mechanical equipment or tools, steel-toed shoes would be preferred to avoid injuries. Generally, footwear should be selected to have slip-resistant soles and enough foot support to prevent trips, falls, or slips. In case that large volumes of hazardous chemicals are handled frequently, special rubber shoes or boots offer protection against spills. It is most critical to ensure that students and workers that are directly facing hazards are wearing proper footwear. In particular, students should understand the importance of wearing shoes that fully cover exposed skin during experiments.

While PPE is an additional layer of safety, it is best to not rely solely on PPE when thinking of performing a new experiment. PPE can fail, so it is important that both engineering and administrative controls are already in place for additional safety.

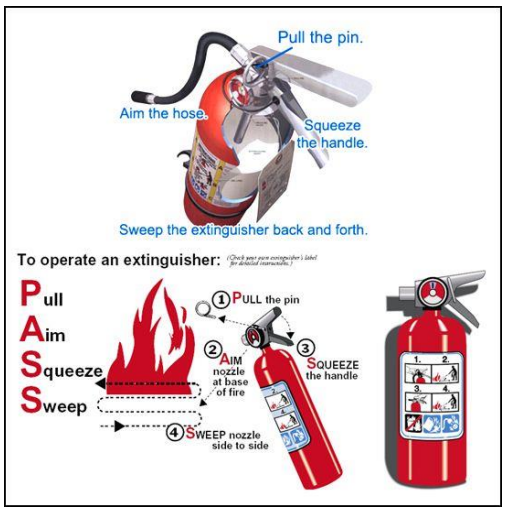
2.5 Safety Equipment – Individuals in the workplace should become trained and familiarize themselves with available safety equipment. It is best to know the location of the nearest fire extinguisher and exit routes. There should also be an emergency plan that all employees can practice and understand for the case of an emergency. In addition, faculty and staff should know the phone number for emergency responders. Fires can be reported to VVC Campus Police (x2555) or 911. In settings where chemicals are a hazard, the most common safety equipment include: fire extinguisher, emergency shower and eyewash, first aid kit, and spill cleanup kits. Following is a description of each type of safety equipment and how they can be used.

2.5.1 Fire Extinguisher & Fire Blanket

Employees should always receive official fire extinguisher training in a controlled setting before attempting to use an extinguisher in an emergency. In a typical fire extinguisher training session, participants learn to put out a small fire on their own. This training is invaluable, since doing it yourself enables muscle memory to react if there is ever a real fire emergency.

The basic concept to remember when using a fire extinguisher is P.A.S.S.

Pull . **A**im . **S**queeze . **S**weep



Keep in mind that there are different types of fire extinguishers for different chemical fires. The chemical SDS will list what kind of fire extinguisher to use. It is good practice to have fire extinguishers inspected once per month by a certified technician. If an extinguisher has been recently discharged, it is not a good idea to place it back without having a technician recharge it. A half-filled fire extinguisher is an empty extinguisher during a fire emergency. The Maintenance and Operations department at Victor Valley College coordinates the servicing of campus fire extinguishers.

Fire blankets are another great tool, however, they are not located next to every fire extinguisher on campus. Thus, be aware of the surrounding emergency accessories that are available in the vicinity of hazardous work. Fire blankets can help in three different scenarios:

- To put out small fires caused by flammable chemicals (Class B) or fats (kitchen fires)
- To cover a victim that is on fire while they stop, drop, and roll
- To use as a shield while exiting a fire emergency

Fires should always be reported to department administrators in order to investigate the situation and improve workplace safety. The diagram below displays how to use a fire blanket. There is also a video link at the end of this chapter.

2.5.2 Emergency Shower & Eyewash

A chemical spill can contaminate anyone in the workplace at any time. If the spill is on the face or in eyes, it is best to use an eyewash station. The eyewash has enough pressure to delicately rinse facial contamination. If there is a larger spill on your body, or on your head, clothes should be removed and an emergency shower must be used. Emergency showers have much more water pressure and should not be used to directly rinse the eyes.

An emergency shower (pictured left) might look like this in the area. The operation is very simple. The metal triangle that is hanging is pulled down to activate the shower. As mentioned before, it is best to remove clothing from splashed area when using the emergency shower. If the spill is high up on the body, the shower may wash the chemical down to other clothing. Wet clothing clings well to skin and presents a greater problem of contamination. If necessary, have a trusted coworker use a laboratory coat or other large cloth to cover the affected person while they use the shower. It may be appropriate to evacuate coworkers out of the immediate area while the spill and affected person are handled.

An emergency eyewash (right) may look similar to the one above. The pad to the right of the basin is pushed forward to begin the water flow. If the contamination is in the eyes, the victim or another person needs to hold the eyes fully open while the washing occurs. Usually, it is more effective if another person helps, since the victim may be too affected to open their eyes fully. Generally, rinsing with this or emergency shower safety equipment should be done for at least 15 continuous minutes. A medical evaluation should be done immediately after washing to ensure that no severe damage has been done to the person's vision.

2.5.3 First Aid Kit

First aid kits are a must in any hazardous work area. Burns, cuts, and accidents should be handled immediately after occurring. Workers should know the location of the nearest first aid kit before beginning any activity. Area supervisors need to ensure and coordinate that the kits are always stocked. Victor Valley College has kits serviced at least once a month by the kit manufacturing company.

First Aid Station

Supervising and designated personnel should be trained on how to properly use all the items in the first aid kit. The kit above is available throughout VVC's chemistry laboratories and storage areas.

2.5.4 Spill Cleanup Kits

All areas that use hazardous chemicals must have spill cleanup kits. Supervising personnel should be trained on how to use spill cleanup kits and on neutralizing techniques in case a spill kit is not on hand. The spill kits that are available (and should be available if not already) in laboratory work areas of campus are: (1) neutralizers, (2) Absorbant Super Sorb, and (3) Sand.

(1) *Neutralizer* - Sodium carbonate and Calcium hydroxide mixture (for acids)
- Citric acid (for bases)

(2) *Absorbent Super Sorb®* - Flammable solvent spills

(3) *Sand* - Spill containment and fire extinguishing

In the areas where oil and automotive spills may occur, a commercial oil absorbent may be kept on hand. Alternatively, it is recommended that cat litter, sawdust, or dirt are effective for soaking up oily spills. Kits for cleaning up biohazards (body fluids and blood) are also on the market. A sample kit for biohazard cleanup is referenced at the end of this chapter.

Spill kits referred to above can be purchased from vendors (Flinn Scientific) in 20lb (or less) buckets. The quantity in one bucket provides plenty of protection against large spills. Other materials that need to be stored with spill kits are cleanup supplies. Brooms (polypropylene), dustpans (polypropylene), and absorbent pillows/towels are musts for the spill cleanup procedure.

SPILL KIT ACCESSORIES: ABSORBENT PADS, PILLOWS, AND CONTAINMENT SOCKS

When a spill occurs, follow this procedure for safe cleanup of the spill.

- *Assess the danger of the spill:* Is the chemical toxic to those around or explosive, causing a need to evacuate the work area? Are there any hazards nearby that can enhance the spilled chemical's threat (i.e. flame sources, oxidizers)? If evacuation is necessary, alert all workers to move and contact emergency services when a safe location is reached.
- *Warn others about the spill*: If the chemical spill is safe enough to not evacuate the area, be sure to place signs around or close off the spill area. Alert coworkers and supervisor.
- *Control the spill:* Wear PPE while cleaning any chemical spills. Use absorbent spill "socks" (pictured in yellow above) to create a barrier around the spill. Depending on the chemical spilled, select the appropriate type of spill kit. Pour the absorbent powder (or sand) that comes in the spill kit onto the spill. Begin at the center of the contained area and work toward the outside. Add more powder to the spill if the initial barrier will not be enough to absorb most of the spilled chemical. Apply absorbent pads and/or pillows over the absorbent to collect excess liquid.
- *Absorb and Pick up:* Allow a few minutes for the absorbent to take up the chemical. Once some time has elapsed, use a broom to start sweeping the absorbent material in a manner that brings all of the absorbent toward the center of the spill. When the powder has been swept to the center, use a dust pan to pick up the absorbent. Pour the contaminated absorbent into a plastic trash bag and tie the bag well with duct tape. Double bag the absorbent. Place contaminated gloves, paper towels, spill pillows, etc. into another trash bag. Double bag contaminated items as well. Attach a waste label onto the bags that identifies the spilled chemical, absorbent type, and contaminated items. Store with chemical waste. Store in secondary container.
- *Solid Spills:* When solid or powder material spills, the most important measure to take is to prevent the formation of dust when picking up the spill. Before beginning the collection of solid, be sure to don respiratory protection, especially if dealing with carcinogens, acute toxicants, reproductive toxicants, and/or respiratory sensitizers. Minimally, a N95 respirator is needed for dust particles, but if the SDS recommends a half-face or full-face respirator (see section 4.1 Airborne Hazards Protection), be sure that a certified user is called to pick up the spill. It may be best to clear others out of the immediate area to prevent them from breathing in stray powder. Check the SDS to see if the solid is not reactive with water. To avoid creating dust, the solid waste can be wetted with water before being swept up. If water is not compatible, check what other solvent can be used to wet the solid before it is picked up. Following pick up, dispose the solid into a plastic bag. Tie the bag securely with duct tape and double bag the waste. Discard contaminated gloves and items into another bag and double bag it as well. Attach a hazardous waste label onto the bags and store in a separate secondary container alongside chemical waste.
- *Decontamination after Pick up:* It is part of good housekeeping to decontaminate areas where a spill occurred. Water or commercial solvents can be sprayed on the contaminated area to prevent slippery floors and prevent corrosive damage. While still wearing PPE, wipe down the water or solvent until the surface is dry. Dispose of the cleaning wipes, paper towels, and gloves into the same bag with contaminated items.

- *Report the spill*: Alert the work area supervisor about the spill. Chemical spills can be reported to a supervisor when they happen (if a toxic chemical has been released) or after the spill has been cleaned up; follow whichever case keeps everyone the safest. If a supervisor is not in the immediate area and it is more prudent to clean up the spill first, then control the spill for the safety of everyone. Supervisors should assess the situation and make changes to unsafe protocol.

2.5.5 Mercury Spill Clean Up

Response Preparation

If Mercury (Hg) is used often in the work area (i.e. thermometers), it is best to have a mercury spill kit available. A web link for a suggested spill kit is referenced at the end of this chapter. Nitrile gloves, goggles, and lab coat (or long-sleeved shirt and pants) should be handy for bodily protection. Disposable pipettes (droppers), index cards, a designated dustpan, and waste bags should be part of the cleanup kit. Mercury collection pads (see below) are also available on the market and effectively pickup trace mercury. Brooms and paint brushes should not be used in mercury cleanup, they can spread mercury pieces into hard to reach areas. Do not use the cleanup items for mercury to clean up other spills. Leave these for mercury emergencies only.

*Optional: Mercury-pickup vacuums and mercury vapor detectors are commercially available for additional protection.

Isolate & Ventilate

Mercury (Hg) releases vapors into the environment which are odorless and fatal in enclosed spaces. When Hg spills, evacuate everyone who is not near the spill. Those near the spill must remain while the spill is handled so that Hg does not transfer to other areas. If HVAC

systems are in use, it is best to shut these down to avoid the suction of Hg vapors into the campus environment. If possible, open windows to clear the air.

Respond to Spill

Designate one or two persons to pick up the spilled mercury. Put on protective gear before touching contaminated areas. Any uninvolved person in the cleanup that is near the spill, must take off their contaminated shoes and/or clothing as they step out of the spill zone. Place contaminated items in a waste bag. In large spills, a respirator should be used to protect from breathing fatal vapors.

Cleanup Process

Use droppers and index cards to pick up visible pieces of mercury. The pieces can be placed on a dustpan during cleaning and disposed into waste bag as cleaning continues. Use a flashlight to illuminate the area and maximize mercury collection. If a spill kit's mercury collection solution is available, read the directions on the bottle and apply on the spill zone. When the spill kit chemical solution is not available, sulfur or zinc powder is said to help amalgamate mercury (suppressing vapor release) for easier cleanup. Place all mercury and contaminated items into the same waste bag, close tightly, affix a waste label, and place in a secondary container while storing in a chemical waste closet.

Decontaminate & Follow-up

Post-cleanup, taking care of the persons involved with mercury is crucial. Anti-dandruff shampoo (1% selenium sulfide) with warm water helps to decontaminate mercury from the skin. Mercury inspection in the spill zone should be done after letting the area ventilate for 24 hours.

2.6 Prudent Experimental Planning – Now that topics of safety have been covered, some guidelines for prudent experiment planning will be listed to bring the concept of safety in the workplace full circle.

- ✓ Design your idea with safest chemicals or tools, if possible, to do the desired job
- ✓ If safer alternatives cannot be found, consult with a knowledgeable supervisor before moving on
- ✓ Check that your area has the necessary, and functioning, engineering controls
- ✓ Ensure safety equipment and proper spill kits are nearby; check they have been recently inspected
- ✓ Know the emergency exit locations and evacuation assembly location
- ✓ Consult with administration for advice on how to minimize your risks of hazards
- ✓ Select the best PPE for the job
- ✓ Never work alone for long periods or odd hours
- ✓ Have emergency phone numbers near the workstation

- ✓ Follow personal hygiene precautions when entering and leaving the work area (i.e. washing hands and leaving food/drinks in designated locations)

Chapter 2 References & Links

OSHA 3404 Laboratory Safety Guidance: https://www.osha.gov/Publications/laboratory/OSHA3404laboratory-safety-guidance.pdf

How to safely remove disposable gloves: https://www.globus.co.uk/how-to-safely-remove-disposable-gloves

PASS graphic: http://plfr.org/public-education/fire-safety/fire-extinguishers-A-using.php

Fire Blanket Demonstration: https://www.youtube.com/watch?v=uuVynt4cJDo

Absorbent Super Sorb Spill Kit: https://www.flinnsci.com/absorbant-super-sorb-20-lb2/se101/

Sand Spill Kit: https://www.flinnsci.com/sand_065286f5/s0005/

Acid Neutralizer: https://www.flinnsci.com/neutralizer-sodium-carbonate-and-calcium-hydroxide-mixture-25-lbs/se106/

Base Neutralizer: https://www.flinnsci.com/e-z-pour-base-neutralizer/se107/

Body Fluid/Biohazard Spill Kit: https://www.flinnsci.com/body-fluidbiohazard-spill-kit/fb0061/

Absorbent Pillows for Spill Control: https://www.flinnsci.com/products/safety-supplies/spill-control--cleanup-materials/absorbent-pillows-for-chemical-spill-control/

Chemical Spill Response and Clean-Up Video: https://www.youtube.com/watch?v=18Kmo-1U1fc

Mercury Spill Kit: https://www.flinnsci.com/merconvap/ap8774/

Safety equipment pictures (fire extinguishing station, emergency shower & eyewash, first aid kit and spill kits) taken at Victor Valley College Chemistry Department.

Chapter 3: Chemical Guidelines in the Workplace

Several academic programs within the Victor Valley College community require the use of chemicals for instruction, demonstrations, and group activities. Each department has assigned individuals, or technicians, which specialize in the ordering, handling, storing, and disposing of hazardous chemicals. This chapter details general guidelines that each department should keep in mind when concerned with chemicals.

3.1 Procurement of Chemicals - Good habits of chemical safety begin with the procurement of chemicals. Every chemical that comes into the college should enter with a specific purpose in mind and approved plan for use. There should already be a designated area for its storage and arranged plans for the proper disposal of the waste and empty container. It is important to obtain chemicals which will be consistently in use so that they do not sit in storage for long periods of time. Chemicals which are not necessary for the college will take up space and are a potential hazard to surroundings. In addition, some chemicals have shorter shelf lives and degrade regardless of storage in appropriate temperature/moisture conditions. Workers should be responsible in ordering materials which will be useful and not expire before being completely used.

Workers should limit their chemical, and supply, purchases to the college's requisition and purchase system, Financial 2000. The system ensures that chemicals are shipped from contracted vendors that abide by pre-established safety terms. Chemicals that the college receives must include Safety Data Sheets (SDS) for the chemicals (formerly known as Material Safety Data Sheets, MSDS) and chemical education posters which should be posted in the workplace. Without these items in packaging, the college cannot accept hazardous materials. The SDS contains valuable information about a chemical's proper storage, reactivity information for incompatible chemicals, advice on what PPE is needed, and handling instructions. It is an extreme hazard for a worker to use and store chemicals that do not include official SDS documents. Thus, it is not prudent to procure chemicals from outside parties.

3.2 Distribution of Chemicals - Victor Valley College enforces safe distribution of received chemicals before they reach the respective department. Packages reach the Maintenance & Operations department first for inspection. This regulation is crucial for safety. Broken, leaking, and missing materials are found and handled before they even enter other areas with chemicals. The distribution, or sharing, of chemicals between departments is permissible if the receiving party obtains an SDS file along with the chemical. Both distributor and receiver are responsible for discussing the safety of the planned use and storage plans for the chemical in question. Both parties are responsible for checking previously opened chemicals for sufficient purity before passing on to a new user. The chemical information must be recorded in the inventory of the receiving department along with a description of the distributing party (for accountability reasons). It is the responsibility of the receiver to have an arranged storage location and waste disposal plan.

3.3 Safety Data Sheets – All manufactured, distributed, and imported chemicals are required to have a Safety Data Sheet (SDS) as part of the OSHA Hazards Communication Standard (29 CFR 1910.1200). The SDS document is broken into sections that list different information about a chemical:

Section 1 – Chemical Product & Company Identification – Name of the chemical and manufacturer/distributor information; recommended use; restrictions on use

Section 2 – Hazards Identification – Lists all chemical hazards; required label elements

Section 3 - Composition, Information on Ingredients – Information on chemical ingredients

Section 4 – First Aid Measures – Important symptoms/effects, acute, delayed; treatment required

Section 5 – Fire Fighting Measures – Extinguishing techniques/equipment; chemical hazards from fire

Section 6 – Accidental Release Measures – Emergency procedures, protective equipment, suggested methods of containment and cleanup

Section 7 – Handling & Storage – Precautions for safe handling and storage; incompatibles

Section 8 – Exposure Controls, Personal Protection – OSHA's Permissible Exposure Limits (PELs), Threshold Limit Values (TLVs), and/or any limits recommended by the manufacturer; appropriate engineering controls and PPE

Section 9 – Physical & Chemical Properties – Chemical characteristics (appearance, pH, melting/freezing point, flash point, solubility, relative density, etc.)

Section 10 – Stability & Reactivity – Chemical stability and potential hazardous reactivity

Section 11 – Toxicological Information – Routes of exposure, related symptoms, acute and chronic effects, numerical values of measured toxicity

Information listed in sections 12 – 15 is regulated by other agencies than OSHA; may vary since these are non-mandatory by OSHA

Section 12 – ***Ecological Information*** – Test results which may help to evaluate the environmental impact of the chemical in cases of release to the environment

Section 13 – ***Disposal Considerations*** – Guidance on proper disposal measures of the chemical and container. Safe handling practices when disposing chemical

Section 14 – Transport Information – Guidance on classification information for shipping and transporting

Section 15 – Regulatory Information – Safety, health, and environmental regulations specific for the product that is not indicated anywhere else on the SDS. May be information from national and/or regional regulatory agencies

Section 16 – Other Information – Date the SDS was prepared and last known revision date; amended section information

3.4 Storage Guidelines - Storing chemicals properly is a large responsibility whether a workplace keeps 10 or 100 chemicals. Once a chemical is received, the SDS is a great guide for deciding where to place a new bottle. This section discusses a chemical compatibility chart as a guide for deciding the appropriate storage neighbors of a chemical. In addition, proper storage cabinets and housekeeping rules will be discussed according to chemical classes.

3.4.1 Chemical Compatibility Prior to Storage

The chart below displays chemical classes along the top (x-axis) and left column (y-axis). This chart is a great reference from the University of California, Los Angeles (UCLA) Environmental Health & Safety (EH&S).

	FLAMMABLE LIQUIDS	OXIDIZERS	ORGANIC ACIDS	INORGANIC ACIDS	BASES	WATER REACTIVES	AQUEOUS SOLUTIONS	CYANIDES
FLAMMABLE LIQUIDS		X		X				
OXIDIZERS	X		X					
ORGANIC ACIDS		X		X	X	X		X
INORGANIC ACIDS	X		X		X	X		X
BASES			X	X				
WATER REACTIVES			X	X			X	
AQUEOUS SOLUTIONS						X		X
CYANIDES			X	X			X	

To check if two chemicals can be stored together, locate the space where the first chemical type on one axis meets with the second chemical type on the other axis. White (blank) spaces are safe

combinations of two different chemical classes that can be safely stored together. The spaces with a red X are combinations of chemicals which are reactive together and should not be stored together. The green spaces are combinations of the same chemical class along the x- and y-axes. These chemicals in the same class can always be stored together. Check the chemical SDS to determine the class type. If there is a mixture, consider the class of solvent (water or organic) and store with other aqueous solutions or organic solvents accordingly.

3.4.2 Designating Chemical Storage & Storage Guidelines

The place of storage for new chemicals is easy to determine if the work area is kept neat and organized into separate chemical classes. After following a few safety guidelines that are discussed below, do not hesitate to store new chemicals right away in their proper space.

Keep these housekeeping guidelines in mind for safe chemical storage:

- If the chemical to be stored is a prepared solution or a sample from a larger container, be sure to pour the mixture into an appropriate bottle and apply a detailed label before storing. *Never store unlabeled bottles.*
- When storing chemicals in a separate container from the manufacturer's original container, the new vessel and secondary container where it is stored must be properly labeled. These must list:

    a. Chemical name and chemical formula (if applicable)
    b. Date transferred and expiration date (if chemical is perishable)
    c. Primary hazard type (corrosive, flammable, oxidizer, etc.)
    d. Precautionary statements (irritant, air-sensitive, acute toxicity, etc.)
    e. Globally Harmonized System (GHS) signal word and pictogram

- Chemical storage containers are just as important as deciding what shelf to place a chemical. Some chemicals will appear to store well in bottles of certain materials, but over time, the chemical and the bottle degrade. An example of this is concentrated hydrochloric acid (HCl) in plastic bottles. HCl, and other concentrated acids, disintegrate the plastic over time through reaction, turning black. Store any concentrated acids in glass bottles to maintain chemical purity and avoid leaking containers. Ensure that any caps or droppers that may contact the concentrated acid are not made with thin plastic. Over time, dropper tops become brittle from acid contact and will break off when the dropper is used. Avoid storing chemicals in food or miscellaneous containers. Do not reuse empty chemical containers, especially cleaning solution bottles, to store different chemicals. Reaction could occur with the former chemical's residue (i.e. chlorine bleach and ammonia). *Check the SDS for storage container suggestions.*
- Store bottles of the same chemical class in *secondary containers* or trays.
- *Do not store empty containers or chemical waste* back on the storage shelf.
- *Always inspect chemical* bottles for damage before picking up off a shelf.

- Always *wear gloves before touching container* surfaces just in case of a leak or residue
- Ensure that *bottle caps and/or lids fit a container properly*. If a different cap must be used for a bottle, make sure that it fits tightly and the replacement cap is clean. Do not store bottles back on shelves if the cap is cracked or partially fits. Remember that the next person will not know about the unfitting cap.
- *Look out for chemicals that are expired* or that have the potential to transform to more hazardous substances if kept too long (i.e. peroxide formers). Expired chemicals may show signs of crystallization/precipitate (if originally a liquid), color change (darkening, yellowing, fading, oxidation by rust), and changes in smell (pungent fishy smell or overall very different smell than expected for the chemical). To prevent the storage of expired substances, make a habit to write the "opened on" date and "emptied on" date on the chemical label. Store empty containers that are peroxide formers with waste to ensure that they are removed from the lab space.
- Store chemicals of the *same class in alphabetical order* for easy finding

With the above hygiene protocol in mind, types of storage for chemical housing can be discussed. Chemical cabinets and shelving are typical in the laboratory workplace. Cabinets are a great place to store liquids, since cabinet doors provide an extra layer of stability and containment in the case of earthquakes. Any liquid chemicals in volumes larger than or equal to 4L should always be stored inside of cabinets. Flammable liquids in volume greater than 10L should not be kept outside of a chemical cabinet. Flammables, acids, and bases are the best kept inside of cabinets. The cabinets shown in the image below are the most appropriate type. When it comes to cabinets, be sure that the doors have a secure locking mechanism before even locking with a key. Cabinets with doors that open with little effort are not going to provide fall protection for chemical bottles.

When storing chemicals in tall chemical cabinets, be mindful to place heavier and larger volumes on the bottom shelf. Smaller bottles are best on shelves at shoulder level and above. Tall yellow cabinets most typically store flammables (volatile organics such as acetone, ethanol, and hexane).

Large Storage Cabinet Flammables

Benchtop Cabinet for Acids, Bases can be Stored in Similar Cabinets


Chemicals Stored in Secondary Containers


Chemical Shelving with Lips to Prevent Falling

The same cabinet type (yellow) can also store corrosives (weak acids: boric acid, acetic acid; strong acids: hydrochloric acid solutions). Benchtop cabinets are typically used for storing acids or bases. Benchtop cabinets provide limited space. They can store about three 4L bottles and smaller than

1L bottles. Tall acid and base cabinets (blue) are also available in the market, in case that larger quantities of acid and base bottles need to be stored.

After designating a storage cabinet, for one chemical type, be sure to place warning signs on the cabinet doors. Some cabinets have labels that are already posted on the surface. Additional signs that can be fixed to the doors may be warning signs against inhaling chemical vapors. Some flammable organics (alcohols) and weak acids (acetic acid) smell strongly when stored in groups. Chemical smells become concentrated behind closed doors and will quickly impact anyone who opens the cabinet. Store chemical bottles in alphabetical order, then make a list of the chemicals inside of each cabinet. Post the list of chemicals on the cabinet door to help other workers locate what they need and to avoid unnecessary chemical vapors.

Place chemical bottles of the same chemical class inside of trays that can contain spills (see picture above). Whether bottles are inside of a cabinet or on a shelf, secondary containers maintain chemical hygiene. If shelving without doors will be used for storage, maintain bottles in trays and be sure that the shelving units have lips to stop bottles from falling forward. Shelves are most practically used for bottles of less than or equal to 1L of liquid or less than 2kg of solid.

In addition, be aware that strongly corrosive chemicals will begin to degrade storage cabinets (and refrigerators) if a ventilation system is not attached. Replace chemical storages before corrosion becomes severe; it is good practice to eliminate highly corrosive chemicals if they are unnecessary and substitute them with gentler alternatives.

3.4.3 Chemical Inventory Procedures

The Victor Valley College campus updates its chemical inventory annually through a contracted company. Each department is serviced separately and the inventory reports are directed to the Executive Director of Facilities & Operations. Chemical bottles on campus have a barcode label with the company name. Labels are not to be removed, even when the bottle has been emptied. Empty chemical bottles may be collected by the waste collection company. As the inventory is updated annually, empty containers are removed from the inventory.

3.4.4 Mentionable Chemical Classes

Flammables - Substances having a flash point below 199.4˚F (93˚C). Flammable liquids usually emit volatile vapors which can be ignited without contacting the liquid. An SDS, as well as the NFPA pictogram, will list the category of flammability. Appendix B of the OSHA standards (Physical Hazards Criteria), linked at the end of this Chemical Hygiene Plan (Appendix B) provides definitions for each category of flammability. Keep flammables away from oxidizers at all times. Oxidizers fuel fires and will cause toxic gases to emit from a fire. Flammable vapors can escape from a chemical bottle and contact a nearby oxidizer. Any flammable chemicals that are dispensed from containers of conductive materials (metal drums) must be grounded before chemical is dispensed. Flammable chemicals hold static charge when poured or transferred through

electrically conductive materials. Electrical build up can be released in the form of sparks and create a fire with flammable vapors. Because of the volatile gases that escape flammable substances, it is also not safe to store flammables in a conventional chemical refrigerator. Flammable gases that build up inside of a closed refrigerator can suddenly explode from the spark of an electrical issue. Flammable chemicals must be stored in special refrigerators, preferably explosion proof type.

- *Examples of common flammables*: Acetaldehyde, Ethyl ether, Acetone, Benzene, Toluene, gasoline, diesel fuel, solvents, thinners, cleaners, adhesives, paints, and polishes

Conventional Refrigerators	Flammable Storage Refrigerators	Explosion Proof Refrigerators
		
• Contain sparking components inside the refrigerator cabinet, such as thermostats and switches, that can ignite vapors from the flammable liquids stored inside. • Commonly used due to low cost. • **Flammable materials must never be stored in these types of refrigerator!** • Please look in your refrigerator now and remove any flammable materials if your refrigerator is not approved for flammables storage.	• UL listed for storage of flammable chemicals. • Electrical sparking devices are on the outside of the refrigerator and cannot ignite flammable vapors from chemicals stored inside. • More costly than conventional refrigerators, but can safely store chemicals that exude explosive vapors. • Cannot be placed in a room containing explosive vapors.	• UL listed for explosion-proof. • Similar in design to flammable approved units, but operating components and electrical junction boxes are sealed from explosive vapors. • Limited use on campus. • Only required for storage of volatile materials in areas or rooms with explosive atmospheres, such as solvent dispensing rooms. • Very expensive and requires special wiring.

Peroxide Forming Chemicals (PFC) - A class of compounds that can form explosive peroxide (O-O peroxo units) crystals. The crystals are shock-sensitive and could explode upon opening of a chemical bottle, if crystallization occurs along the ridges of the cap. These compounds should be monitored for crystallization, yellowing, and changes in odor every few months or before performing distillations/evaporations. It is best to dispose of these chemicals when they have expired past the manufacturer's date. Label these chemicals as "peroxide formers" to keep track of them.

There are three classes of PFCs:

Class A (severe, spontaneous decomposition and explosion hazard by exposure to air)

- *Examples:* Butadiene, Chloropropene, Divinyl acetylene, Isopropyl ether, Potassium amide, Potassium metal, Sodium amide, Tetrafluoroethylene, Vinylidene chloride

Class B (peroxide hazard based on concentration; evaporation or distillation sensitive)

- *Examples:* Acetal, Acetaldehyde, Benzyl alcohol, Benzaldehyde, 2-Butanol, Cumene, Cyclohexanol, 2-Cyclohexen-1-ol, Cyclohexene, Diacetylene, Diethyl ether, Dioxanes, Ethylene glycol dimethyl ether (glyme), Furan, Methylacetylene, Methylcyclopentane, 2-Pentanol, 4-Penten-1-ol, 1-Phenylethanol, 2-Phenylethanol, 2-Propanol, Tetrahydrofuran

Class C (hazard of violent polymerization of monomers when peroxides accumulate)

- *Examples:* Acrylic acid, Acrylonitrile, Butadiene, Chloropropene, Chlorotrifluoroethylene, Methyl methacrylate, Styrene, Tetrafluoroethylene, Vinyl acetate, Vinyl acetylene, Vinyl chloride, Vinyl pyridine, Vinyladiene chloride

Pyrophorics - A class of substances that spontaneously combust (ignite) in air, below 130˚F. Pyrophorics must be handled and stored in inert gas conditions (i.e. inside of a glovebox with Argon). Contact with oxygen or moisture in air causes oxidation of compounds at a rate so rapid that chemicals ignite. Since these materials are flammable in normal air conditions, special training must be given to the persons handling them outside of the glovebox. Flame-resistant lab coats, gloves, and other flame-resistant PPE must be worn for handling. Ensure the work area has efficient emergency sprinkler system.

- *Examples:* Metal hydrides (Sodium, Potassium, Lithium Aluminum), Fine metals (Aluminum, Lithium, Magnesium, Titanium, Zinc, Zirconium, Sodium, Potassium, Strontium), Palladium on Carbon catalyst, Gases (Silane, Diborane, Phosphine)

Water Reactive - Substances that are reactive when water is present. Explosions and emission of flammable gas are most likely to occur. Extent of reactivity is classified into categories, available on the chemical's SDS. Category 1 is the most hazardous for igniting spontaneously in water. Categories 2 and 3 are not listed to ignite spontaneously, but along with Category 1, will release flammable gases. Water reactive metal compounds with cyanide or chloride ions, for example, are dangerous due to their release of hydrogen cyanide or hydrogen chloride gas when reacting.

- *Examples:* Lithium, Sodium, Cesium, Potassium, Magnesium, Barium, Calcium, Lithium aluminum hydride, Calcium hydride, Potassium hydride, Grignard reagents

Metals, such as sodium, may be stored in mineral oil to prevent the moisture in air from reacting with it spontaneously.

Corrosives - A variety of chemicals that degrade metal and destroy human tissue when in contact. Corrosives can be acidic or basic. Some corrosives are flammable, and others can form explosive compounds when reacting with other substances. For example, strong corrosives that attack metals release hydrogen in the reaction. Hydrogen is an explosive gas under high enough temperatures.

When working with corrosives, use them in a well-ventilated area. Inhalation or direct contact with corrosives will burn the respiratory and skin tissues. Corrosives of higher concentration than 1M must be stored below eye level.

- *Examples:* Hydrochloric acid, Sulfuric acid, Nitric acid, Chromic acid, Acetic acid and Hydrofluoric acid. Ammonium hydroxide, Potassium hydroxide (caustic potash) and Sodium hydroxide (caustic soda).

The danger which corrosives present with the corrosion of skin tissue should be a reminder for personnel to always wear splash proof eye goggles, not just safety glasses. Depending on the volume of corrosives dispensed and the concentration, it may be advised that personnel use face shields and rubber gloves and aprons. Eye wash stations are critical when working with corrosives and should be maintained in good standing in areas that handle corrosives constantly. Employees should know the location and operation of emergency wash stations. Any chemical spills on clothing should be immediately addressed by removing clothing and activating the emergency shower.

Particularly Hazardous Substances (PHS) - Substances that pose a significant threat to human health (Cal/OSHA) are divided into three types: Acute Toxicants, Reproductive Toxicants, and Carcinogens.

- *Acute Toxicants* - OSHA has described acute toxicants as potentially "fatal" or to "cause damage to target organs as the result of a single exposure or exposures of short duration". The toxicity of this subclass is measured by Lethal Dose (LD_{50}) or Lethal Concentration (LC_{50}). Lethal Dose is the amount of a substance, given all at once, that kills 50% of a test animal population in chemical studies. LD_{50} measures the effect of exposure to a single dose. Lethal Concentration is the concentration of a chemical in air or water that will kill 50% of a test animal population after the chemical has been administered over a four hour period. Test animals are monitored over the next 14 days; the concentration to kill 50% of the population will be recorded as the LC_{50}. LC_{50} measures the effect of constant exposure to a chemical over a period of time. The routes of exposure to acute toxicants can be through inhalation, absorption from direct contact (eyes, skin, mucous membrane), or by ingestion. The LD_{50} or LC_{50} of an acute toxicant varies depending on the route of exposure and the type of chemical. The table below shows toxicity ranges for two categories of acute

toxicants, as determined by OSHA standards. However, the specific values for lethal exposures to follow are found on a chemical's SDS.

Routes of Exposure		Toxicity Range		Hazard Statement	Pictogram
		Category 1	Category 2		
Oral (mg/kg body weight)		$LD_{50} \leq 5$	$LD_{50} > 5$ and ≤ 50	Fatal if swallowed	
Dermal (mg/kg body weight)		$LD_{50} \leq 50$	$LD_{50} > 50$ and ≤ 200	Fatal in contact with skin	
Inhalation	Gases (ppm)	$LC_{50} \leq 100$	$LC_{50} > 100$ and ≤ 500	Fatal if inhaled	
	Vapors (mg/L)	$LC_{50} \leq 0.5$	$LC_{50} > 0.5$ and ≤ 2.0		
	Dust (mg/L)	$LC_{50} \leq 0.05$	$LC_{50} > 0.05$ and ≤ 0.5		

Due to the sensitive and extreme toxic nature of acute toxicants, it is even more important to keep chemical hygiene a priority. This includes working with chemicals in designated well-ventilated areas, keeping food and drink out of the workplace to prevent exposure through ingestion, washing hands thoroughly during the work period, cleaning up surfaces thoroughly if the space is shared with other chemicals, and using proper PPE to avoid exposure. When weighing substances with the health hazard or skull and crossbones label, wear at least N95 respirators to prevent the inhalation of potential dust particles. Always handle toxic chemicals in the hood to prevent the spread of their smell and put a barrier in between you and chemical solutions.

- *Examples:* Acrolein, Arsine, Chlorine, Diazomethane, Diborane, Dimethyl mercury, Hydrogen cyanide, Hydrogen fluoride, Methylfluorosulfonate, Nickel carbonyl, Nitrogen dioxide, Osmium tetroxide, Ozone, Phosgene, Sodium azide, Sodium cyanide and other cyanide salts, Tetramethylammonium hydroxide (TMAH)

- *Reproductive Toxicants* - Under this class are chemicals known to affect the human reproductive system (RS). Reproductive toxicants are harmful to both male and female workers. The RS is impacted by chromosomal damage, or mutations in reproductive cell DNA. Chemicals which cause mutations in reproductive DNA are known as **mutagens**. They can harm either sperm or eggs and, according to studies, be passed on to new generations with the inflicted mutations. The other type of reproductive toxicant is known as a **teratogen**. Teratogens can cause birth defects, or congenital malformations, in fetuses. It is crucial for pregnant workers to protect themselves when working with this type of hazard. Check the chemical SDS for reproductive health hazard data.
  Examples of Reproductive Toxicants are listed below.

- *Examples:* Acetaldehyde, Arsenic, Aniline, Benzene, Carbon disulfide, Chloroform, Chloroprene, Dimethyl formamide, 2-Ethoxy ethanol, Ethylene thiourea, 2-Ethylhexanol, Glycol ethers, Hydrazine, Hexafluoroacteone, Halothane, Lead compounds, 2-Methoxyethanol, 2-Methoxyethyl acetate, Methyl chloride, N-Methyl-2-pyrrolidone, Propylene glycol monomethyl ether (acetate), Propylene oxide, Trichloroethylene, TOK (herbicide), Toluene, Vinyl chloride

- *Carcinogens* - Chemicals that increase the probability of developing cancer are identified by this class. The International Agency for Research on Cancer (IARC) has grouped carcinogens into three groups, based on carcinogenicity research:
  - *Group 1 - Carcinogen to Humans*
  - *Group 2A - Probably Carcinogenic to Humans*
  - *Group 2B - Possibly Carcinogenic to Humans*

The likelihood of negative impact from handling carcinogenic substances is dependent on the concentration that is being handled and how long it is being handled. Use of carcinogenic compounds should be approved by a workplace supervisor before beginning use. Supervisors can protect workers by administrative and engineering controls. Regulated carcinogens have Permissible Exposure Limits (PEL) values, check the chemical SDS toxicity data section. PEL measurements are based on either an eight hour Time Weighted Average (TWA) or a 15 minute Short Term Exposure Limit (STEL). To prevent any one worker from handling a carcinogen for an extended period of time, supervisors can alternate workers. It is also crucial that projects are planned according to PEL values, in order to maintain safe concentrations at all times.

- *Examples:* Acetaldehyde, Acetamide, Acrylamide, Acrylonitrile, Actinomycin D, Allyl chloride, p-Aminoazobenzene, o-Aminoazotoluene, Aniline, Antimony trioxide, Arsenic compounds, Asbestos, Azobenzene, Benzene, Benzyl chloride, Beryllium compounds, Bromodichloromethane, 1,3-Butadiene, Cadmium compounds, Carbon tetrachloride, Chromium compounds, Cobalt metal and (II) oxide, Dichloromethane (Methylene chloride), Ethylene dihalides, Formaldehyde, Glycol, and Lead compounds

The list above is very concise compared to the extensive list of known carcinogens. An expanded list of carcinogens can be found in the References & Links section at the end of this chapter. Explore the list under “List of Select and Suspected Carcinogens” link.

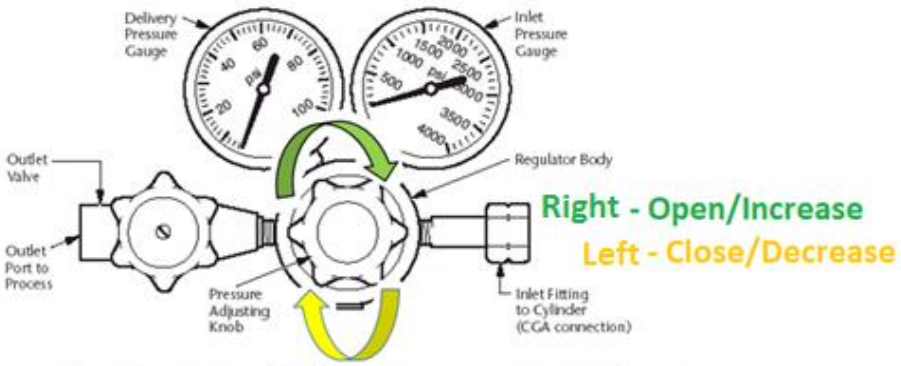
3.4.5 Compressed Gas Cylinder Storage & Safety

Special areas on campus may need to store gas cylinders for specific uses. Gas tanks must be stored in a separate area that is away from other chemicals and ignition sources. They must always stand upright and must have their storage cap on tightly when not in use. Gas cylinders must be kept chained against a wall or in a special cabinet for compressed gas cylinders. Bolted gas tank racks

must be installed if the cylinder(s) will be stored by a wall. A sturdy metal chain (about 3/4 up from the bottom of the cylinder) must be used to restrict the cylinder in its position. Best storage practice for cylinders is to install two metal chains: the first about 1/3 and the second about 2/3 up the length of the cylinder. This is to ensure maximum stability in an earthquake situation. Other guidelines to follow regarding cylinder storage are:

- *Never store gas cylinders in a laying down position*, regardless if empty or full
- *Never store cylinders without the cap* over the valve
- Ensure the *tank valve is fully closed* and the *regulator is depressurized* before removing the regulator
- Store *gas cylinders in cool and dry place*; high temperatures affect compressed gases
- Ensure that the material used to secure cylinders is very sturdy - *metal chains are the best*, avoid rope, rubber cords, and stretchy materials.
- Store *incompatible gases separately*; have *at least 20 feet distance* or a five-foot firewall barrier in between if incompatibles must be stored in the same area. Gases travel if a cylinder is leaking, thus, barriers provide additional safety.
- Lecture bottles (small gas tanks) are especially susceptible to leaks. The valve may suffer more impacts from improper storage (see image below). *Do not store lecture bottles with regulator* (described below) attached, pressure may build up if the valve is leaking.
- *Label empty cylinders* clearly and maintain separate from cylinders in use

When cylinders are to be used, remove the storage cap and check that the top valve is fully closed. Then, select an appropriate gas tank regulator (see schematic below).



Schematic of Gas Cylinder Pressure Regulator

Install the regulator by lining up the regulator inlet fitting to the gas cylinder's valve opening. Screw on the assembly to the point where the nut is on finger-tight. Once finger-tight, take a wrench and turn the nut until it is tight. Avoid overtightening. A line will need to be installed on the outlet side of the gas regulator depending on the application. The material of the line will be determined by the type of gas to flow. Typically, copper or stainless-steel tubing can be used to create a gas line. Check the SDS of the gas or gas manufacturer for recommended line materials. If a cylinder will be connected permanently next to an instrument or somewhere that it will be used on a regular basis, make sure that the regulator is not obstructed or in danger of receiving impact by a tight space. After regulator and line installation, the flow of the gas can be safely controlled. Before opening the gas tank valve, ensure that the pressure adjusting knob of the regulator is turned a few times to the left. This closes the flow of gas from leaving the regulator. Once the gas tank is open, the gas flows in to the regulator from the right inlet. The inlet pressure gauge (right) will increase, stabilize, and reflect the gas pressure inside of the gas cylinder. To control how much gas pressure from the tank can be release into the line on the left side of the regulator, turn the pressure adjusting knob slowly to the right. The knob should feel tighter as it is turned. Turn the knob a few times to the right and slowly the pressure on the delivery pressure gauge will increase. Adjust the knob slowly to ensure the pressure does not spike to an undesired level. The left side delivery pressure gauge determines how much gas pressure can enter the gas line. Discussion of the basic parts of compressed gas cylinder use is highly important for chemical hygiene. Due to the sensitive and risky nature of compressed gases, it is imperative that those who handle gas vessels understand and follow the careful assembly, operation, and storage of gas cylinders and lecture bottles.

Just the same as the laboratories which store solid and liquid chemicals, if a work area keeps different types of gases, there are bound to be chemical types which must be separated. Hygienic practices with gas cylinders come in with respect to gas regulators. Since regulators are the main tool which meets gas molecules, designate regulators to specific gases. Labeling regulators for use with only certain gas cylinders avoids contamination or dangerous mixtures of incompatible gases within regulators. Incompatible gases:

Airgas
an Air Liquide company

Incompatibility Table

The table below provides criteria for separating hazardous materials:

Type Material	Nonflammable Gas	Flammable Gas	Oxidizing Gas	Highly Toxic & Toxic Gas
Nonflammable Gas	—	C	C	C
Flammable Gas	C	—	20 feet or separation	20 feet or separation
Oxidizing Gas	C	20 feet or separation	—	20 feet or separation
Highly Toxic & Toxic Gas	C	20 feet or separation	20 feet or separation	—
Corrosive Gas	C	20 feet or separation	20 feet or separation	20 feet or separation

C - compatible

*Common **Nonflammable** gases:*

Argon, Helium, Neon, Nitrogen (includes Liquid Nitrogen)

*Common **Flammable** gases:*

Acetylene, Propane, Butane, Ethylene, Hydrogen, Methylamine, Vinyl Chloride

*Common **Oxidizing** gases:*

Oxygen, Nitrogen Oxides, Halogens (Chlorine and Fluorine)

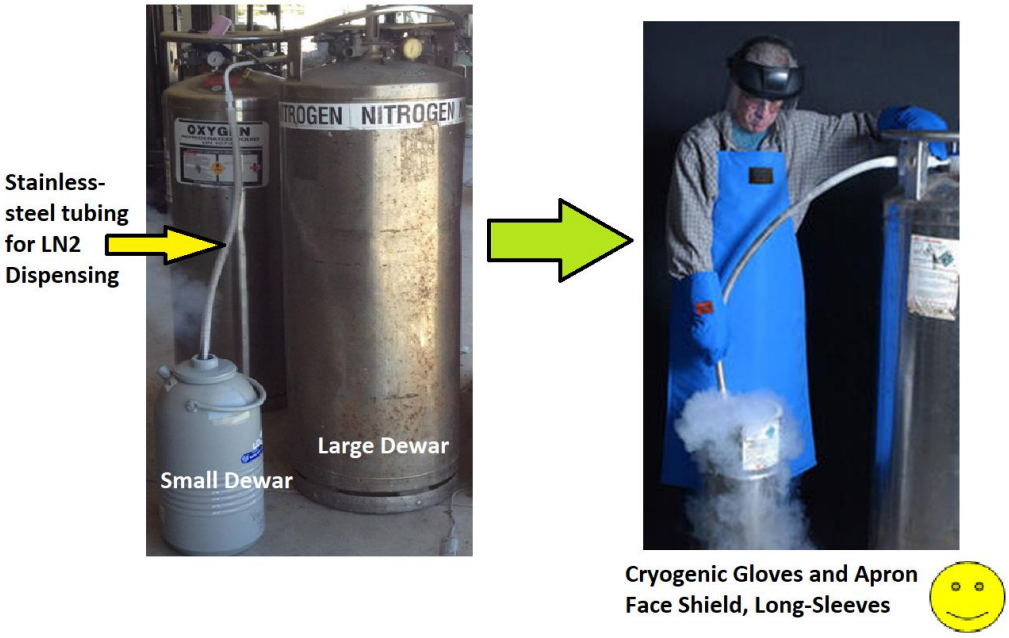
*Common **Highly Toxic & Toxic** gases:*

Carbon Monoxide, Hydrogen Chloride, Sulfur Dioxide, Nitrogen Oxides, Ammonia

*Common **Corrosive** gases*:

Ammonia, Hydrogen Chloride, Chlorine, Methylamine

Apart from the classes above, another mentionable compressed hazard type is the cryogen class. Liquid nitrogen is the most commonly used workplace cryogenic substance. Despite being nonflammable, noncorrosive, and odorless, this liquefied gas can be extremely hazardous for unprotected workers. The best plan for users of liquid nitrogen (LN_2) is to wear cryogenic gloves, a face shield, and protective clothing (apron and long sleeves or lab coat, long pants, and closed-toe shoes) when dispensing. The fumes and liquid of LN_2 can freeze and damage skin tissue; high volumes of LN_2 displace oxygen in the surrounding atmosphere, leading to asphyxiation. LN_2 is sold in large, cold-resistant, stainless-steel cylinders called Dewars. These Dewars are usually much larger and heavier than thin gas cylinders. Do not attempt to move Dewars alone or without a dolly that is specifically for transporting Dewars. Smaller Dewars are available for dispensing LN_2 from the large tank into a more convenient vessel.



To know what storage class a new cylinder falls under, read the SDS of the gas as well as inspect the cylinder surface for hazard labeling. Cylinder labels display the molecule name and hazard class in the form of colored diamonds such as the ones below.

These pictograms help to immediately recognize the type of hazard that the gas presents. Do not remove these labels. Store cylinders of the same class together. Remember to maintain at least 20-foot distance between incompatibles and at least three meters distance of flammables from ignition sources.

Workers may need to move gas cylinders from time to time. Gas cylinders must be handled with extensive care when transported. Avoid handling cylinders alone. Purchase a dolly/cart that is specifically for carrying gas cylinders. Do not forget to chain cylinders at all times when moving them. Sometimes a cylinder must be rolled out of a space before transporting. Short-distance rolling may be safe if it is done slowly and is done only to move the cylinder onto a dolly. Long periods of shaking, rolling, or pulling agitate the compressed gas. There is an increase danger of cylinders falling or suffering impact when moved incorrectly. Most importantly, do not move a cylinder if the storage cap is not on tightly. If the gas valve suffers impact, the cylinder can leak silently, becoming a problem in the future, or - worse - become a projectile if the valve has been hit severely.

3.5 Waste Disposal - Different workspaces in our community will generate different types of waste. The Occupational Safety and Health Administration (OSHA) defines hazardous waste or hazardous substances as "all substances that exposure to which results or may result in adverse effects on the health and safety of employees" (29 CFR 1910.120). This section provides information for keeping unwanted materials in the most hygienic system possible.

3.5.1 Waste Collection Information

Firstly, the college community must have a contracted waste collection and disposal company. Employees in charge of handling chemicals or materials, laboratory technicians for example, are responsible for coordinating with the Maintenance & Operations (M&O) department for the collection of hazardous waste containers. The contracted waste company has a set schedule for two pickups during the academic year (summer and winter). However, if storage locations become

too full, it is best to arrange a pickup to prevent overcrowding in storage or the need to store excess waste in undesignated areas.

3.5.2 Types of Waste Containers

Depending on the department, appropriate designated locations and containers must be provided to store unwanted chemical, biohazard, and sharps waste. Following is an image with examples of common waste containers.

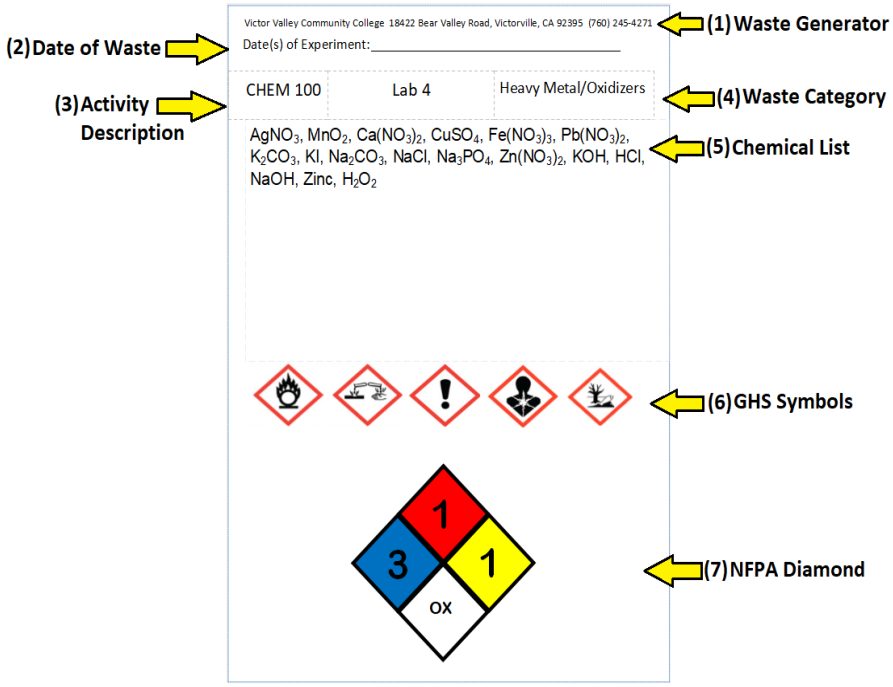
The top three waste containers are most commonly found in the chemistry laboratories of our campus. The High-Density Polyethylene (HDPE) plastic containers are used to store waste from chemistry course experiments. Larger HDPE containers can be used for waste if the quantity of the same waste demands it. Broken glass is also a kind of waste. It must be disposed of in a cardboard or plastic box to prevent injury to anyone collecting the waste. Additionally, waste glassware will most likely be contaminated with chemicals which may permeate a ruptured trash bag. Sharp and biohazard waste containers are needed most commonly in biological or healthcare type of laboratories. Sharps refer to needles which are contaminated with biological substances

and/or chemicals (pharmaceuticals). These red sharps containers are especially designed to keep pointy hazards inside. Biohazard containers vary in design but the warning symbol will be the same for this type of waste. These containers store anything from examination gloves, cloths, swabs, or anything (that is not a sharp) that met biological agents (bacteria, blood, body fluids). Biological waste is typically stored separately of chemical waste. This is due to the difference in waste treatment. Biohazards can be treated with high temperatures, while some chemicals might react under the same conditions.

Fire containment containers would most benefit the mechanical/machinery workspace. Many flammable chemicals and materials, such as engine oil, are constantly used there. Fire containment waste drums can hold any contaminated paper, cloth towels, or gloves. In areas with large flammability risk, it is the most hygienic practice to clean up and contain all flammable hazards into one steel drum. Liquid waste in automotive or machine areas should be disposed into designated steel containers. Waste from cars or machines is highly toxic to the environment and should never be poured into a sink or on a grassy area. Mechanical parts that are contaminated with chemical waste should not be disposed in public trash. These parts are usually recycled by waste collection companies. Consult with the campus waste collection company as to the types of mechanical waste that can be picked up or for suggestions on proper disposal alternatives.

3.5.3 Proper Waste Labeling

Before one drop of chemical waste is disposed into a container, a label must be placed on the container. Especially in work areas that received waste from many different student experiments, it is easy to mix up or forget the type of waste you are handling. Below is a sample label for a waste bottle in the chemistry department. Labels are created on the Microsoft Publisher Software.



(1) Waste Generator: Include the college's full name, address, and phone number for accountability

(2) Date of Waste: Write in the date that the first drop of waste was created. Some chemicals may change while they sit too long in storage. For safety reasons, waste should be in and out in a timely manner to prevent the housing of transformed chemicals. Likewise, biohazardous waste is not a product that should be kept too long in the workplace.

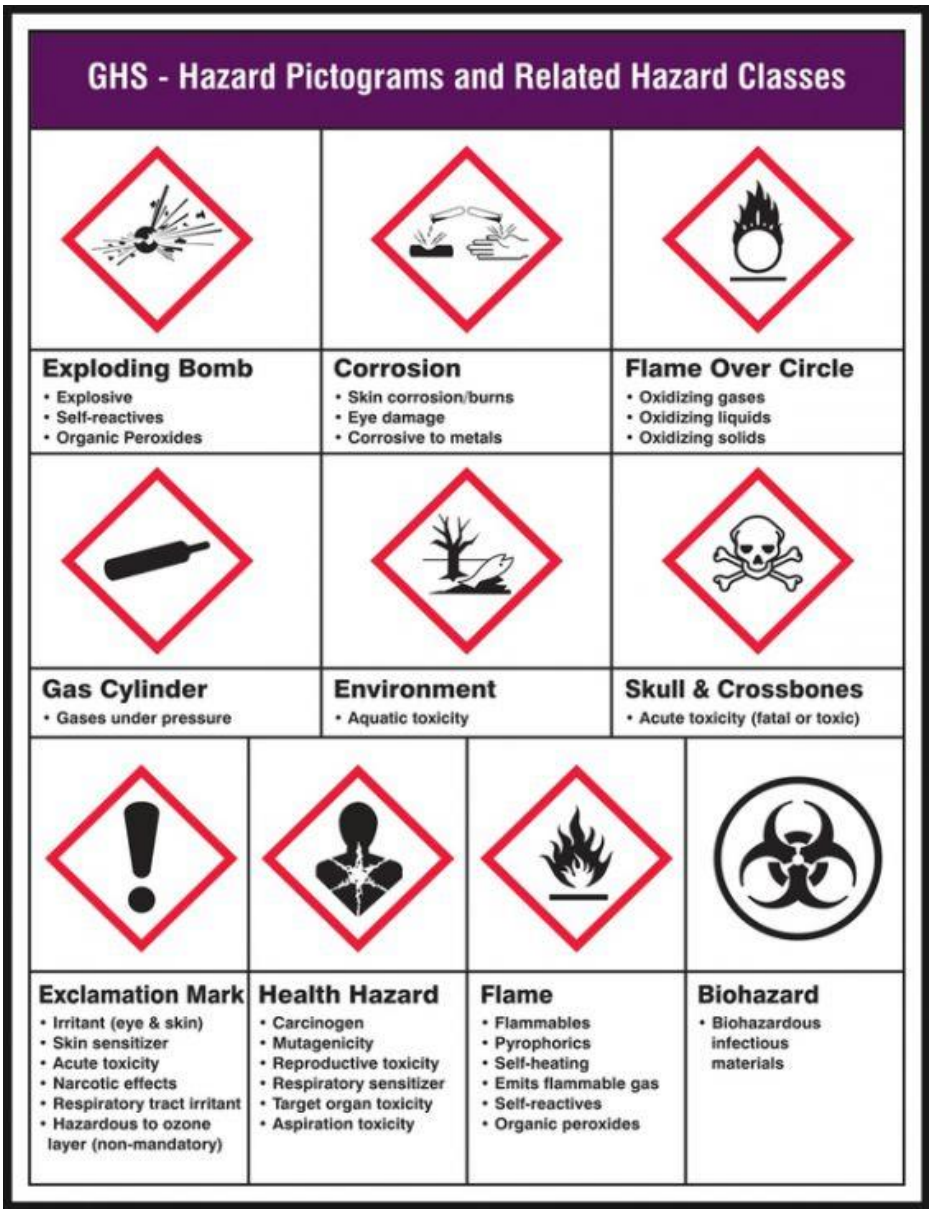
(3) Activity Description: Simply writing the experiment number and course can help to trace unknown waste back to its origin. This is helpful in the case that part of the original label may be compromised.

(4) Waste Category: In chemical labs, most compatible chemical mixtures can be coupled into one or two waste categories. Examples: Heavy metals, oxidizer, non-halogenated organic, halogenated organic, or inorganic. In some organic chemistry experiments, organic and aqueous chemicals may be used simultaneously. It is best to keep aqueous solutions separate from organic solvents, especially if the organic solvents are highly toxic to aquatic life (i.e. methylene chloride, fluorene, etc). Set out separate waste containers if this case applies. Other broad categories of waste include acid and base. Highly acidic and highly basic chemicals should not be stored in the same waste container without neutralization. Acids can be neutralized with sodium bicarbonate ($NaHCO_3$) powder or solution until bubbling ceases. Bases, such as sodium hydroxide can be neutralized with acetic acid (vinegar). Set out separate waste containers if unsure that the combination is unsafe.

(5) Chemical List: The chemical list is the most crucial information for a waste label. Before fixing on a label, be very sure that the compound formulas are written correctly. Check the SDS if there is uncertainty over stoichiometry. Rules of thumb for a more concise chemical list include: (a) common chemicals such as hydrochloric acid or sodium hydroxide can be written as HCl and NaOH. However, never skip writing concentrations. 12M HCl is more concerning in storage than 0.5M HCl. (b) Inorganic compounds can also be written as formulas instead of the entire name, unless the chemical list is short, or you want to specify a coordination number for a metal compound. (c) Organic compound names should always be written out. Carbon can form stereoisomers that have the same stoichiometry but are arranged in different positions. 1-pentanol and 2-pentanol are both $C_5H_{12}O$. Thus, writing $C_5H_{12}O$ may not be too helpful to an outside reader if they need the specific chemical name. Approach organic names by using the most common nomenclature for the chemical. It is not necessary to write the full IUPAC (International Union of Pure & Applied Chemistry) name if there is a simple and well-known name for the chemical. Check with the waste collection company for any questions that come up when labeling waste.

(6) Globally Harmonized System (GHS) Hazard Symbols: The United Nations (UN) agreed upon a system of symbols and regulations for chemical labeling in 2003. The system was called Globally Harmonized System (GHS) for Hazard Communication. In summary, these pictograms are globally recognized warning symbols. They are printed onto chemical containers and immediately describe chemical hazards. For example, a flammable chemical has a fire symbol. It

is an OSHA standard to communicate hazards on every chemical and waste label. The graphic below briefly describes the GHS pictograms.



Full details of the hazard pictograms are given in the link that is sited in Appendix B: Resources Page - Allocation of Label Elements. The link is an official OSHA Laboratory Standard publication.

(7) National Fire Protection Agency (NFPA) Diamond: Another important pictogram to add on a chemical or waste label is the NFPA diamond. The colors on the diamond represent different categories. Blue: Health, Red: Flammability, Yellow: Instability/reactivity, and White: Special class.

If there is ever a spill or fire emergency, the response team needs to immediately recognize which containers hold flammable, oxidizing, explosive, or water-reactive materials. The NFPA diamond is designed to hold number rankings on each color. A brief explanation of the NFPA 704 ratings is depicted below.

NFPA Rating Explanation Guide

RATING NUMBER	HEALTH HAZARD	FLAMMABILITY HAZARD	INSTABILITY HAZARD
4	Can be lethal	Will vaporize and readily burn at normal temperatures	May explode at normal temperatures and pressures
3	Can cause serious or permanent injury	Can be ignited under almost all ambient temperatures	May explode at high temperature or shock
2	Can cause temporary incapacitation or residual injury	Must be heated or high ambient temperature to burn	Violent chemical change at high temperatures or pressures
1	Can cause significant irritation	Must be preheated before ignition can occur	Normally stable. High temperatures make unstable
0	No hazard	Will not burn	Stable

RATING SYMBOL	SPECIAL HAZARD
ALK	Alkaline
ACID	Acidic
COR	Corrosive
OX	Oxidizing
☢	Radioactive
W	Reacts violently or explosively with water
W OX	Reacts violently or explosively with water and oxidizing

More details on the NFPA diamond are found in the link of Appendix B: Resources Page - Frequently Asked Questions on NFPA 704.

The waste label provided above is one example that Victor Valley College uses to label chemical waste. Some vendors have blank labels that can be filled out and posted on waste containers. Since these labels may not have pictograms, be sure to be as detailed as possible about chemical hazards (toxic, corrosive, flammable, etc.) when filling them out. If there is risk of the label becoming wet or coming off, vendors can supply clear slips that stick onto containers for securely holding the printed label.

3.5.4 Waste Container Storage Guidelines

Now that types of waste containers and container labeling has been discussed, it is time to approach the guidelines that workplaces should implement when storing chemical waste. This section will cover: (i) location for waste, (ii) secondary containment, (iii) empty containers, and (iv)waste from spills.

(i) ***Location for waste*** - Waste container storage locations should provide enough room to store several containers without danger of overcrowding. If different types of chemical waste are going in the same location, shelving containers by type is a good solution for keeping incompatible containers separate. If shelving is not possible, consider setting up more than one waste storage location to prevent incompatibles from being in proximity. In addition, waste should be stored in areas with proper ventilation. Preferably, store waste in designated closets with fume hood ventilation capabilities. It is best that the storage has a lock and key closure to prevent intruders from tampering with the chemical waste. Locked storage doors also work to contain bottles in case of an earthquake.

(ii) ***Secondary containment*** - In the case that a waste container is very full or is at risk for falling, it is best to store these bottles in a secondary container. A large, rectangular, plastic tray can serve as a secondary container to catch spills.

(iii) ***Empty containers*** - Although tempting to discard of empty chemical containers in the typical trash can, it is not the most hygienic route. Empty containers may hold residual solid, volatile fumes, or traces of viscous liquid. Disposing these in the trash is hazardous to the custodial staff and the environment when the trash bag is sent to a landfill. Not to mention, used chemical bottles in a trash can are a large fire hazard if an unsuspecting co-worker disposes of another chemical contaminant in the same trash can. The safest practice is to label the container as empty, with the date, and store empty chemical containers with chemical waste. A waste disposal company will handle the proper disposal of the container.

(iv) ***Waste from spills*** - Waste from spills should also be stored in a chemical waste closet. Absorbents that were used to soak up a spill should be double bagged and stored in a secondary container to prevent leakage. A detailed hazardous waste label must be affixed to waste from spills.

3.6 Decontamination Procedures - All VVC workplaces that handle equipment which processes, or stores, chemicals and biohazardous substances must perform routine decontamination to maintain workplace hygiene. The following list contains examples of equipment that should be decontaminated:

- Centrifuges
- Fume hoods
- Glove boxes
- Incubators
- Ovens
- Refrigerators & Freezers
- Storage cabinets
- Water baths & Sinks
- Animal cages and equipment
- Biological safety cabinets

Equipment with chemicals should be drained of the substance as much as possible before being scrubbed with soapy water. The chemical and rinse need to be collected as waste if the residue is hazardous to humans or the environment. Surfaces that contacted microorganisms or biohazards need disinfecting. A 1:10 Sodium hypochlorite (bleach) solution can be used to disinfect equipment. Since bleach is corrosive to metal equipment, the solution must be rinsed off after a few minutes of application. Again, collection of the contaminated bleach solution as waste is necessary. Decontamination is not strictly for equipment. Bench surfaces, floors, or glassware may also need deeper cleaning after certain uses. If soapy water is not enough to cleanup glassware, more stringent solutions can be found on the market that remove harsh chemicals.

It is also a good idea to inspect and decontaminate PPE, especially if it is shared in the work area. Begin by cleaning PPE with soapy water. Chemical splash goggles and safety glasses can be deeply cleaned with a commercial solution or routinely with ethanol; allow ethanol to air dry before using goggles.

Chapter 3 References & Links

OSHA Quick Card - Hazard Communication Safety Data Sheets: https://www.osha.gov/Publications/HazComm_QuickCard_SafetyData.html

Chemical Storage Compatibility Table: https://www.ehs.ucla.edu/specialty/research-safety/chemical-storage-handling

Secondary Containment for Liquids: https://www.ehs.gatech.edu/chemical/lsm/14-3

Chemical Shelf Lips Storage: http://www-bfs.ucsd.edu/emerg/images/Shelf_lips.html

Chemical Storage: Categories, Hazards, and Compatibilities: https://www.jove.com/science-education/10380/chemical-storage-categories-hazards-and-compatibilities

Flammables in Refrigerators: https://scholarblogs.emory.edu/ranews/2014/12/01/flammable-chemicals-and-refrigerator-storage/

Flammable Liquids Standard Defined: https://safety.blr.com/workplace-safety-news/hazardous-substances-and-materials/flammable-liquids/The-flammable-liquids-standard-defined/

Peroxide Forming Chemicals: https://ehs.weill.cornell.edu/sites/default/files/peroxide_formers.pdf

Pyrophoric Chemicals: https://ehrs.upenn.edu/health-safety/lab-safety/chemical-hygiene-plan/standard-operating-procedures/sop-pyrophoric

Water Reactive Chemicals: https://ehrs.upenn.edu/health-safety/lab-safety/chemical-hygiene-plan/standard-operating-procedures/sop-water-reactive

Corrosive Materials - Hazards: https://www.ccohs.ca/oshanswers/chemicals/corrosive/corrosiv.html

Particularly Hazardous Substances (PHS): https://www.ehs.ucla.edu/specialty/research-safety/chemical-storage-handling

Acute Toxicants - What is LD50 and LC50: https://www.ccohs.ca/oshanswers/chemicals/ld50.html

Carcinogens: https://www.osha.gov/SLTC/carcinogens/standards.html

List of Select and Suspected Carcinogens: https://ehrs.upenn.edu/health-safety/lab-safety/chemical-hygiene-plan/standard-operating-procedures/sop-carcinogens

Chemical Storage & Handling - Particularly Hazardous Substances: https://www.ehs.ucla.edu/specialty/research-safety/chemical-storage-handling

Gas Cylinder Rack: https://store.interstateproducts.com/products/justrite-gas-cylinder-barricade-rack-5-cylinder-capacity.html

Lecture Bottles: https://ehrs.upenn.edu/health-safety/lab-safety/chemical-hygiene-plan/fact-sheets/fact-sheet-lecture-bottle-safety

Compressed Gas Cylinder Safety Slideshow:
https://www.slideshare.net/industrialsafetyblog/compressd-gas

Safe Cylinder Lifting Handle: http://sublift.ie/product/gas-bottle-lifting-handle/

Incompatible Gases Table: https://slideplayer.com/slide/12689995/

Gas Cylinder Hazard Diamonds: https://www.worksafe.qld.gov.au/injury-prevention-safety/hazardous-chemicals/managing-hazchem-risks/gases-in-cylinders

LN_2 Safe Dispensing: https://www.analytica-world.com/en/whitepapers/108525/burn-injuries-under-freezing-labor-protection-conditions.html

Lab Decontamination:
https://www.cmich.edu/office_provost/ORGS/Lab_Safety/Chemical_Safety/Pages/Laboratory-Equipment-Decontamination-Procedures.aspx

NFPA 704 Informational Bulletin: https://sonomacounty.ca.gov/PRMD/Fire-Prevention/Bulletin-NFPA-704/

Chapter 4: Safety in the Technical Workplace

4.1 Airborne Hazards Protection - Airborne contaminants from toxic chemicals are sometimes difficult to control in the workplace. In our community at Victor Valley College, there are different options of PPE to keep our breathing environment as filtered from hazards as possible. Below is a chart that showcases common equipment that our community may use as barriers to airborne chemical hazards.

N95 Particulate Respirator 	***Dust & small airborne particles (0.3microns)** ***Blocks some liquids and microorganisms** ***Disposable (place in separate trash bag before discarding)** ***Not intended against strong acids & volatile organics**
Surgical Mask 	***Barrier to biological agents: blood, body fluids, bacteria** ***Same mask should not be worn >8hr continuously** ***Does not protect against pungent chemical odors** ***Disposable in biohazardous waste**
Full Face Respirator 	***Filters solid, liquid, and gas particles when fitted properly** ***Filter cartridges must be chosen for the application** ***Not suitable for claustrophobes or respiratory illnesses** ***Only trained users should wear when handling chemicals** ***Mask can be heavy for new users, dangerous if not fitted properly**
Half Face Respirator 	***Similar respiratory protection as full face respirator** ***Eyes require additional protection, not provided** ***Filter cartridge sometimes not replaceable** ***Respirators must be cleaned with solution to be safe** ***Protect from strong acids & volatile organics with proper filter cartridges**
Face Shield 	***Intended for splash protection (i.e., with large liquid vol)** ***Minimal protection against pungent chemical odors** ***Not explosion-proof** ***Should be wiped with solution before use and if shared among workers**

4.1.1 Respiratory Protection Program

Respiratory Protection

The Respiratory Protection standard (29 CFR 1910.134): Employers are required to establish a respiratory protection program. A respirator shall be provided to each worker when the respirator

is necessary to protect workers' health. The employer shall determine the hazards in the workplace which require respiratory protection. As part of the Respiratory Protection standard, employers shall provide medical evaluation for certification, equipment, and training on the PPE free of charge to employees. The employees must submit to a medical evaluation and fit testing before use of tight-fitting respirators. Employees that use respirators on a routine basis should be medically evaluated periodically if their environment has a high exposure to respiratory hazards.

- ***Medical Evaluation*** - Full and half-face respirators are great tools for respiratory protection in risky environments. Training before use of these face pieces is highly important due to the limited breathing space that the respirators provide for first time users. To be certified in using a respirator, employees need to be in good respiratory health and feel comfortable in potentially claustrophobic environments. Physical examinations are a requirement in the Respiratory Protection standard. A doctor must evaluate a worker as healthy enough to work with a respirator on for potentially long periods of time. Among the routine medical tests for respirator approval are that of lung capacity, flexibility, and brief aerobic performance.
- ***Fit Testing*** - During fit training, users are walked through the installation of the respirator (N95, full or half-face) on their face and the proper positive and negative pressure tests that must be performed to ensure proper facial seal. Trainings of full and half-facepiece respirators test respirator seal by performing a gas test. A non-hazardous gas (such as banana oil) is burned around the filter area. The user is asked if any trace can be smelled inside the mask. If any gas enters the respirator, the user must adjust the facepiece until the seal is properly mastered. Trainers will often hold a conversation with the trainee to ensure that calm breathing is sustainable when wearing the mask.

The use of full and half face respirators is a serious matter and all training before approved wear is important. Workers should not attempt to use these respirators without prior instruction or in solitary environments. The N95 Particulate Respirator, surgical mask, and face shield do not require such rigorous training prior to use but should nonetheless be used with caution and pre-meditated safety measures. A video link for the proper installation of an N95 Particulate Respirator on the face is listed at the end of this chapter.

- ***Hazard Training –*** Employers are responsible for arranging training for respirator users. Training must include the "donning and doffing" of respirators in routine and emergency situations. Employees must be trained in the proper protocol for exiting the workplace in case that breathing environment is highly contaminated or the respirator fails to protect. Employees must also be informed on the limitations of the PPE which they are using.
- ***Maintenance of Respiratory PPE –*** Employers must inform workers on the disinfection of respirators. It is important to clean respirators so that contaminants do not build up inside of the breathing and filtering chambers. Commercial solutions are available for disinfection. Depending on the hazard that the respirator is contacting, the appropriate solution should be applied as soap and water may not clean enough. Employees should also be aware that filtering cartridges must be replaced depending on the frequency of use. Manufacturers may have suggestions for how often cartridges should be switched out. A record should be maintained by the employer on the date that cartridges are changed.

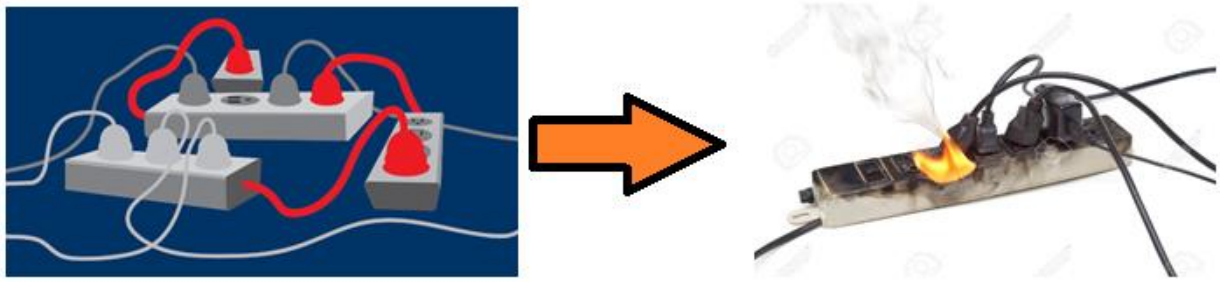
- ***Program Audit –*** Respirators are a part of the PPE program. The efficiency of workplace respirators should be audited annually or as necessary.

4.2 Mechanical/Machinery Safety - This section discusses the precautions that should be taken in the departments which handle and store machines, power tools, automobiles, and such mechanical instruments. The exact procedures, called Standard Operating Procedure (SOP), and manuals for safely using these machines should be stored in the workplace. Hygiene here does not only refer to the cleanliness of oneself, but the cleanliness of the work space. Accidents are preventable when:

- *Signs* with clearly labeled hazard warnings are present in the appropriate workspace
- Tools, machines, and power cords are *picked up* and out of the walk ways, emergency exits, fire extinguisher station, and emergency eyewash and shower
- Workers wear appropriate *PPE* for places with potentially falling parts, sparks, chemicals, or moving parts from automobiles, machines, and/or power tools
- Workers are *instructed* on and *supervised* before operating any equipment alone

Most machines need chemicals to operate smoothly. As with any typical laboratory setting, chemicals that are used with machinery should include a Safety Data Sheet (SDS). The SDS will give a comprehensive list of the compounds which make up the substance and what hazards could be present with storing the chemical. It is important to read and keep the SDS available to all. Even if the chemical is a common fluid that is sold in stores, for example, the manufacturer usually has an SDS available online. Many chemicals which are used with machinery can be flammable, volatile, and toxic. In some cases, they can be carcinogens (chemicals which promote cancer). Thus, all workers should understand their role by using PPE, washing hands thoroughly, and avoiding smoking, eating, and drinking in the workplace. Be sure that the machine conditions (temperature and pressure) are appropriate for any chemical that may be placed inside or used in conjunction. Avoid using explosives or highly flammable materials around machinery. The heat and friction created by machinery may create sparks and lead to unforeseen chemical ignition.

4.3 Electrical Safety - Safe use and setup of electrical equipment is important in all work settings, but most critically in those which store chemicals. For convenience, some people may be tempted to connect several electrical extensions together (as shown below). This is called a "daisy chain" and is highly dangerous. The connection can become overloaded and cause a fire.



Daisy chains are not safe in laboratories and automotive/machinery stations due to the proximity of flammables and oxidizers. The best practice is to have fire sensitive chemicals stored in special cabinets that are away from incompatible chemicals. Improper chemical storage can lead to explosions, and thus the generation of toxic gases, during a fire emergency.

Proper chemical hygiene must include the knowledge and practice of maintaining a space free of hazardous situations. Thus, power cords should not have too many connections for long periods of time, especially if they are unnecessary or unsupervised. Due to the need in laboratory areas for many different pieces of equipment, it is best to arrange equipment to connect directly to a wall outlet. If a surge protector must be used, limit the number of connected appliances and avoid daisy chaining power cords.

Ensure that other workers in the area are safe by posting signs in locations where high voltage equipment is in use. Train workers to be cautious around operating electrical equipment. Communicate the ***"Lockout/Tagout" OSHA standard: The Control of Hazardous Energy standard (29 CFR 1910.147).*** Electrical equipment is required to be locked out and tagged as unusable while it undergoes repair, testing, maintenance, or is set in a project of construction. The standard ensures that all electrical and mechanical equipment is completely shut down and labeled to prevent sudden electrical emergencies to unaware users. Allow only trained personnel to work with electronics and that only certified technicians repair equipment. Avoid interfering with the inner connections of electrical equipment; especially avoid touching electrical zones while the equipment power is on. Completely unplug equipment if there is a technical issue and do not run it until a repair person arrives. Place signs over equipment that is "Out of Order", so that others do not operate faulty electrical equipment.

4.4 Hot Work - When performing work that produces flames or sparks, such as brazing, cutting, grinding, soldering, thawing pipe, torch applied roofing, and welding, certain precautions must be taken. Projects that involve high temperature are referred to as "Hot Work". Due to high flammability risk, all hot work must be pre-approved by an area supervisor. Workers in hot work environments should not be allowed to work alone. Someone should supervise, or "spot", hot

workers while the work is performed. Supervisors and workers should pre-designate a safe area for hot work to take place. A safe area is well-ventilated, free of flammable materials, and clear in case of necessary exit. Signs should be placed around the hot work area to warn others about the nearby hazard. Hot workers and spotters should know how to use a fire extinguisher and how to setup hot work equipment properly. Workers should also know the nearest fire exits in the area. Spotters should watch for fire hazard during the hot work and for a minimum of an hour after the hot work is finished. For practical reasons, flammable or explosive chemicals (compressed gases, fuel) need to be at least 50 feet away from the designated hot work area.

Hot workers must wear fire-resistant PPE (gloves, coat/apron) at all times while working. Special eye and face protection is required to protect worker's eyesight from the damaging light that is emitted from high-temperature torching and welding. Face protection is required during spark-emitting processes. Select PPE that is best for the work.

4.5 Noise Hazards - Several departments on campus work in areas of variable noise. In relation to chemical hygiene, the regulated approach to workplace noise is in everyone's best interest in order to prevent chemical accidents. OSHA has standards of noise which are acceptable in the workplace, as shown by the table below (standard 1910.95(b)(2)).

Permissible Noise Exposures

Comparison of Duration Per Day in Hours to Allowable Sound Level in dBA (Slow-Response SPL)		
Duration per day (hours)	Sound level (dBA, slow response)	**PEL = 90 dBA (TWA), or 100% Dose**
8	90	
6	92	
4	95	
2	100	
1	105	
½	110	
0.25	115	

- **PEL:** The permissible exposure limit (PEL) for noise is **90 dBA**, as an eight hour time-weighted average (TWA). The PEL is also referred to as a 100 percent "dose" noise exposure. [Table G-16]

Not only can noise be damaging to health, but it can also be a distraction while working. Personnel who handle chemicals or perform hazardous processes should be fully aware of their surroundings. Prudent laboratory practices dictate that workers (and students) should avoid wearing headphones (for entertainment purposes) that can completely prevent them from hearing in the workplace. Workers should be able to hear others in the area and clearly hear conversations. Hearing in the workplace is especially necessary when handling hazardous chemicals, power tools, or hot items. If there is some noise in the area and handling the previously mentioned hazards is necessary, move slowly and look around before turning or proceeding into a different room.

In some cases, noise is not for entertainment purposes; it can be a workplace-related noise. Supervisors should ensure that necessary and continuous noises are regulated in loudness and length of time. If noise is not able to be turned down or shut off after eight hours, workers can use workplace earplugs or approved noise-cancelling headphones. Another option is to isolate the hazard by soundproofing the area surrounding workplace noise.

4.6 Pregnant Worker Safety - From time to time pregnant workers may arise in our community. There are governmental laws which protect and allow pregnant women to continue in their position. Pregnant students should notify their professors before continuing laboratory work in a course. Pregnant workers should talk with their doctor about the hazards which may be present in their workplace. A list of chemicals which the woman is most exposed to should be discussed with their care provider. Doctors consider the type of chemical, exposure length, quantities used, and whether the patient's work environment has engineering and administrative controls. Doctors can suggest if more PPE is necessary around discussed chemical hazards.

Some pregnant women may have symptoms that can affect their everyday work. For example, some women experience rashes during their pregnancy. The prolonged use of laboratory gloves may begin to irritate their skin. Thus, hand washing is important not only for cleansing away hazardous chemicals, but for keeping the skin free from irritants like sweat. Skin moisturization must be a part of the hygienic routine to prevent cracking of skin and itching. Scratching could open the skin further and leave it vulnerable to quick entry by chemicals.

Sensitivity to odor and nausea may be another change for a pregnant worker to experience. When working around chemicals, certain smells may become enhanced or uncomfortable. Especially when opening cabinets with many chemicals, the smell can be overwhelming. Ensure that the workplace has available dust masks (N95 respirators) and a half-facepiece respirator for organics/acid vapors. If necessary, have another person retrieve chemicals to avoid direct contact with chemical odors. Allow any enclosed chemical storage areas to air out before retrieving chemicals yourself.

Read the labels of every chemical before opening. Powders and volatile organic liquids should be handled most carefully. These are the most likely to be inhaled if there is lack of ventilation. All chemical work should be confined within a chemical fume hood. Respiratory masks help when working outside of the fume hood. Workers in biohazard environments should wear surgical masks to prevent the contraction of biological agents. Mask types are discussed in the Airborne Hazards

Protection section (4.1). It is crucial that pregnant workers wear gloves and long-sleeved PPE to prevent the contact of any chemical with their skin. Certain chemicals classified as teratogens are harmful to unborn children. If these chemicals achieve crossing into the placenta, they can cause mutations in the fetus' development also known as congenital malformation. In general, all workers should always protect themselves from teratogenic and mutagenic chemicals. Section 3.4.4 of this document lists more information on Reproductive Toxicants and some chemical examples.

Other workplace hazards that pregnant workers should keep in mind include: avoiding heavy lifting, slippery areas, performing tasks that can lead to a fall (reaching too high on a shelf, standing on a chair to reach something), avoiding the holding of chemicals too close to the body, and avoiding trauma to the abdomen. Keep the body well covered with a closed laboratory coat or wear an apron under a laboratory coat. Avoid tasks or environments of extreme heat or extreme cold. Discuss administrative controls with workplace supervisors and healthcare provider when unsure if a task is safe.

Chapter 4 References & Links

Dust Mask

https://www.dharmatrading.com/tools/dust-masks.html

https://www.fda.gov/medical-devices/personal-protective-equipment-infection-control/masks-and-n95-respirators#s5

Surgical Mask

https://www.osha.gov/Publications/respirators-vs-surgicalmasks-factsheet.html

Full-face Respirator & Half-face Respirator

https://www.osha.gov/video/respiratory_protection/resptypes_transcript.html

Face Shield

https://www.grainger.com/content/qt-face-shield-protection-373

Using an N95 Respirator Mask: https://www.youtube.com/watch?v=_kIYxfJXfhc

OSHA Noise Conservation Standards:
https://www.osha.gov/SLTC/noisehearingconservation/standards.html

Chapter 5: Standard Operating Procedures

The Victor Valley College campus hosts several departments that require the use, storage, and disposal of hazardous chemicals and equipment. Although the application of each department's hazardous materials may be unique to their vocation, it is imperative that the handling of hazards be standardized. Key regulations and practices must be put in place in an effort to unify the safe use, storage, and disposal of hazardous materials. Standard Operating Procedures (SOPs) as listed in this Chemical Hygiene Plan (CHP) serve as basic and unifying guidelines that every department should follow.

5.1 Standard Operating Procedures of Chemical Safety:

- Personnel should respect hazardous materials at all times, especially if these chemicals have not yet been handled in the workplace
- Personnel will respect chemical hazards by using practices such as:

    - Researching chemical information prior to using the substance
        - Chemical containers list limited information, always refer to manufacturer's SDS
        - Safety Data Sheets contain extensive information on incompatible chemicals, reactivities, handling precautions, PPE recommendations, exposure limits, chemical toxicity data and storage information
        - Know what routes of exposure the chemical can enter and symptoms of exposure
        - If SDS is not clear, discuss any concerns with a supervisor before proceeding

    - Protecting themselves from all possible routes of exposure (even if the chemical has no listed hazard)
        - Never touch chemical hazards with bare skin, even if container is closed
        - Abide by chemical exposure limits as recommended by SDS and OSHA
        - Abide by SDS recommendations of PPE. Some chemicals require respiratory protection or other special precaution. Do not proceed without the right PPE.
        - Train on emergency spill, accident, and fire procedures to minimize exposure during a chemical event

    - Avoiding the use of unlabeled chemicals and unknown mixtures
        - Always assume that unknown chemicals are toxic chemicals

5.2 Standard Operating Procedures of Good Housekeeping:

- Personnel will take individual responsibility in keeping the workplace clean and neat
- Organization minimizes chemical hazards
- Safety of personnel will be enhanced when:

    - Chemicals are properly labeled and stored
        - All containers should list the chemical/product name, ingredients if it is a mixture or commercial chemical, hazard pictogram or chemical class (toxic, corrosive, flammable, etc.), and manufacturer information.
        - Personnel label all containers with transferred materials and label containers which have shorter shelf-lives (i.e. peroxide formers). Label with chemical name, date of opening or transferring, and hazard class
        - Incompatible chemicals are segregated
        - Waste is labeled with the date that it was first generated

    - Items in the workspace are put away in their place
        - Hazardous waste is disposed in proper container and stored away from community workspace
        - No chemicals are on the floor or unnecessarily sitting on counters
        - Equipment does not obstruct emergency stations, exits, or telephones
        - Electrical cables do not lay over walk ways

    - Equipment is decontaminated routinely
        - Equipment that processes chemicals can be cleaned with soapy water first, or a commercial solution if soap is not enough
        - Equipment that processes biological agents will need a 1:10 bleach solution
        - Routine cleaning prevents chemical buildup or degradation of equipment by harsh chemicals
        - Routine decontamination of biohazards prevents the growth of microorganisms
        - PPE needs cleaning as well to prevent chemical contamination on the skin (goggles, shared gloves, face shields, face masks, aprons)
        - Frequently contacted surfaces (scales, benchtop counters, fume hood bench & sash, shared computers, contaminated door handles) should be wiped clean after using chemicals to prevent trace particles from contacting exposed skin

5.3 Standard Operating Procedures of Laboratory Controls:

- No hazardous workplace should operate without hazard controls. Workers and supervisors should understand and use controls in everyday operations. This Chemical Hygiene Plan informs personnel of the standard controls which should be enforced in their workplace:
    - Engineering Controls
        - Emergency equipment to protect both employees and the facilities from damage
            - Shower, eyewash, first aid kits, fire extinguisher, sprinklers, spill kit
        - Facilities which control and/or diminish chemical hazards from environment
            - Fume hood, glovebox, storage cabinets, ventilated waste cabinets
        - Facilities inspected regularly to maintain contaminant control

    - Administrative Controls
        - Personnel are not required to handle hazardous substances for prolonged time
        - Personnel should not work alone while handling chemical hazards
            - Supervisors and personnel will plan work schedule to minimize exposure length and number to handling times

    - Personal Protective Equipment Controls
        - Workplace will provide employees with the required PPE to do handle hazards
            - PPE listed on chemical SDS should be available to all employees
        - Minimally, the following should be available: eye goggles, chemical hazard gloves, aprons/lab coats, face shields, and respiratory equipment
        - No employee should be using PPE without prior training on its' proper use

The Standard Operating Procedures (SOPs) discussed above are general regulations that every chemically hazardous workplace should follow in order to keep personnel safe.

When it comes to the chemical application differences between departments, each department must create their own catalog of SOPs, to be reviewed by the Chemical Hygiene Officer (CHO). Department specific SOPs are documents which describe processes (chemical or equipment), chemical preparations, and/or detailed methods for handling specific and especially hazardous chemicals. Supervisors should ensure that SOPs are always available to employees; personnel must always refer to SOPs before beginning a new and hazardous task.

Chapter 6: Emergency Preparedness

6.1 Evacuation

Part of emergency preparedness when working with chemical hazards includes knowing how to evacuate safely in extreme situations. Instructors and staff of chemical workplaces should be particularly knowledgeable in exiting classrooms while making sure that students do not injure themselves with surrounding hazards. This section covers evacuation procedures in general. Other sections in this chapter are dedicated to procedures that should be followed for specific evacuation reasons. For more detailed emergency preparedness information, refer to the Victor Valley Community College District Emergency Preparedness Plan, linked at the end of this chapter.

When an area (laboratory or classroom) is to be evacuated, make sure all personnel and/or students exit the area. Each building has a designated Building Emergency Coordinator (BEC) which ensures that the building has been evacuated. The BEC carries a radio to remain in contact with campus police. BEC's report to the police when the building has been successfully evacuated or if there is a problem evacuating. BEC's close the work area and place a sign on the door that says room is empty. Instructors carry a roster to account for everyone at the place of assembly. Do not return indoors until an "all-clear" announcement is given by emergency personnel.

Emergency Assembly Areas

Lower Campus: Football field
Lot Q - (Across the street from the main gym)

Upper Campus: Grass field North of Allied Health
Lot B - (Across the street from the Jacaranda Bus Shelter)

6.2 Earthquake

During an earthquake, if you are inside a chemical work area, stay inside and do not evacuate. If there is chemical work in progress, try to shut off any electrical and heating equipment. Close off any compressed gases if they are being used. Cover any open chemicals and try to close the fume hood sash, if working in the hood. Stay out of the way of windows, falling objects such as glassware, equipment, light fixtures, and chemical storage units. Take cover beneath a laboratory bench, desk, table or doorway; **protect your head and neck**. Assists anyone who is disabled to find a shelter.

After earthquake has ended, check if you or anyone in the area has been injured. Use the nearest first aid kit; do not move injured persons unless they face danger if left in the same area. Begin to evacuate anyone who can walk out safely and disabled persons who are not injured. Only make calls in emergency situations (fire or medical) to avoid tying up the phone lines. Do not use elevators in emergencies and do not run outside. Due to danger of chemical fires in other rooms, check doors for heat before opening. Take alternate routes if fire is present. Convene in the

designated assembly area outdoors. Instructors and supervisors will account for all students and personnel, then report to disaster team. All evacuees will remain together outside until the safety coordinator gives further instructions. No evacuee is to return into any building until they have been cleared for post-earthquake safety.

Chemical personnel must assess the chemical hazards that were caused and left behind after the earthquake. Chemical spills must be contained and cleaned immediately. Unplug any equipment that was not able to be shut off during the earthquake.

6.3 Fire

If a fire emerges from chemical work, briefly assess the situation. Some fires can extinguish themselves by covering glassware (such as beaker) with a watch glass. In larger fire situations or sudden smoke, know the acronym: "R.A.C.E." to safety.

Rescue

Evacuate the room with the fire source immediately. If safe to do so, shut off equipment or move chemicals that may interact with the fire. Assist others to evacuate. Crawl out if room has become filled with smoke. Do not use elevators.

Alert

Once out of the room, pull the nearest fire alarm to alert others to evacuate. When a safe area is found nearby, call Campus Police 760-245-4271 ext 2555 or 911.

Confine

Close doors and windows where fire is located. Do not return inside, even if personal items have been left behind.

Extinguish

As mentioned before, if fire is small or is confined, such as in a trash receptacle, some personnel may want to try extinguishing it themselves. If someone in the area is trained to use a fire extinguisher, they may use it. Others in the area should still call for help in case the fire cannot be contained with the extinguisher or grows out of control. Not all extinguishers are appropriate for all fires, thus, be prepared to evacuate in case the attempt does not put out the fire. Remember the acronym "P.A.S.S."

Pull the pin (ring) out; **Aim** at the base of the fire; **Squeeze** the extinguisher handle together to release agent, **Sweep** the nozzle back and forth across the fire

If untrained in fire extinguishers, do not risk your safety. Evacuate after confining the fire and let the fire be extinguished by responders.

6.4 Hazardous Materials

Since our campus houses several facilities that use hazardous materials, personnel should be prepared for hazardous material emergencies. Chemical personnel should be trained to identify an outbreak of hazardous materials, both in their own workplace and in other campus locations. Unexpected leaks of hazardous materials may arise from workplace accidents or as a cause of natural disasters, such as earthquakes. Hazardous materials in either situation become a large problem; it begins with chemicals reacting in an unexpected way. Reactions quickly emit gases or odors when growing out of control. When engineering controls fail to remove contaminants, personnel may suffer from sudden noxious gases, difficulty breathing, and immediate irritation to lungs and coughing. Side effects of sudden exposure can be nausea, light-headedness, and dizziness. If sudden chemical vapors are seen, immediately report incidents to Campus Police extension 2555 and to Maintenance department, ext 2216. Close windows and doors to contain the vapors and evacuate.

Hazard emergencies do not only occur from gases. Large spills or spills of toxic, reactive substances are also immediately dangerous. If odorous chemicals spill, leave, close doors and call for help. Trained personnel may attempt to clean up spill, if it is safe enough to do so. Remember to wear complete PPE while cleaning up spills. Wear a respiratory device. Try to prevent spills from going down drains. When facing a toxic or reactive chemical, it is best to evacuate and call for help. Help others evacuate if they are having difficulty with exposure. Move to an assembly area that is upwind from odors. Emergency responders should set up a treatment area for exposed individuals. Follow instructions of emergency responders as it relates to returning indoors. Laboratory personnel should be prepared to assist in assessment of spills within their area.

6.5 Lockdown Procedure

In campus-wide lockdown emergencies, personnel in chemical hazard work areas should know how to act to keep everyone safe. When a lockdown has been instructed, the campus community will be immediately informed via the emergency alert system. Personnel that work near classrooms should immediately and calmly alert instructors who may be lecturing. All doors and windows should be locked, and chemical work must be shut down. Lights and audio-visual equipment should also be turned off to prevent drawing of attention. Entries into chemical stockrooms should be locked to prevent intruders from accessing hazardous materials. Staff must assist in securing students that may be immediately outside, inside of classrooms. If any gunshots are heard on campus, all persons in authority must alert students or personnel to get down flat on the ground. Students and personnel need to barricade under desks, stay away from windows, and if possible, move furniture in front of locked door to reinforce security. While barricaded, remain calm and quiet. Wait for announcements from campus police before coming outside. Do not evacuate if alarms are pulled, it may be a false alarm to put people in danger. Do not use telephones after police has been notified; emergency responders will escort everyone out of classrooms when the danger has passed.

6.6 Medical Emergency

Unexpected medical emergencies may occur from time to time in the workplace or in the classroom. Employees and students that work with chemical hazards are especially susceptible to suffering injuries that require first aid. Personnel that work in conjunction with chemical instructors should know how to administer first aid and how to act in case of more severe medical emergencies. When a medical emergency has occurred, immediately call Campus Police ext. 2555 or 911.

Some people wear jewelry with medical inscriptions. Be sure to tell responders about the jewelry instructions. Any trained personnel should give first aid to a victim until emergency responders arrive. Avoid moving the victim as this can worsen their condition.

Basic First aid Tips:

- Bleeding - Call 2555 or 911. Press directly onto the wound with sterile gauze, sanitary napkins, clean cloth, absorbent paper or bare hands. Maintain steady pressure for 5 to 15 minutes. If bleeding from arm or leg, elevate that limb. Have victim lie down and treat for shock (see below) until emergency personnel arrives.

- Choking - Call 2555 or 911. Do nothing if the victim is moving air by coughing or gasping. If no air movement, apply four abdominal thrusts by grabbing victim from behind with your hands over the navel area; quickly squeeze in and up.

- Seizure - Call 2555 or 911. Protect victim from self-injury, avoid restraining if possible. Keep victim comfortable until emergency personnel arrive. Watch for vomiting.

- Shock - Call 2555 or 911. Keep victim calm and warm, with legs slightly elevated until emergency personnel arrive.

- Chemical Contamination - Call 2555 or 911. Have the victim remove contaminated clothing if spill occurred. Help victim engage the emergency eyewash or shower. Have victim rinse affected area for no less than 15 minutes. Assist victim with opening their eyes while using the eyewash. If victim suffered exposure to toxic vapors, move victim to an area with fresh air. Keep victim calm until emergency help arrives, provide first aid if necessary. Stay with victim in case they suffer symptoms from chemical exposure.

- Unconscious/unresponsive - Call 2555 or 911. Check for breathing. If not breathing, initiate Rescue Breathing.
    - Rescue Breathing - Gently lift the head back to open the airway. Watch chest and listen for air from mouth. If not breathing, pinch the nose and give 2 slow, full breaths. Watch the chest rise and fall during each breath. Breathe into the victim's mouth once every 5 seconds until emergency personnel arrive.

Check for pulse by pressing the side of the victim's throat. If no pulse, and if an AED is available, open AED and apply. Administer CPR as required. If you don't know CPR, continue rescue breathing.

6.7 Explosion

In the event of an explosion, take cover under desks or laboratory benches if in a chemical work area. Following the explosion, notify Campus Police at extension 2555 or 911. Due to the possibility of unforeseen additional explosions, everyone must evacuate. Alert everyone in the building by pulling a fire alarm. Watching the surroundings for any side effects of the explosion, walk quickly to the nearest exit. Assist anyone trying to evacuate that may be injured but can be moved outside safely. Do not use elevators. Report to the nearest evacuation assembly area. Keep streets and walkways clear for emergency responders. Trained personnel may be asked to give first aid to injured evacuees. Assist responders as necessary. Do not return to an evacuated building as attendance will be taken. Wait and follow instructions of responders.

Chapter 7: Information and Training

As mentioned in Chapter 1 individual duties, it is the responsibility of the department chair to ensure that all personnel working with hazardous materials receive and follow training. Laboratory supervisors will ensure that new and current workers are knowledgeable in all job specific procedures and acquire training when new processes or hazards are introduced. New employees shall receive information and training when initially hired and at the beginning of each semester, as necessary.

All employees will be informed on:

- General hygienic and behavioral practices for maintaining safety in the workplace
- Safe and proper methods for working around hazardous chemicals, as outlined in the CHP and any specific SOPs
- Methods (personal, administrative, engineering) to minimize workplace exposure to hazards
- Location and relevant content of the CHP, SOPs, and SDS
- Exposure limits, regulations, and standards, set by OSHA, for particular substances that will be encountered in their workplace
- Special symptoms that should be reported if the employee is exposed to hazardous chemicals
- Emergency equipment locations and contact information for the case of emergency

All employees will be trained in:

- Good housekeeping practices in regard to storing, disposing, and cleaning up chemicals
- Selection of appropriate PPE, the correct use of PPE, and the limits of PPE
- Chemical/physical hazards in their work area and how to protect themselves from hazards by use of personal, engineering, and/or administrative controls
- Prevention of accidents by identifying incompatible chemicals, situations, and symptoms of dangerous chemical reactivity
- Use and care for equipment, both standard and emergency
- Department specific SOPs as related to the employees' position

Employees shall not be assigned to a task without prior training. All personnel shall receive training when new information becomes part of the CHP. The CHO is responsible for giving refresher training to personnel that covers policies in the CHP. Refresher training should be given once per year, or as deemed necessary by the CHO. Records of employee training shall be kept by the department and CHO.

Chapter 8: Exposure Evaluation and Medical Consultation

Under OSHA standards, employers must provide medical assistance to employees that are working with hazardous chemicals. When medical examinations are given to employees, consultations must be performed with or under supervision of a licensed physician. Medical care must be provided "without cost to the worker, without loss of pay, and at a reasonable time and place." (OSHA Standard 1910.1450(g)(2)).

Circumstances that merit medical attention, under this standard, include:

- Employee develops signs or symptoms that are related to a hazardous chemical which they have handled, potentially being exposed
- It has been discovered, after monitoring hazard levels in the work area, that the levels of dangerous chemicals routinely exceed limits as set by OSHA. Regulated substances have exposure monitoring and medical surveillance requirements. If a work area exceeds the set standard, exposed employees must receive medical attention as is outlined by the regulation of the particular substance.
- Whenever a chemical accident occurs in the workplace (spill, leak, explosion, etc.) that lead to or increased the likelihood of employee exposure to hazardous chemicals.

Records of the medical consultation must show that the physician has made an examination knowing as much information about the exposure as possible. This allows the best treatment and the best information to be given to the patient. Workers who undergo a medical evaluation must reveal to the physician:

- The name of the chemical that caused the exposure
- Conditions during the exposure (ventilation, temperature, exposure time)
- Data of exposure monitoring, if possible, or details of concentration(s) handled
- Particular symptoms experienced

After discussing the chemical event with a physician, the opinion of the physician serves to:

- Recommend or refer the worker to a proper treatment with a specialist, if necessary
- Recommend associated testing that clarifies severity of exposure
- Disclose if the employee is at increased risk of developing illness from continuing exposure to certain chemicals
- Disclose any medical condition that would prevent the employee from handling certain hazardous chemicals in the workplace

Records of resulting medical opinion shall be kept in the employee file as part of exposure or accident investigation. As part of the medical attention received, employees must acknowledge the receipt of physician's result and advice for treatment. Investigations that reveal cause as a result of chemical exposure shall be evaluated to improve training and workplace conditions.

Chapter 9: Records and Recordkeeping

All records that involve chemical workplaces on campus shall be maintained by the Chemical Hygiene Officer (CHO). As mentioned previous, the CHO is responsible for improving and reviewing the CHP. The CHP can be amended by the CHO and the campus Environmental Health & Safety (EH&S) Committee. Records of changes to the CHP shall be demonstrated in Committee meeting minutes. The CHP shall be amended according to the agreed changes from CHO and Committee input.

The following records shall be maintained from each department:

- Training transcripts for all employees that work in hazardous laboratories
- Inspection documents from annual laboratory safety audits
- Records of routine inspections of workplace emergency equipment (eyewashes, showers, extinguishers, fire alarms)
- Fume hood inspection records
- Records of any additional inspections that the CHO may deem necessary (i.e. equipment is not working properly before the next routine inspection)

These records will be maintained for at least 5 years by the Chemical Hygiene Office and a copy sent to Administration.

Additionally, workplaces that handle chemical hazards should maintain their own copies of employee training transcripts. This prevents employees that are not trained from being assigned

unsafe tasks. Training transcripts show accountability and that a workplace is up to date during safety inspections. Other records that laboratories should keep include chemical and equipment inventory, SDS database or binders, Illness & Injury Prevention Plan, and SOP files for quick access. Department offices should also keep copies of these documents, as well as an updated CHP.

Chapter 10: Review of the Chemical Hygiene Plan

Review of the CHP shall be carried out by the CHO and the document shall be amended with suggestion from the EH&S committee. After the CHP has been published, it will be reviewed within 12 months for effectiveness. The CHO will review the CHP annually to maintain the most current and relevant regulations possible. The CHP may be reviewed at a different time than scheduled when circumstances arrive that challenge or change CHP policies. Investigations may be used to reflect on the current CHP and to amend policies accordingly. The EH&S committee shall discuss changes to the CHP with the CHO; the resulting changes shall be recorded by meeting minutes and physical changes to the CHP.

Appendix A - Chemical Hygiene Checklists

Laboratory Chemical Safety Checklist

Eyewash/Emergency Shower Inspection Checklist

Laboratory Safety Inspection Checklist

LABORATORY CHEMICAL SAFETY CHECKLIST

Room: _____ Building: _____
Inspection Date: _____ Dept: _____
Inspected By: _____

	GENERAL	ES	O	/A
1.	Emergency phone numbers and procedures are posted.	____	____	____
2.	Appropriate warning signs are posted on doors.	____	____	____
3.	Written Chemical Hygiene Plan is located in the department.	____	____	____
4.	All personnel know how were the MSDS's are located.	____	____	____
5.	All personnel have received Lab Safety training.	____	____	____
6.	Signs noting the location of the first-aid safety equipment are visible.	____	____	____
7.	Lab coats are available.	____	____	____
8.	Chemical protective gloves are available.	____	____	____
9.	Safety glasses/goggles are available.	____	____	____
10.	An approved fire blanket is present and kept in an accessible location.			
10.	An emergency eyewash station is present and tested.	____	____	____
11.	An emergency shower is present and is tested.	____	____	____
12.	Refrigerators/freezers are clearly labeled for the type of storage. Those used for storing chemicals should be labeled “NOT FOR STORAGE OF FOOD”.	____	____	____
13.	Food and Beverage are not stored or consumed where they may become contaminated.	____	____	____
14.	Good housekeeping prevails and aisles are uncluttered without tripping hazards.	____	____	____
15.	Chemical spill kits are available.	____	____	____

16. Non-contaminated sharp objects in labeled, puncture-proof containers. ____ ____ ____

17. Fume hoods are tested annually for adequate airflow. ____ ____ ____

18. All exit ways are clear and unobstructed. ____ ____ ____

19. Fire extinguishers are available and unobstructed. ____ ____ ____

20. There are ground fault circuit interrupters (GFI's) on electrical outlets near sinks.

21. Fire extinguishers have service tag and are sealed. ____ ____ ____

22. The location of the master electrical and gas shut-off controls are clearly labeled and accessible.

23. Current inventory of chemicals is available. ____ ____ ____

CHEMICAL STORAGE AND HANDLING

1. Gas cylinders are properly secured. ____ ____ ____

2. No leaking containers are present. ____ ____ ____

3. All chemical containers are properly labeled. ____ ____ ____

4. Chemicals are stored according to compatibility. ____ ____ ____

5. Cabinets and open shelves are equipped with lips or barriers to prevent spilling of chemicals and protect containers from falling.

6. Peroxide forming reagents are dated when opened. ____ ____ ____

7. Gas outlets and burners are maintained in safe working condition.

8. Peroxide forming reagents are disposed of or tested after exp. date. ____ ____ ____

9. Flammable storage area(s) is labeled. ____ ____ ____

10. Flammable liquids not stored outside of a storage cabinet in excess of 10 gallons.

11. Flammables are kept away from sources of heat, ignition, flames, etc. ____ ____ ____

12. Flammable liquids are not stored in refrigerators, unless the refrigerator is certified as explosion-proof.

13. Corrosive chemical storage area(s) is labeled. ____ ____ ____

14. Corrosive materials are stored on the lower shelves. ____ ____ ____

15. Cal/OSHA carcinogen storage area(s) is labeled. ____ ____ ____

16. Chemicals in the open are kept to a minimum. ____ ____ ____

17. Flammable/Combustible liquids do not exceed NFPA storage limits. ____ ____ ____

18. Flammable/Combustible liquids are stored in approved cabinets. ____ ____ ____

19. Poisonous gases are not present. ____ ____ ____

CHEMICAL WASTE

1. Hazardous waste containers are labeled and have closed lids. ____ ____ ____

2. Hazardous waste labels are complete. ____ ____ ____

3. Hazardous wastes are not stored beyond 90 days. ____ ____ ____

COMMENTS: _____
_____
_____
_____

EYEWASH/EMERGENCY SHOWER

INSPECTION CHECKLIST

NOTE: The eyewash/emergency shower must be inspected at least monthly (CCR Title 8, Section 5162).

SITE: _____ **DATE:** _____

WORK AREA: _____**INSPECTOR:** _____

S		**U**	**COMMENT**
☐	Eyewash/deluge shower clearly identified	☐	_____
☐	Eyewash nozzle shields are in place and in good condition	☐	_____
☐	Access to eyewash/deluge shower is not obstructed	☐	_____
☐	Eyewash water flow remains on without the use of operator's hands	☐	_____
☐	Deluge shower water flow remains on without the use of operator's hands	☐	_____
☐	Eyewash water flow remains on until intentionally shut off	☐	_____
☐	Deluge shower water flow remains on until intentionally shut off	☐	_____

☐ Eyewash activation/line flush test ☐ _____

☐ Eyewash water flow rate is 3 gpm minimum ☐ _____

☐ Deluge shower activation/line flush test ☐ _____

☐ Deluge shower water flow rate is 30 gpm minimum ☐ _____

☐ General condition of eyewash/deluge shower ☐ _____

OTHER ITEMS IDENTIFIED BY INSPECTOR BUT NOT LISTED ABOVE

☐ _____ ☐ _____

☐ _____ ☐ _____

COMMENTS: _____

_____

LABORATORY SAFETY INSPECTION CHECKLIST

Building: _____Department: _____Date: _____

Inspector: _____Room: _____ Mail Code: _____

Job Title: _____ Phone: _____

HEALTH AND SAFETY MANAGEMENT

Yes	No	N/A		
o	o	o	1.	Is there a Chemical Hygiene Program present?
o	o	o	2.	Are personnel trained in chemical health/physical hazards and laboratory safety?
o	o	o	3.	Do lab personnel have access to and are familiar with the use of Material Safety Data Sheets (MSDSs)?
o	o	o	4.	Have personnel using biohazards, toxins, and regulated carcinogens been given documented special training?
o	o	o	5.	Are personnel instructed in emergency procedures (exits, location, and use of fire extinguishers, medical)?
o	o	o	6.	Have personnel been instructed on how to respond in the event of a chemical spill?
o	o	o	7.	Are complete training records and documents available for review by the Personnel Office and outside agencies?
o	o	o	8.	Have all hazards identified by the annual survey been abated? (Action records must be retained.)

o	o	o	9.	Do laboratory personnel perform semi-annual lab inspections? (PI must retain records.)

GENERAL SAFETY

o	o	o	10.	Are rooms and cabinets containing regulated carcinogens, biohazards, and radioactive materials labeled?
o	o	o	11.	Are work areas clean and uncluttered?
o	o	o	12.	Do employees know the location of the first aid kit and is it accessible?

Yes	No	N/A		
o	o	o	13.	Is equipment greater than 5 feet tall seismically secured to prevent tipping during an earthquake?
o	o	o	14.	Do shelves have lips, wires, or other seismic restraints to prevent items from falling?
o	o	o	15.	Are food and beverages kept away from work areas and out of laboratory refrigerators or cabinets?
o	o	o	16.	Are fire extinguishers accessible and charged? (If not, please call Physical Plant Services.)
o	o	o	17.	Are sinks labeled, “Industrial Water – Do Not Drink”?
o	o	o	18.	Have personnel been instructed on the hazards of wearing contact lenses in the laboratory?
o	o	o	19.	Are protective gloves available and worn for laboratory procedures where skin absorption/irritation may occur?

o o o 20. Are safety glasses or other eye protection available and worn in the laboratory?

COMMENTS

Biosafety Cabinet: Date last inspected?

Types of regulated carcinogens

Types and quantity of compressed gasses

Gallons of flammable liquids

Types of personnel protective equipment

LABORATORY EQUIPMENT

o o o 21. Have chemical fume hoods been tested within the past year?

o o o 22. Is storage in hoods kept to a minimum and is it placed so it does not impede proper airflow?

o o o 23. Does fume hood draw air (test with a tissue on hood edge) and is alarm installed and working?

o o o 24. Is the lab ventilation negative with respect to corridors and offices?

o o o 25. Are rotating or moveable parts and belts guarded with screens having less than ¼ inch opening?

o o o 26. Are refrigerators and freezers, which are used for storage of flammables, spark proof and properly labeled?

o o o 27. Are non-spark proof refrigerators labeled as “Unsafe for Flammable Storage”?

o o o 28. Are all gas cylinders restrained to prevent tipping or falling?

o o o 29. Are valves of gas cylinders capped when not in use?

HAZARDOUS MATERIALS

o o o 30. Are chemicals labeled to identify contents and hazards?

o	o	o	31. Are regulated carcinogens handled safely to reduce employee exposure?
o	o	o	32. Are chemicals separated by hazard class and stored to prevent spills (acids, bases, oxidizers, flammables, etc.)?
o	o	o	33. Are chemicals inventoried (chemical name, quantity on hand, amount used per year)?
o	o	o	34. Are chemical wastes properly segregated and stored with Waste Pick-up Tags attached to the containers?
o	o	o	35. Are all hazardous wastes disposed of and not poured into the sewer system?
o	o	o	36. Is a plumbed emergency eyewash station available within 100 feet of all areas where chemicals may splash onto an employee's body?
o	o	o	37. Is a plumbed emergency eyewash station available within 100 feet of all areas where chemicals may splash or mechanical hazards such as grinding?
o	o	o	38. Are either and other peroxide formers dated?
o	o	o	39. Are sharps stored in puncture-proof containers and labeled appropriately (infectious waste or hazardous waste)?

FIRE AND ELECTRICAL SAFETY

Yes	No	N/A	
o	o	o	40. Are fire doors unobstructed and readily closeable?
o	o	o	41. If greater than 10 gallons of flammables are stored, is an approved flammable storage cabinet used?
o	o	o	42. Are flammable liquids stored in less than 1-gallon quantity or kept in less than 2-gallon safety cans?
o	o	o	43. Are flammable liquids limited to 60 gallons per fire area?
o	o	o	44. Are plugs, cords, and receptacles in good condition (no splices or frayed cords)?
o	o	o	45. Is all equipment properly grounded?
o	o	o	46. Are extension cords used? (These are not to be used in place of permanent wiring, running through walls, ceilings, doors, etc.)
o	o	o	47. Are all electrical boxes, panels, receptacles, and fittings covered to protect against electrical shock?
o	o	o	48. Are control switches, circuit breakers, electrical panels, and emergency power

cabinets free of obstructions?

o	o	o	49. Are circuit breakers labeled to indicate what equipment is served by each?
o	o	o	50. Have all outlet adapters been removed? (Install additional outlets or use fused power strips if current demand is within the strip's rating.)

EYEWASH/DELUGE SHOWER

Yes	No	N/A	
o	o	o	Eyewash/deluge shower clearly identified
o	o	o	Eyewash nozzle shields are in place and in good condition
o	o	o	Access to eyewash/deluge shower is not obstructed
o	o	o	Eyewash water flow remains on without the use of operator's hands
o	o	o	Deluge shower water flow remains on without the use of operator's hands
o	o	o	Eyewash water flow remains on until intentionally shut off
o	o	o	Deluge shower water flow remains on until intentionally shut off
o	o	o	Eyewash activation/line flush tested
o	o	o	Eyewash water flow rate is 3 gallons per minute minimum
o	o	o	Deluge shower activation/line flush tested
o	o	o	Deluge shower water flow rate is 30 gallons per minute minimum

Appendix B – Resources Page

These resources are official publications from OSHA and describe all regulations in explicit detail.

OSHA Globally Harmonized System (GHS) Proposal – 2009
https://www.osha.gov/dsg/hazcom/global.html

Proposed Appendix A: Health Hazard Criteria
https://www.osha.gov/dsg/hazcom/appendix_a.pdf

Proposed Appendix B: Physical Hazard Criteria

https://www.osha.gov/dsg/hazcom/appendix_b.pdf

Proposed Appendix C: Allocation of Label Elements

https://www.osha.gov/dsg/hazcom/appendix_c.pdf

Proposed Appendix D: Safety Data Sheets

https://www.osha.gov/dsg/hazcom/appendix_d.pdf

Proposed Appendix F: Guidance for Hazard Classifications Regarding Carcinogenicity

https://www.osha.gov/dsg/hazcom/appendix_f.pdf

This resource is from the official National Fire Protection Association and describes the Fire Diamond and other emergency codes in detail.

Frequently Asked Questions on NFPA 704

https://www.nfpa.org/Assets/files/AboutTheCodes/704/704_FAQs.pdf