Chemical Hygiene Plan

College of Science & Engineering
August 2003

Preface

The College of Science and Engineering (COSE) has developed this Chemical Hygiene Plan (CHP) to serve as a blueprint for operating teaching and research laboratories safely and in compliance with applicable regulations. Consistent with the University’s CHP, the COSE CHP applies to all its operations and personnel covered under *OSHA’s Laboratory Standard. The affected departments include Chemistry & Biochemistry, Biology, Geoscience (Hydrogeology Lab), Physics (Thin Film Lab), and the School of Engineering (Environmental Lab). *OSHA: Occupational Health and Safety Administration

This document is not intended to apply to computer labs and other “labs” that don’t regularly use hazardous chemicals per the definition of OSHA. If you are not sure whether your operation falls under this standard, please contact the COSE Health and Safety Specialist at the following extension, x8-6892.

Principal Investigators (PI’s) and staff laboratory managers are typically in charge of their laboratories and have both the authority and responsibility to specify the rules, practices, and equipment necessary to safely work there. Specifically, they must:

- Document the current inventory of hazardous chemicals.
- Specify the personal protective equipment required to work in the lab.
- Evaluate both chemical and physical hazards for specific lab work.
- Convey standard operating procedures, codes of safe work practices, safety rules, instructions, precautions and other applicable safety and health-related information.
- Conduct quarterly hazardous materials self-inspections.
- Train all incoming lab workers in safe work practices, chemical hazards, proper waste handling and disposal, and emergency procedures.
- Document new worker safety training within 30 days of start date.
Emergency Contacts.

**Campus Police** *(Department of Public Safety)*
- Dispatcher/Emergency Line: 911 or 8-2222
- Business Line: 8-7200

**Office of Environmental, Health and Occupational Safety (EHOS)**: 8-1449

**Plant Operations/Work Control**: 8-1568

**Chemistry Stockroom**: 8-2259

**COSE Health & Safety Specialist**: 8-6892

Emergency Guidelines.
See Appendix C for details.

Website Listings.

**COSE Safety Website**:
[http://www.sfsu.edu/~cse/ehs](http://www.sfsu.edu/~cse/ehs)

**Printable MSDS’s**:  
[http://www.hazard.com/msds2](http://www.hazard.com/msds2)

**Chemical fact sheets**:

**Cal-OSHA permissible exposure limits**:  
[http://www.dir.ca.gov/title8/5155.html](http://www.dir.ca.gov/title8/5155.html)

**Cal-OSHA’s Laboratory Standard**:  
[http://dir.ca.gov/title8/5191.html](http://dir.ca.gov/title8/5191.html)

**Choosing the right gloves**:  
[http://www.orcbs.msu.edu/chemical/chemical.html](http://www.orcbs.msu.edu/chemical/chemical.html)

**Using fire extinguishers**:  
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# Chapter 1: Reviewing the OSHA Laboratory Standard

## What is the OSHA Laboratory Standard?

Officially titled "Occupational Exposure to Hazardous Chemicals in Laboratories, the [OSHA Lab Standard](http://www.osha-slc.gov/OshStd_data/1910) was developed to address health hazards unique to laboratories. In fact, for laboratories, it supersedes requirements from other OSHA health standards (in 29 CFR part 1910, subpart Z) with the following exceptions:

- If a worker is exposed to a chemical with an established [Permissible Exposure Limit](http://www.osha-slc.gov/OshStd_data/1910) (PEL) or action level, then the exposure must be maintained below that level as written in the applicable standard;
- If another OSHA health standard specifies that skin and eye contact is prohibited, then that requirement will apply to laboratory workers;
- If the action level or PEL is routinely exceeded for an OSHA regulated substance that has required exposure monitoring and medical surveillance, then those requirements will apply. For example there is a special standard for formaldehyde exposure.

## Where can I find the full text of these regulations?

To see the full text of both the federal and state versions of the OSHA Lab Standard, visit the following internet sites:

- [http://www.dir.ca.gov/title8/5191.html](http://www.dir.ca.gov/title8/5191.html)

## How does OSHA define “Laboratory”?

A laboratory is "a facility where the laboratory use of hazardous chemicals occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis”.

## How does OSHA define “Laboratory Scale”?

Laboratory scale is “work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person”. This definition excludes those workplaces whose function is to produce commercial quantities of materials.

## How does OSHA define “Laboratory Use”?

Laboratory use is “handling or using hazardous chemicals that meet all of the following conditions:

- Chemical manipulations are carried out on a “laboratory scale”;
- Multiple chemical procedures or chemicals are used;
- The procedures involved are not part of a production process, nor in any way simulate a production process; and
- Protective laboratory practices and equipment are available and in common use industry-wide to minimize the potential for employee exposure to hazardous chemicals."
How does the OSHA Lab Standard define “Hazardous Chemical”?

A hazardous chemical is a "chemical for which there is statistically significant evidence, based on at least one study, conducted in accordance with established scientific principles, that acute or chronic health effects may occur in exposed employees". Chemicals with potential adverse health effects include carcinogens, sensitizers, reproductive toxins, hepatotoxins (liver), nephrotoxins (kidney), neurotoxins (CNS), and hematopoietic toxins (blood).

How do chemicals with “Physical Hazards” fit into the above definition?

A chemical is a physical hazard if it is unstable at room temperature, reactive with water or air, flammable, or has some other property that can cause physical damage to persons or property. Hazardous chemicals with physical hazards are covered under OSHA’s Hazard Communication Standard (Employee Right-to-Know) and other OSHA standards that apply to specific situations. The OSHA Lab Standard generally does not supersede any OSHA standards that cover physical hazards.

Why is a Chemical Hygiene Plan necessary?

The OSHA Lab Standard requires that employers develop and carry out the provisions of a written Chemical Hygiene Plan which is “capable of protecting employees from health hazards associated with hazardous chemicals in that laboratory and capable of keeping exposures below the limits” specified in Title 8, CCR, Group 16, Section 5139 et seq., of the General Industry Safety Orders.

This is a performance-based standard based, in part, on the book, “Prudent Practices in the Laboratory”* prepared by a National Research Council committee. Performance-based means that the employer is free to develop a customized program that protects the health of its laboratory workers as long as the minimum requirements in the OSHA Lab Standard are met.

* Prudent Practices in the Laboratory. Handling and Disposal of Chemicals
Committee on Prudent Practices for Handling, Storage, and Disposal of Chemicals in Laboratories.
Board on Chemical Sciences and Technology
Commission on Physical Sciences, Mathematics, and Applications
National Research Council

Note: A review copy is available from the COSE Health & Safety Specialist, x8-6892.
Chapter 2: Revisiting Laboratory Safety

Laboratory managers must provide the safest possible environment for teaching and research. According to the National Research Council's book "Prudent Practices in the Laboratory", there are four fundamental principles to working in a laboratory:

- Planning ahead
- Minimizing exposure to chemicals
- Never underestimating the risks
- Being prepared for accidents

2.1 Planning Ahead

Before starting a new experiment or research project, think about the chemicals and equipment you will need and what could go wrong. This is where a Job Hazard Analysis or Job Risk Assessment is useful as shown in Table 1. The format is basic and widely used, but non-mandatory, and is intended to help you organize your thoughts.

What is a Job Hazard Analysis?

You should plan experiments thoughtfully using the information in your job hazard analysis. Written operating procedures (Codes of Safe Work Practices, as they are called in the campus IIPP) based on these analyses can be used to communicate hazards and precautions to people who work in your lab.

<table>
<thead>
<tr>
<th>List Tasks and Equipment</th>
<th>List all the things that COULD go wrong -- not just what is likely to go wrong.</th>
<th>List the things you could implement that would minimize the risk of someone being hurt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using a bunsen burner</td>
<td>Burns; hair could catch fire; flammable materials nearby could ignite; solution being heated could react violently; material could boil and spill; clothing or notes could catch fire</td>
<td>Specifying which solutions or liquids may be heated using the bunsen burner; substituting another heating method; tying back hair and securing long sleeves; clearing paper and flammable materials from work area; specifying the preparation of the solution carefully so it won’t react badly when heated.</td>
</tr>
</tbody>
</table>

What exactly are Codes of Safe Work Practices?

Codes of Safe Work Practices are your written operation procedures for using equipment, performing certain tasks and starting up or shutting down equipment. The level of detail is up to the Principal Investigator or Staff Manager. See Appendix F for examples. Written procedures or practices may be posted near an operation, accessible in a file or binder, or available on a computer and should include the following information:

- Type of hazard such as hot surfaces, skin absorbing chemicals, flammability;
- Precautions such as protective equipment, power shut off, handling technique;
- List of steps along with safeguards;
- Cautionary information like special hazards to watch out for.
Should listing chemicals, materials and equipment also be part of the planning process?

Knowing what materials and utilities you will need not only makes sense but is also good safety practice. Deciding where you will store items, where equipment will be plugged in, what emergency equipment is necessary, and who will be allowed access is all part of the planning process.

2.2 Minimizing Exposure To Chemicals

The risk of toxic effects is a function of the extent of the exposure and the inherent toxicity of the chemical itself. You can get information about chemical hazards from material safety data sheets (MSDS) and from chemical fact sheets on the internet.

http://www.hazard.com/msds2
http://www.cdc.gov/niosh/npg/npg.html
http://www.scorecard.org/chemical-profiles/index.tcl

What are permissible exposure limits?

Permissible exposure limits (PELs) are legal limits of chemical exposure published in the California Code of Regulations, Title 8 Section 5155. You can see the entire list on-line at http://www.dir.ca.gov/title8/5155.html. An occupational health standard, the PEL is the concentration (of a particular chemical) in breathing air that the average healthy person could be exposed to each day at work for his or her lifetime without significant adverse health effects. People working in labs must be protected from exposure above PELs. Exposure monitoring, usually through air sampling, may be conducted if there is reason to believe that exposure may exceed legal limits.

What about mixtures of chemicals?

When planning an experiment, recognize that the combination of toxic effects of two substances may be significantly greater than the toxic effect of either substance alone. To be prudent, you should assume that resulting mixtures are more hazardous than their most hazardous component. Note that such mixtures may never have been evaluated.

What are routes of exposure?

A person is not exposed to a hazardous chemical merely because it is present in the area. To be exposed, the chemical must actually enter or contact a person’s body. A “route of exposure” is the means by which a substance (chemical, pathogen, radioisotope, etc.) can enter the body and cause localized or systemic effects.

There are four recognized routes of exposure to hazardous substances:

- inhalation
- absorption
- injection
- ingestion
What methods are available to control exposures?

The first line of defense is to engineer out the hazards through equipment design, ventilation, substitution of less hazardous materials, and isolation of hazardous materials. Fume hoods and glove boxes are examples of engineering controls.

Also critical to maintaining safety are administrative controls such as

- effective training (for example, when new hazards are introduced)
- consistently enforced safe work practices (i.e. washing hands, decontaminating surfaces)
- good housekeeping practices (such as storing incompatibles separately, cleaning up spills)
- informative labels, signs and postings (such as emergency information on doors)
- securing the work area from untrained persons (such as locking up very toxic materials)

The last line of defense is personal protective equipment (e.g. gloves, eyewear and respirators) in part because its effectiveness is dependent on consistently both choosing the right equipment and wearing it properly.

When should personal protective equipment be used?

Engineering and administrative controls aren’t always effective in eliminating hazards and sometimes aren’t feasible for specific tasks. In these situations, using personal protective equipment (PPE) is necessary to protect the health and safety of workers. However, choosing the wrong personal protective equipment is often worse than using none at all because it fosters a false sense of security. Choose gloves, goggles, and respirators that are rated by the manufacturer as being effective barriers against the hazardous chemicals used in your lab. To help you choose gloves, try this web site at Michigan State University: http://www.orcbs.msu.edu/chemical/chemical.html

Teach people how to use their PPE. When it comes to safety, effectively using and caring for protective equipment is as important as choosing the right equipment.

- Train lab workers to use and store PPE properly;
- Inform them of equipment limitations; and
- Enforce their use.

### TABLE 2. Routes of Exposure and Methods of Control

<table>
<thead>
<tr>
<th>Routes of Exposure</th>
<th>Inhalation</th>
<th>Absorption</th>
<th>Injection</th>
<th>Ingestion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fume hoods</td>
<td>Bottle carrier to avoid spills</td>
<td>Using “sharps” containers for needles and broken glass</td>
<td>Avoid using beverage and food containers to store chemicals</td>
</tr>
<tr>
<td>Exposure controls</td>
<td>Glove boxes</td>
<td>Prompt clean-up of spilled materials and thorough rinsing of skin and eyes upon contact</td>
<td>Purchasing “safety” syringes</td>
<td>Keep food, drinks, and makeup out of contaminated areas</td>
</tr>
<tr>
<td></td>
<td>Caps on containers</td>
<td>Prevention of unauthorized entry of untrained people</td>
<td>Inspecting glassware and other sharp objects before using them</td>
<td>Wash hands frequently</td>
</tr>
<tr>
<td></td>
<td>Respirators</td>
<td>Resistant gloves</td>
<td>Cut or puncture-resistant gloves</td>
<td>Avoid tasting chemicals for identification or mouth pipetting,</td>
</tr>
</tbody>
</table>
When should respirators be issued? Respirators may only be issued to an employee (or student) after EHOS has assessed the potential for overexposure to an air contaminant in the work area. OSHA's Respiratory Protection Standard has strict rules governing respirators including requirements for medical surveillance, hazard assessment, fit testing, and employee training. Before a person may wear a full or half-face respirator for work, he/she must pass a medical evaluation and fit test. Contact EHOS at x8-1449 for details about the respirator program.

Are dust masks respirators? Dust masks are a type of respirator. However, dust masks are not allowed to be used as protection from air contaminants present at concentrations greater than permissible exposure limits (PELs). For particularly dusty tasks, dust masks may be issued by the stockroom manager for “comfort use” only. The lab supervisor must complete a dust mask request form which includes the reason for the request, comfort use only statement, and instructions for basic training and care. The stockroom manager may consult with EHOS staff prior to issuing a dust mask if there are any concerns. To see the most recent information, go to the COSE EHS website at http://www.sfsu.edu/~cse/ehs.

What protocols should be in place for work with very toxic chemicals? If your research requires using very toxic, mutagenic, or teratogenic chemicals, you must plan your experiments carefully, store the chemicals in a restricted and secure area, and be scrupulous in enforcing safe work practices. Pay special attention to chemicals that absorb through skin.

- Establish a secure area designated for the chemical(s).
- Use containment devices such as fume hoods and glove boxes.
- Ensure safe storage and removal of contaminated waste.
- Develop and enforce decontamination and hygiene procedures.
- Set up a procedure for “prior approval” for particularly toxic materials.

Note: If asked, you must be able to justify your protocols to an inspector.

### 2.3 Understanding The Risks

Working in a laboratory, especially a research laboratory, poses special risks to workers due to the number, variety and toxicity/volatility of the chemicals and the potential for exposure to them. Think about the experiments and the associated procedures and ask yourself the following questions:

- How could someone get hurt? Is there a safer way to do it?
- What personal protective equipment should be available?
- When do I expect my lab workers to wear the items?
- Are my lab workers aware of the dangers of every chemical they will use?
- Do they know what to do if something spills, reacts or splashes on them?
- Do they know what NOT to mix together?
- Do they know how to shut down an experiment or equipment in an emergency?
- Do they know about major hazards from others’ research in a shared lab?
- Do they know what to do with the waste they generate?
What is the policy for working alone?
The COSE strongly discourages working alone with hazardous chemicals or equipment, but does not have a blanket policy prohibiting the practice. When it is absolutely necessary for someone to work by themselves, the PI or lab manager is responsible for all documentation and communication and should establish a policy for his/her lab. After-hours work requires Department Chair approval and a pass authorized by COSE management. See Appendix A for the “COSE’s After-hours Work Policy”.

If an accident or other emergency occurs, having another person available to get help could be critical to preventing harm or minimizing serious injury. Using the “Buddy System” is strongly encouraged. See Appendix B for the University’s “Buddy System Guidelines”.

What precautions should be taken when creating chemicals during research?
Researchers often develop new chemical substances with no published toxicity information. This can pose hazards to your lab workers because the combination can be more toxic than the individual components alone. If you produce a chemical exclusively for your laboratory or it is a by-product of your research, you must identify its hazardous properties, if possible and take the following actions:

1. Assess the hazards based on your experience and knowledge of the components.
2. Assume the substance is hazardous if you aren’t sure what the components are.
3. Place a label on the container with its “name” or identification and likely hazards.
   1. If you don’t know, write “Toxicity Unknown. Avoid Exposure. Handle with Care.” on the label as a precaution and limit access to the material.
   2. In a limited number of cases, an “identification” can be a chemical structure along with a reference to a laboratory notebook.
   (You should be able to justify why the material name can’t be used.)
   3. Train your lab workers so they can handle the substance safely, label it with identification, hazards, date and your name, and dispose of it per campus hazardous waste policy.

2.4 Being Prepared For Accidents
The best strategy for dealing with accidents is to prevent them in the first place using good housekeeping and purchasing practices and effectively training laboratory workers.

How can training minimize accident risks?
Training laboratory workers in safe work practices and in emergency procedures is critical to protecting their safety and health. All people working in a lab should know who to call, when to call, when to evacuate, where to find emergency equipment, and how to safely shut down equipment and ongoing experiments. New hires are required to have a documented safety orientation within 30 days of starting work and should include the following information:

- Importance of washing hands, wiping bottles, and decontaminating surfaces;
- When gloves, eye protection, and lab coats should be worn;
- Which chemicals can be stored together;
- How to safely handle glassware, syringes, and other equipment;
- How to contain and clean-up minor spills.
What housekeeping practices can minimize the risk of accidental spills or reactions?

Many laboratory accidents can be prevented with good storage practices, consistent housekeeping and thoughtful organization.

- Clean up minor spills on bottles, counters, and shelves promptly to prevent accidental contamination.
- Store chemicals in secondary containers and use them to segregate chemicals.
- Discard in-house manufactured chemicals within one year, unless clearly marked for continued research.
- Evaluate stored chemicals and discard those that are past their shelf life at least annually.
- Avoid ordering quantities of chemicals that you can’t use up within the year, regardless of the “savings” on bulk orders.
- For research, use the smallest possible quantities of chemicals to minimize storage, waste and exposure concerns.
- Mark the date received on all incoming chemical containers.
- Don’t store flammable liquids near open flames, spark sources, distillation units, or flammable solids.
- Don’t store flammable liquids or solids in refrigerators that are not clearly labeled “EXPLOSION-PROOF” or “FLAMMABLE MATERIALS”.
- Don’t store more than 10 gallons of flammable liquids in any one room outside of a flammable storage cabinet.
- Segregate chemicals from incompatible hazard classes.

### TABLE 3. Recommendations for Storing Incompatible Chemicals

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Storage Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air reactives</td>
<td>Store in metal container or sealed glass container away from flammable liquids and other chemicals</td>
</tr>
<tr>
<td>Water reactives</td>
<td>Store in metal container or sealed glass container away from flammable liquids and other chemicals</td>
</tr>
<tr>
<td>Flammable solids</td>
<td>Store away from other hazard classifications.</td>
</tr>
<tr>
<td>Strong oxidizers</td>
<td>Store away from organic solvents, metals, and acids.</td>
</tr>
<tr>
<td>Volatile toxic chemicals</td>
<td>Store separately in a cooled atmosphere such as an explosion-proof refrigerator</td>
</tr>
<tr>
<td>Highly toxic or carcino-genic chemicals</td>
<td>Store in areas with restricted access. Label container as highly toxic or carcinogenic and make sure precautionary note/procedure is attached.</td>
</tr>
<tr>
<td>Metal hydrides</td>
<td>Store hydrides in a cabinet away from other flammables.</td>
</tr>
</tbody>
</table>
The most important thing to do is to avoid panic. Remain calm and assess the problem. Call for help when necessary and don’t put yourself in danger. For details about handling different emergencies, see the COSE’s Emergency Guidelines handbook in Appendix C.

<table>
<thead>
<tr>
<th>Nature of Emergency</th>
<th>Recommended Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small (Incipient) Fire</td>
<td>• For small fires in the incipient stage, use a fire extinguisher to put it out.</td>
</tr>
<tr>
<td></td>
<td>• Break the small plastic seal on the handle.</td>
</tr>
<tr>
<td></td>
<td>• Remember to point the nozzle at the base of the fire and sweep back and forth.</td>
</tr>
<tr>
<td></td>
<td><strong>Do not put yourself in danger!</strong></td>
</tr>
<tr>
<td></td>
<td>• For information on fighting fires in a laboratory, check this web site:</td>
</tr>
<tr>
<td>Spreading Fire</td>
<td>• Evacuate the room and close the door. Do not attempt to fight it.</td>
</tr>
<tr>
<td></td>
<td>• Pull the fire alarm or call 911</td>
</tr>
<tr>
<td>Evacuation Alarm Sounds</td>
<td>Leave the building using the nearest safe stairwell and wait outside until the building is cleared for re-entry by police or evacuation team.</td>
</tr>
<tr>
<td>Small Chemical Spill</td>
<td>• If the spill is small and you know how to clean it up, do so promptly.</td>
</tr>
<tr>
<td></td>
<td>• If unsure contact the PI or Stockroom.</td>
</tr>
<tr>
<td></td>
<td>• Wear protective equipment (i.e. gloves) and avoid breathing vapors from spill.</td>
</tr>
<tr>
<td></td>
<td>• Use appropriate kit to neutralize and absorb inorganic bases and acids or other chemicals.</td>
</tr>
<tr>
<td></td>
<td>• Collect residue into a container and dispose as chemical waste.</td>
</tr>
<tr>
<td>Spill is Larger Than You are Comfortable Handling</td>
<td>• Isolate the spill area</td>
</tr>
<tr>
<td></td>
<td>• Remove ignition sources and shut down equipment</td>
</tr>
<tr>
<td></td>
<td>• Open windows (if safe to do so)</td>
</tr>
<tr>
<td></td>
<td>• Evacuate the room and close the door</td>
</tr>
<tr>
<td></td>
<td>• Call 911 and alert the stockroom and nearby labs</td>
</tr>
</tbody>
</table>
### Nature of Emergency | Recommended Action
---|---
**Uncontrolled Chemical Reactions** | Leave the area promptly and close the door.  
Call 911.  
Alert the stockroom and nearby labs.  
If you believe there is a serious and immediate danger to others, pull the fire alarm in the main hallway to evacuate the building.

**Injury or Loss of Consciousness** | If first aid is not feasible or you’re unsure, call 911. Campus Police has officers trained in first aid and CPR and will provide assistance.

**Chemical Splash on Body** | Take person(s) from spill area to nearest emergency shower.  
Remove contaminated clothing while victim is under the shower. Use a towel or coat to shield the person from view.  
Flood affected area for at least 15 minutes or longer if pain persists. (Don’t use creams, lotions, or salves – leave that for medical personnel.)  
Don’t worry about making a mess.  
Take person to Student Health Center AFTER flushing the affected area if he/she is able to walk. Call 911 if the injury is too serious to move the victim.  
Ask someone to alert the stockroom or campus EHOS* (x8-1449).

**Chemical Splash on Face** | Remove contaminated clothing while victim is under the shower. Use a towel or coat to shield the person from view.  
Flood affected area for at least 15 minutes or longer if pain persists. (Don’t use creams, lotions, or salves – leave that for medical personnel.)  
Don’t worry about making a mess.  
Take person to Student Health Center AFTER flushing the affected area if he/she is able to walk. Call 911 if the injury is too serious to move the victim.  
Ask someone to alert the stockroom or campus EHOS* (x8-1449).

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*EHOS: SFSU Office of Environmental, Health, and Occupational Safety
Chapter 3: Administering the Chemical Hygiene Plan

The University is made up of colleges and departments that operate semi-autonomously under the umbrella of the campus Environmental, Health, and Occupational Safety Department (EHOS) and University Chemical Hygiene Plan. The EHOS Department is not involved with daily CHP implementation but provides the following services and technical assistance:

- Answers questions concerning storage, handling and disposal of hazardous chemicals.
- Provides general hazardous materials safety training upon request.
- Conducts exposure assessments and laboratory inspections periodically and by request.
- Assists in evaluating personal protective equipment (PPE) and administers the respirator program.
- Handles hazardous waste testing and disposal.
- Inspects and certifies fume hoods, eye washes and emergency showers annually and flushes eye washes and emergency showers monthly.

3.1 Chemical Hygiene Officer

Who is responsible for implementing the CHP?

The departments with laboratories meeting OSHA Lab Standard definitions are responsible for developing and implementing laboratory-specific CHPs. Department Chairs are responsible for ensuring that CHPs are implemented and enforced in all laboratories where the Lab Standard applies.

The University’s official Chemical Hygiene Officer (CHO), Dr. Robert Shearer, provides general oversight of the CHP but daily implementation is the responsibility of each department.

Who is the Chemical Hygiene Officer for the department?

The role of department CHO is usually assigned to the Stockroom Manager. However, in Chemistry & Biochemistry, the role of the CHO has been assigned to Chemistry Safety Committee. The COSE Health & Safety Specialist assists as needed. The CHO fulfills the following duties:

- Works with administrators to develop and implement a CHP
- Monitors procurement, use and disposal of chemicals
- Helps the COSE Health & Safety Specialist ensure that quarterly self-audits are conducted, new lab workers are trained, and annual chemical inventories are submitted.
- Helps faculty develop precautions and adequate chemical storage practices.
- Maintains knowledge of current legal requirements concerning “regulated substances” and makes sure regulated substances are secured.
- Ensures that the University EHOS has access to all chemical storage areas.
3.2 **Principal Investigators and Teaching Lab Managers**

Faculty, who direct research, typically have control over purchases, work practices, and equipment, and just as importantly, the authority to implement and enforce chemical hygiene in their work areas.

Faculty and staff, who manage or coordinate teaching labs, must work within department budget restrictions, but still have both the authority and responsibility to enforce safe work practices.

**What are Teaching Lab Managers and Principal Investigators required to do?**

Faculty and staff who manage laboratories have an obligation to maintain a safe work space, train each lab worker appropriately, and enforce the Chemical Hygiene Plan.

- Ensure lab workers know how to work safely and establish laboratory rules
- Enforce laboratory rules and safe work practices.
- Make appropriate personal protective equipment available and enforce its use.
- Inspect emergency equipment and chemical and waste storage areas regularly.
- Make sure teaching assistants and student lab managers who set up labs and supervise others receive additional training explaining the policies in effect and their enforcement responsibilities.
- Document inspections, training, accidents, and significant spills.
- Provide a list of new hires to the COSE Health & Safety Specialist or stockroom manager at the beginning of each semester.
- Make sure ALL new hires complete a documented safety orientation within 30 days of starting work.

3.3 **Training and Records**

**What are employee training requirements?**

The College of Science & Engineering (COSE) specifies in its Injury and Illness Prevention Program (IIPP) that new employees (including student volunteer employees) receive documented initial safety training within 30 days of their work start date. Lecturers, student teachers and office personnel may receive their training in the form of information handbooks. Research lab workers may receive training in the form of any combination of reading material and informal or formal hands on training. In addition to orientations, safety training is also required when new hazards are introduced or discovered.

*All persons working in research labs must have documented training in safe work practices, emergency procedures, and proper handling of hazardous waste.*

**What is the frequency of refresher training?**

The College of Science & Engineering (COSE) specifies in its Injury and Illness Prevention Program (IIPP) that refresher training is required at least every three years for all employees working with hazardous materials.
What records must each department update?

1. Departments must provide a **current chemical inventory** (or sign a statement saying there are no significant changes) to the stockroom manager by **March 1** each year. The stockroom manager is responsible for teaching labs and the stockroom and Principal Investigators are responsible for their research areas. The inventories are then turned over to the EHOS department for their annual report to the city.

2. **Each quarter**, Principal Investigators, stockroom managers, and other lab managers must conduct a documented **self-inspection** for rooms where hazardous materials are used or stored. These self-inspections are a necessary part of maintaining the University's hazardous materials operating permit, which is part of the University's Business Plan. For Business Plan details, contact the EHOS department at x8-1449.

3. **Departments must supply the COSE with a list of new hires each semester** and are required to forward documented safety training to the COSE Health & Safety Specialist.

What kind of records is the University required to collect and maintain?

To comply with San Francisco's Business Plan requirements, the University EHOS department collects chemical inventories from all departments that use or store hazardous materials. EHOS also maintains a master training database, air and water monitoring records and archived MSDSs. Occupational medical records are available from the Student Health Center upon written request to the EHOS department.

The College of Science & Engineering has its own Health and Safety Specialist who assists departments in coordinating the health and safety program and maintains written documents including training and inspection records.

**Summary of records maintained by the University:**

- Quarterly hazardous materials self-inspections
- Initial safety training documents
- Refresher training records
- Annual safety and hazardous materials inspections
- Fume hood, biohood and other equipment monitoring records
- Air and exposure monitoring records
- Annual chemical inventory update

What are the provisions for medical consultations and examinations?

Medical consultations and examinations are available to employees who work with hazardous chemicals, without cost or loss of pay, and at a reasonable time and place under the following circumstances:

- Whenever an employee develops signs and symptoms of possible exposure to a hazardous chemical in the laboratory;
- As part of the University medical surveillance program; and
- When a baseline medical exam is required by an applicable regulation or policy.
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Chapter 4: Implementing Effective Exposure Controls

Implementing effective controls to protect workers from health hazards requires attention and dedication. For example, equipment needs to be purchased, inspected, and maintained. People need training and supervision. Work rules must be logical, effective, clearly communicated, and consistently enforced. Sustaining effective controls over the long-term depends on the combined commitment and vigilance of University management, faculty, staff and students.

Effective exposure controls can be grouped into three categories:

- Engineering controls: the first line of defense
- Administrative controls: safe work practices and effective management
- Personal protective equipment: the defense of last resort

4.1 Engineering Controls

The most consistently effective way of minimizing the risk of injury and chemical exposure is to engineer the hazards out, where possible. Safety training, personal hygiene, signs and security can be effective, and are important, but such methods are subject to human error. Note that ventilation is only one type of control. There are others:

- Substituting less hazardous materials;
- Developing safer experiments or procedures;
- Isolating hazardous materials from the user.

What laboratory equipment qualifies as engineering controls?

Laboratory equipment qualifies as engineering controls if it controls the release (at the source) of hazardous materials into the work area or prevents access to dangerous components or energy sources.

- Chemical fume hoods
- Glove boxes
- Secondary containment
- Ventilated storage
- Explosion-proof refrigerators
- Local exhaust, such as “elephant” ducts
- Machine guards and interlocks
- Biosafety cabinets

Who maintains COSE biosafety cabinets?

The College of Science and Engineering arranges for biosafety cabinets (aka biohoods) to be certified each year by a qualified contractor. Users should check the date on the certification sticker before using the biohood. Contact the COSE Health and Safety Specialist at x8-6892 for details or when moving or adding biohoods.
What are some limitations of chemical fume hoods?

A chemical fume hood cannot provide absolute containment or absolute protection from the materials in the hood. However, a correctly designed hood in a properly ventilated room can provide adequate protection, as long as appropriate work practices are followed. People working in the lab should have a basic understanding of the limitations of chemical fume hoods and how to use them properly to help ensure the hoods effectively direct vapors, fumes, and gases away from the user.

What are operating requirements for chemical fume hoods?

- All fume hoods operated in the College of Science and Engineering must be inspected and certified by the University EHOS department at least annually and marked with a compliance sticker.
- Hoods are required to operate at an average face velocity of at least 100 LFPM (lineal feet per minute) with a minimum of 70 LFPM at any point. When measuring the face velocity, the area at the face is divided into sections and readings are taken at each location.
- The maximum approved sash height must be marked on the hood face. The fume hood sash should be set between 12-18 inches high. Note: Operating the hood with a sash height higher than 18 inches could compromise the effective draw of the hood and may not protect the user's breathing zone and face from accidental splashes or contain unexpected reactions.
- Fume hoods not achieving a minimum average face velocity of 100 LFPM (and 70 LFPM for each section) must be marked with a sign indicating that the hood may not be used for hazardous substances.

Who should be contacted for chemical fume hood problems?

Unless it is an emergency, direct questions or requests for evaluation to the stockroom. For emergencies, contact EHOS x8-1449 or 911 if it is after hours.

If you believe a fume hood is not working correctly, STOP using the fume hood until it has been tested and cleared by EHOS. **DO NOT CONTINUE TO USE IT!**

- Stop what you are doing;
- Close containers and stop experiments (if possible);
- Pull the hood sash all the way down to close it;
- Report your concern to your stockroom manager;
- Post a sign taking the hood out-of-service.

What are some established safe work practices for chemical fume hoods?

The work practices listed below are recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) in their text: "Industrial Ventilation: A Manual of Recommended Practices." More stringent or specific practices may be necessary in some circumstances. Faculty should evaluate proposed tasks and institute appropriate control measures.

- Conduct all operations that could generate hazardous air contaminants at or above action levels inside a hood.
- Keep all apparatus at least 6 inches back from the face of the hood. A stripe on the bench surface is a good reminder.
- Do not put your head in the hood when contaminants are being generated.
- Do not use the hood as a waste disposal mechanism.
• Store flammables and corrosives in appropriate storage cabinets. Excessive storage of chemicals or apparatus in the hood will impair the performance of the chemical fume hood.

• Be sure that the switch is in the "on" position whenever the hood is in use and test hood often for air flow (i.e., attach a narrow strip of Kimwipe to the hood sash).

• Do not use most hazardous solids (powders) in the hood.

• Do not block air flow to hood baffles slots with excessive storage.

• Minimize foot traffic past the face of the hood.

• Keep laboratory doors and windows closed, unless the room was designed for the lab doors to be open.

• Do not remove hood sash or panels.

• Do not place electrical receptacles or other spark sources inside the hood when flammable liquids or gases are present. No permanent electrical receptacles are permitted in the hood.

• Use an appropriate barricade if there is a chance of an explosion.

• Keep the sash below chin level when working in a fume hood.

**Should fume hoods be used to store chemicals and wastes?**

Although the practice is fairly common, avoid using chemical fume hoods to store chemicals. Instead, use ventilated storage cabinets whenever they are available. Storing chemicals in hoods limits work space, increases the chance for unwanted chemical mixing, and compromises air flow. Be sure to take these factors into account if work must be done in hood doing double duty as ventilated storage.

If ventilated cabinets are not available, reassess your storage practices. Storing fewer chemicals in smaller quantities, sharing limited ventilated storage space, and consistently putting chemicals away after using them in the hood are some possible ways to reduce reliance on fume hood storage.

**4.2 Administrative Controls**

Administrative controls are procedural in nature and are only effective if established by knowledgeable management and enforced consistently.

• Having informative labels and signs on lab doors to indicate special hazards within.

• Restricting access to hazardous areas;

• Maintaining an active safety program;

• Minimizing exposure time for individual employees;

**What information must be on a container label?**

All containers, including squeeze bottles and the flasks in distillation units, must have legible labels identifying the contents and specifying significant hazards. Ideally, the owner and date of receipt or transfer should be on the label too. Containers of soap and distilled water must also have labels to prevent confusion.
What information should be on signs?

- Mark each laboratory door with a sign stating important information such as
  * Room number
  * Laboratory supervisor’s name
  * Emergency contacts (i.e., names, office location, telephone numbers)
  * Special hazards or instructions (i.e., presence of highly toxic substances, storing large quantity of flammables, presence of an alarm system).

- Designate and label each refrigerator or freezer as a “Food Only” unit or marked with a “No Food Permitted” sign. Place a warning label onto units storing radioactive, biological, or flammable materials.

- Use a “Defective-Do Not Use Tag” or equivalent to place equipment needing repair or modification out of service. If it must be thrown out, render it useless and place it in the trash bin (uncontaminated equipment only).

- Place warning signs in a prominent location wherever carcinogenic, highly toxic, genotoxic, radioactive, and biohazardous materials are used or stored.

What are examples of security measures?

Limiting access to authorized students and employees and requiring personal protective equipment (PPE) to enter hazardous areas, protects visitors and other building occupants from harm. Visitors and students should be supervised. Students who must work in the lab after-hours must have a pass signed by the PI, Department Chair, and COSE Dean or Director of Operations authorizing them to be there.

Laboratory personnel should not work alone, but if it is occasionally necessary to do so, establish a protocol to address their safety and security (i.e., on weekends, have personnel notify campus police x87200 when they arrive and then again when they leave).

Which work practices can help prevent inadvertent exposure to hazardous chemicals?

Scrupulous personal hygiene practices and regular attention to housekeeping can prevent the spread of contaminants. The goal is to prevent inadvertent contamination of surfaces like elevator buttons, doorknobs, and instruments, or samples that could expose personnel. It is critical that laboratory supervisors enforce work practices like the following:

- Washing hands frequently;
- Changing gloves when they become contaminated;
- Taking gloves and lab coat off for trips to the bathroom or elevator;
- Cleaning up small spills and drips on containers promptly;
- Keeping containers securely closed;
- Using carriers or carts to carry hazardous chemicals between rooms or floors.

Who conducts safety inspections?

Regular inspections are an integral part of any safety program. COSE staff and department safety coordinators conduct inspections each semester. In addition, the campus EHOS Department inspects the campus and submits a report of their findings annually.

Faculty and staff supervisors should regularly inspect their own work areas for safety hazards and to make sure equipment is in good working condition. Each quarter, a documented inspection of rooms with hazardous materials is required by the University’s
hazardous materials permit. These quarterly inspections are documented on a campus form designed to comply with EPA regulations, and the campus Business Plan.

To resolve discovered problems, notify the Stockroom Manager so he/she can generate a work request or inform the appropriate staff.

What is the goal of training laboratory workers?
Initial and on-going training in recognizing hazards and understanding safe work practices is essential to making sure everyone knows how to protect themselves and others.

How can scheduling help minimize exposures?
Chemical exposure is a function of both the toxicity of the material and the length of time it is in contact with the body. Plan work to minimize the time laboratory workers spend with particularly hazardous chemicals.

4.3 Personal Protective Equipment
Assess how chemicals are used in your laboratory and choose personal protective equipment (PPE) that best suits your work and exposure hazards. The Principal Investigator or Lab Manager is responsible for assessing needs and purchasing equipment. The University EHOS department is available to help with the PPE assessment.

PI’s may use the tables shown below to assist them in choosing the appropriate PPE or attach separate assessment sheets.

TABLE 4. Assessment for Gloves

<table>
<thead>
<tr>
<th>Chemical Hazard or Task</th>
<th>Type of Glove</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TABLE 5. Eye or Face Protection

<table>
<thead>
<tr>
<th>Chemical Hazard or Task</th>
<th>Eyewear and Face Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Safety Glasses</td>
</tr>
<tr>
<td></td>
<td>Safety Glasses</td>
</tr>
</tbody>
</table>

TABLE 6. Protective Clothing

<table>
<thead>
<tr>
<th>Chemical Hazard or Task</th>
<th>Clothing Required</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LabCoat</td>
</tr>
<tr>
<td></td>
<td>LabCoat</td>
</tr>
</tbody>
</table>
4.4 Laboratory Rules and Safe Work Practices

To be effective, a Chemical Hygiene Plan must apply to the operations taking place in each laboratory. Standard operating procedures, safety rules or precautions, task and PPE analyses and postings should all be relevant and used for training new lab workers. The purpose of this section is to outline the written documents necessary for each laboratory.

1. Written Chemical Hygiene and Safety Plan for this specific laboratory.
   Instructions and an optional template are available in Appendix G.

2. Department and/or laboratory rules

3. Emergency information including contacts, references, and equipment

4. Written operating procedures and hazard assessments.

5. Current list of chemicals and biological microbes used or stored.

6. Current list of authorized personnel (if applicable)

7. Appropriate warning labels and signs

Note: The laboratory-specific hygiene and safety plan may be posted but a copy must be attached to this document.

Option 1: Insert laboratory documents in Appendix G

- Include department laboratory rules
- Insert documents such as procedures or rules specific to this laboratory
- Use relevant forms and templates from Appendices D, F, and G. File them here if desired. (To get forms and templates, contact the COSE Health & Safety Specialist or access the Biology Department or College of Science & Engineering websites.)

Option 2: Place laboratory-specific documents in the front of this CHP

Consider attaching your specific “Lab Chemical Hygiene and Safety Plan” to the front of this document or binder.
Chapter 5  Managing Hazardous Materials at C.O.S.E.

5.1  Procuring Materials for Laboratories

It is important to know what you already have before ordering hazardous materials for the coming semester or school year. Keep your list (or inventory) of hazardous materials up-to-date and use the information for training, planning, and ordering. Order only what you think you can use up during the year to minimize storage needs.

- Before receiving a hazardous substance, make sure you have the MSDS and know how to safely store and handle it.
- Reject any container without a label specifying the contents and significant hazards.
- Notify the stockroom of new acquisitions so they can be added to the inventory.
- Avoid purchasing chemicals in bulk because of the strain on limited space, the expense of ultimate disposal of unused quantities, and the potential hazards caused by large quantities in a small space.

What is the policy for donated chemicals?

The University does not accept donated chemicals without prior approval from the University EHOS Dept. [Very often the chemicals are near their expiration date or are in quantities that you won't be able to use up. The problem: Although this does save the donating company the expense of disposing of these chemicals, the University ends up paying for the disposal. Disposal costs are expensive and the University spends much more than the initial cost savings. The University is then the new generator of the waste and is responsible for it forever. The EPA (Environmental Protection Agency) uses the phrase, "from the cradle to the grave".]

What are recommended distribution practices?

- Distribute chemicals in the smallest quantities possible.
- If you must take a chemical to the stockroom or even down the hall, try using a bottle carrier, bucket or other carrying device. Use the freight elevator when possible. It is not good practice to carry unprotected hazardous liquids in a dirty lab coat and gloves in a passenger elevator with the public.
- Avoid buying liquids in bulk whenever possible. Unless large quantities are used regularly, bulk liquids often end up wasting storage space and costing more in disposal than any savings in the initial purchase.
- When transferring flammable liquids from drums 5 gallons or greater into small containers, ground the drum and bond the small container to the drum. This practice can prevent static build-up and the associated electrical shock hazard.

What are some good inventory management practices for stockrooms and labs?

To prevent unwanted chemical reactions, you must establish a chemical storage system in your lab that separates incompatibles by distance or containment. You must also plan experiments to minimize the risk of unwanted reactions.

- Clean up minor spills promptly and thoroughly to prevent accidental contamination of clothing or other chemicals.
• Use secondary containers to store chemicals on counters, fume hoods and to separate incompatibles.
• When transferring a chemical to a different container, affix an identification label onto the transfer container. Make sure the label is secure and legible.
• Mark the date received for all incoming chemicals— including those from vendors.
• Segregate chemicals by hazard class prior to restocking them.
• Store flammables in a storage cabinet for flammable liquids or safety cans – avoid storing on the floor.
• Discard chemicals manufactured in-house within one year, unless part of current research.
• Periodically evaluate stored chemicals and discard those that are past their shelf life.
• Store chemicals reactive to air, water, light, and room temperature clustered together. Improperly stored chemicals like this degrade quickly so check them frequently.
• Avoid storing chemicals in beakers or test tubes topped with paraffin or foil.

5.2 Storing and Using Lab Chemicals

What are some guidelines for safely using compressed gas cylinders?

Compresses gas cylinders can be very hazardous if mishandled. Common hazards include mixing of incompatible gases, asphyxiation in confined areas, explosion from leaking flammable or oxidizing gas, and sudden release of pressure from a broken valve.

• Contact the department stockroom for assistance with gas cylinders.
• Always secure cylinders to a wall or heavy furnishings.
• Keep caps screwed on unless actively using the cylinder.
• Transport cylinders with caps screwed on using a cart designed for moving cylinders.
• Don’t lift a cylinder by its cap.
• Store flammable gases separately (by at least 20 ft. or with a fire wall) from oxygen and open flames.
• Separate incoming cylinders from empty ones and mark them with tags as “empty” “full”, or “in service” as appropriate.
• Store gas cylinders that won’t be used during the summer or regular semester. Remove the regulator and replace it with a securely screwed on storage cap.
• Install in-line filters or devices to prevent flashbacks or spread of bacteria and other biohazards when using compressed gases.

How should highly reactive chemicals be handled?

Highly reactive chemicals such as organic peroxides and perchloric acid must be labeled “DANGER! Highly Reactive Material”. Use only the smallest amounts possible to minimize risks. If a refrigerator or inert atmosphere is necessary to keep these materials stable, note this clearly on the container label. You should also install a warning system and/or back up system in case of system failure.

• Write date received on the label
• Store highly reactive chemicals as indicated on the manufacturer’s label.
• Purge these chemicals from inventory every year.
Prudent Practices in the Laboratory has an entire chapter devoted to managing chemicals, namely Chapter 4, “Management of Chemicals”. This is an excellent reference for what your peers are (or should be) doing. To see a review copy, contact the COSE Health & Safety Specialist at x8-6892.

Some of the more common practices are listed below for you to consider when arranging your laboratory for optimum performance.

- Separate chemicals by hazard class first before arranging them alphabetically.
- Avoid storing chemicals on bench tops, fume hoods or on the floor and keep them away from sunlight and hot conditions. Follow manufacturer’s storage recommendations to ensure a stable product.
- Inspect storage containers periodically for damage, integrity or evidence of unwanted reactions. Clean spillage on the outside to prevent inadvertent contact by other lab occupants.
- Store chemicals below eye level on shelves with doors, lips or other restraints.
- Place the user’s name and the date received on all purchased materials.
- Keep volatile toxics and smelly chemicals in a ventilated cabinet or fume hood when handling them.
- Use corrosion resistant storage trays or secondary containment to retain materials if the primary container breaks or leaks. These can be used to separate incompatibles if space is tight.

### Which hazard classes are considered incompatible?

In most cases, the materials below should be stored separately.

<table>
<thead>
<tr>
<th>Organic Family</th>
<th>Inorganic Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flammable Liquids</td>
<td>Oxidizers</td>
</tr>
<tr>
<td>Organic Acids</td>
<td>Hydrides</td>
</tr>
<tr>
<td>Mineral Acids</td>
<td>Halogenated Solvents</td>
</tr>
<tr>
<td></td>
<td>Biohazards</td>
</tr>
<tr>
<td></td>
<td>Radioactives</td>
</tr>
<tr>
<td></td>
<td>Flammable Solids</td>
</tr>
<tr>
<td>Metals, hydrides</td>
<td>Acids, peracids, anhydrides</td>
</tr>
<tr>
<td>Halides, sulfates, sulfites, thiosulfates, phosphates, halogens</td>
<td>Alcohols, glycols, amines, amides, imines, imides</td>
</tr>
<tr>
<td>Amides, nitrites, azides, nitrates (except ammonium nitrate)</td>
<td>Hydrocarbons, esters, aldehydes</td>
</tr>
<tr>
<td>Hydroxides, oxides, silicates, carbonates</td>
<td>Ethers, ketones, ketenes, halogenated hydro carbons, ethylene oxide</td>
</tr>
<tr>
<td>Arsenates, cyanides, cyanates</td>
<td>Isocyanates, epoxy compounds</td>
</tr>
</tbody>
</table>
What are some guidelines for storing incompatible materials?

- Store inorganic acids in a (preferably non-metal or lined) cabinet in a plastic secondary storage tray. Strong organic acids may be stored in the same cabinet only if they are in a separate storage tray or other secondary containment.
- Store strong bases in a (preferably non-metal or lined) cabinet in a plastic secondary storage tray. Acids may be stored in the same cabinet only if they are in a separate storage tray or other secondary containment.
- Keep flammable solids and other water reactive chemicals in a dry location away from organic solvents.
- Keep strong oxidizers away from acids and organic solvents.
- Always store nitric acid, a strong oxidizer, away from acetic acid, bases and organics.
- Store acetic acid with other organic acids because it is corrosive as well as combustible. However, it is acceptable to store acetic acid with flammable solvents as long as it is separated with secondary containment. Keep away from strong nitric acid!
- Store perchloric acid and strong (70%) nitric acid in separate trays made of resistant plastic or glass, as they are both highly corrosive and reactive to many materials.
- Do not store halogenated solvents, such as methylene chloride, in flammable storage cabinets because they are not flammable and may pose a hazard to fire fighters if they mix and catch fire. *Phosgene (a toxic gas) is formed as a by-product of combustion.*
- Separate pyrophoric chemical compounds from other flammable liquids.

What are some chemical-specific storage policies?

- Hydrides: Store separately in labeled metal containers.
- Flammable solids: Store separately in labeled metal containers.
- Pyrophorics: Store in refrigerators designated as “explosion-proof”.
- Cans: Bottles shipped in sealed cans must be opened upon receipt and inspected. Don’t store such cans unopened in the laboratory.
- Ether: Date containers upon receipt and check expiration dates. Ether must be used within 1 year or before the expiration date, whichever is less. *The practice of buying drums of ether has been discontinued.*
- Halogenated solvents: Unless the label says it’s flammable, store separately from flammable liquids. Any cabinet or refrigerator marked “Flammable” must not have any non-flammable halogenated solvents inside.
- Carcinogens: Human carcinogens must have a have a prominent “Carcinogen” label attached to each container. Limit access to authorized individuals only.
- Store organic peroxides at the lowest possible temperature, consistent with the solubility and freezing temperature of the material.

---

**Table 7: Incompatible Chemicals from “Prudent Practices in the Laboratory”**

<table>
<thead>
<tr>
<th>Borates, chromates, manganates, permanganates</th>
<th>Peroxides, hydroperoxides, azides</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitric acid, inorganic acids</td>
<td>Phenols, cresols</td>
</tr>
<tr>
<td>Sulfur, phosphorous, arsenic, phosphorous pentoxide</td>
<td></td>
</tr>
<tr>
<td>Sulfides, selenides, phosphides carbides, nitriles</td>
<td></td>
</tr>
</tbody>
</table>
What is the policy for using refrigerators and freezers for storing hazardous materials?

Each refrigerator and freezer used in the COSE must have a label either designating it for “Food Only” or prohibiting food, i.e., “No Storage of Food or Beverages”. Refrigerators not designed to hold flammable or explosive materials, should not have such materials stored inside. For chemicals requiring refrigeration, use refrigerators designed and labeled for storing flammables. In the Chemistry & Biochemistry department, refrigerators are available for the following hazard classes:

- Flammables
- Non-flammables
- Non-flammable halogenated materials
- Pyrophorics

5.3 Highly Toxic Materials

Sloppy handling can result in unwanted exposures. Some chemicals, like methyl mercury, aniline, and hydrogen fluoride absorb readily through the skin and are deadly. Others, like ethidium bromide are strong mutagens but the user may experience no obvious ill effects. Chronic exposure to carcinogenic chemicals can also cause illness in the long term but without obvious short term ill effects.

Check the list of selected highly toxic chemicals in Appendix E to help you decide whether special precautions and pre-approvals make sense in your operation. Note that you must be able to justify your reasoning if asked.

How should highly toxic materials be handled?

- Designate an area for handling dangerous substances in the laboratory:

  DANGER
  “Specific Agent”
  AUTHORIZED PERSONNEL ONLY
  See “Faculty Name” for more information.

- Institute a prior approval system to protect students from inadvertent handling of dangerous substances. See Appendix D for the “Prior Approval” form.

- Minimize quantities of these chemicals and keep the lowest possible concentrations when in solution.

- Conduct all work with genotoxins, reproductive toxins, carcinogens, and acutely toxic materials within a certified functioning fume hood, biological safety cabinet, ventilated glove box, sealed system or other system designed to control exposure.

- Do not exceed OSHA permissible exposure limits (PELs) for chemicals in your work area. Usually expressed as an eight-hour time weighted average concentration, a PEL is the maximum concentration of a specific chemical in inhaled air that the average healthy worker may be exposed to each day for a lifetime of work without significant adverse health effects.
5.4 Minimizing Chemical Storage

When should I consider discarding chemicals?

Take into account a chemical’s replacement cost, availability, hazard, and storage requirements when deciding whether to keep it or discard it. Buy only what you need and can use in a reasonable amount of time.

- Aggressively purge smelly chemicals from storage before they become offensive.
- Discard containers that may be compromised. Look for evidence like excessive rust, bulges, or pooled material underneath. Be sure to evaluate the safety of handling such containers before moving them.
- Check the expiration date and discard old and expired chemicals.
  
  While it is true that suppliers may choose a date for marketing reasons, rather than because the substance is not longer usable, if it is more than a couple of years beyond that date, it should be discarded. Make room for storing chemicals you do need and will use.
- Dispose of materials which do not have an identified use within a reasonable period, such as 3 years. Stable, relatively non-hazardous substances may be kept longer, as long as they still have a legitimate use.
  
  Replace deteriorating labels if the container itself is still in good condition. Do this before the information is obscured or lost. If the contents cannot be identified by a knowledgeable person, then it must be disposed of a unknown hazardous waste.
- Establish a policy to address faculty retirement and discard or archive materials.
- Remove graduate student research products once he or she graduates, if materials are no longer needed. If the materials are necessary for further research, follow the archival policy. Establish a clean-out policy for your laboratory to avoid accumulating orphaned chemicals.

<table>
<thead>
<tr>
<th>Table 8: Special Practices for Dangerous Substances</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of Substance</strong></td>
</tr>
<tr>
<td>Fine powders</td>
</tr>
<tr>
<td>Hydrogen fluoride</td>
</tr>
<tr>
<td>Aniline</td>
</tr>
<tr>
<td>Carcinogens (such as benzene and acrylamide)</td>
</tr>
</tbody>
</table>
Chemical Hygiene Plan: Chapter 5 - Managing Hazardous Materials at C.O.S.E.

- If the chemical looks like it has undergone a physical change, such as crystals have formed, or it has dried out, discard it regardless of the expiration date. Some chemicals, such as picric acid, Bouin's Reagent, and trinitrobenzene can be dangerous if allowed to dry out. Clear out old ether and tetrahydrofuran containers.

- Justify the use of highly toxic or carcinogenic chemicals in your program. Whenever possible, substitute less toxic chemicals for extremely toxic chemicals like aniline and class A carcinogens like benzene.

Why should I discard chemicals I may use one day (maybe)?

If the chemical is very old, you would probably rather use something that you are sure is still pure for any important research.

As of 1980, laws requiring chemical name and hazard information on all containers went into effect. If the label on your original bottle does not have physical and health hazards clearly printed on it, then it is more than 20 years old and you should get rid of it!

- If there is evidence of deterioration or physical change, it may no longer be a useful reagent and should be designated as waste;
- You free up valuable work and shelf space;
- Annual inventories are much quicker and more accurate when the quantity is manageable and storage is well organized.
- You decrease the chance for tripping over a chemical or accidentally knocking it off the shelf due to the clutter and crowded work space;
- Ongoing culling of inventory saves the University money because the practice minimizes the following expensive services:
  - large laboratory clean-outs when a researcher moves
  - extensive analysis for disposal of unknowns
  - fines from regulatory agencies for poor storage practices.

How should archival chemicals be stored?

Sometime prior to a student's graduation or completion of a research project, all chemicals created by the student should either be archived for future use or disposed appropriately. In addition, student laboratory notebooks should be collected and stored either in the PI's laboratory or office. When faculty retire, use this same practice to handle their chemicals to avoid unnecessary storage of unwanted reagents and creation of "unknowns".

Chemicals that must be saved for some legitimate purpose need to be securely closed and labeled describing this purpose. In addition to the purpose of the chemical sample, the following information must be included on a label or tag securely attached to the container:

- Researcher name
- Identification of the material including laboratory notebook reference
- List of components known to be hazardous along with their hazards
- Date created
5.5 Managing Hazardous Waste

Waste can be defined as substances that are expired, outdated, contaminated or otherwise no longer useful. A "hazardous" waste is a substance that can cause harm to people or to the environment. The person the substance belongs to who decides that it is now waste material is the "generator" of the waste.

Typically the Principal Investigator or lab manager is the generator of the waste and so is responsible for handling the waste appropriately in compliance with campus policy and hazardous materials permit. An identification tag must be affixed to each container as soon as the first drop of waste material goes in. An example of a correctly filled-out tag is included in Appendix D.

How should a waste collection area be set-up?

A waste collection area, known as “Satellite Accumulation Area” (SAA), must be an area separated from non-waste chemicals. In tight spaces, secondary containment can be used to separate waste from non-waste and incompatibles from each other.

- Choose a hazardous waste collection area in or near the laboratory or shop.
- Post a sign designating this area as the “Satellite Accumulation Area” (SAA) for your hazardous waste.
- Inform your lab assistants that an SAA is a discrete portion of the laboratory just for waste storage. Government inspectors look at these areas very closely to make sure they are in compliance with EPA regulations covering hazardous waste.
- Separate wastes according to chemical compatibility and waste type. Biohazardous waste, radioactive waste, broken glass, solid waste, and chemical hazardous waste must be stored in separate secondary containers or areas.
- Do not mix wastes unless you know they are compatible (Many organic solvent wastes are compatible).
- Do not mix halogenated waste with non-halogenated wastes, even if they are chemically compatible, because mixing them adds significantly to disposal costs.

What are the requirements for maintaining a compliant waste collection area?

The generator of the waste is responsible for identifying the waste, completing the waste ID tag, and for making sure waste is stored properly at all times. The generator may delegate this task to someone else, but the generator is still ultimately responsible.

**Stockroom staff is NOT responsible for identifying wastes or filling out waste ID tags for others.**

Review the following information with everyone working in your lab or workshop to make sure everyone knows how to handle hazardous waste generated in the lab.

- Warn lab workers not to pour hazardous waste into the sink or floor drains.
- Make it clear who is responsible for obtaining, labeling and tagging waste bottles.
- Show where to get containers to collect waste (usually from the stockroom).
- Demonstrate how to fill out the waste identification tag.

Follow this procedure once waste has been generated:
• Affix a COMPLETED hazardous waste ID tag to the bottle
• Separate wastes according to chemical compatibility and waste type.
• Keep waste containers closed when not directly adding waste. When finished adding waste, do not leave funnels in containers. Replace the cap.
• Wipe off spilled materials on the outside of containers to minimize inadvertent exposure to the material.
• Take waste to the stockroom for collection when the container is full OR it is nearing 60 days from the date written on the tag. (This date is the day the first drop of waste was added.)

**Important Note:**

**Lab costs for identifying unknowns can run into thousands of dollars!**

---

**How can a waste be declared non-hazardous?**

Justify and document the reasoning for declaring a lab waste as “non-hazardous”. The term “hazardous waste” has legal implications requiring knowledgeable disposal practices. EPA, Cal-EPA, county health, water treatment district and the fire department all regulate waste to some extent. As the generator of the waste, you must be able to justify your collection and disposal protocols.

If you think a waste stream you generate isn't hazardous, obtain a “Petition for Non-Hazardous Waste Status” from the COSE Health & Safety Specialist. You’ll have to describe your process for generating the waste and note the concentration of each material in your wastestream. Upon receipt, University EHOS will evaluate your request and let you know if it is okay to change your disposal practice.

To see a copy of the “Petition for Non-Hazardous Waste Status,” see Appendix D.
5.6 Storing Flammable Materials

1. Organic solvents shall not be stored on the floor

2. Extremely flammable liquids (Class 1A)\(^4\) shall be stored in flammable storage cabinets — regardless of storage limits for other flammables and combustibles.

3. Flammable liquids (including waste) shall not be stored under or next to solvent distillation units.

4. 5 gallon cans of flammable solvents shall be stored only in flammable storage cabinets\(^2\) or flammable storage room\(^3\)

5. Maximum storage of flammable liquids (outside of a flammable storage cabinet) in a non-sprinklered laboratory:
   - 10 gal for rooms >600 sq ft
   - 6 gal for rooms <600 sq ft

6. Ethyl ether and other peroxide-forming\(^4\) chemicals shall have the date received marked on the container.
   - Discard within a year of the received date OR
   - Discard on or before manufacturer’s expiration date, whichever is less.

7. Transfer of flammable liquids from metal containers >1 liter
   - Container must be grounded.
   - If receiving container is also metal, it must be bonded to the donor container.
   - Such transfers must be performed inside a fume hood or ventilated flammable storage room.

8. Flammable gas cylinders must be grounded when in use.
   - If receiving material is an instrument or metal container, it must be bonded to the flammable gas cylinder during transfer.
   - Oxygen and other oxidizing gases must be stored at least 20 ft away or separated by a fire wall.

9. Halogenated\(^8\) solvents shall not be stored with other organic flammable solvents. (forms phosgene gas when burning)
   - Flammable halogenated solvents may be stored separately or in a flammable storage cabinet in a separate secondary container tray.
   - Non-flammable halogenated solvents may be stored separately or in the same cabinet/area with corrosives or general chemicals.

10. Flammable solids\(^6\), such as metal hydrides, must be stored separately from other chemicals, preferably in a metal or glass cabinet (never plastic) and protected from light and moisture.

---

\(^1\) **Extremely flammable liquids:** Chemicals classified as Class 1A or designated as NFPA 4 for flammability.

**Examples:**
- ethyl chloride
- methyl ethyl ether
- ethyl ether
- pentane
- propylene oxide
- petroleum ether
- acetaldehyde
- ethylene oxide

\(^2\) **Flammables cabinet:** Storage cabinet designed to store flammable liquids that meets the design criteria of all applicable regulations i.e., OSHA, NFPA 30, & UFC 79

\(^3\) **Flammable storage room:** Room with spill containment and fire suppression system.

\(^4\) **Peroxide formers:** Prone to forming potentially explosive peroxide crystals upon evaporation or distillation.

**Examples:**
- diethyl ether
- tetrahydrofuran (THF)
- cumene
- isopropyl ether
- furan
- methyl-tert butyl ether (MTBE)

\(^5\) **Halogenated Solvents:** Absorb easily through skin and can be harmful or lethal to biological organisms in sufficient quantities. Halogenated solvents include organic compounds with fluorine (F), chlorine (Cl), bromine (Br), and iodine (I).

**Examples:**
- methylene chloride
- carbon tetrachloride
- chloroform
- trichloroethane
- tetrachloroethane
- dichloroethane (flammable)

\(^6\) **Flammable Solids:** Include alkali metals, magnesium metal, metallic hydrides, some organometallic compounds, and sulfur: lithium aluminum hydride (LAH). Most are extremely water and air reactive.
Appendix A: College of Science & Engineering
Policy for Working After-Hours

The College of Science and Engineering (COSE) encourages students to complete their research
and class work during regular University business hours: Weekdays 7 AM to 10 PM.

Faculty Advisors may request a Student Building Pass for students that need to work on campus
after-hours. To do so, they must apply to their Department Chair for approval.

The COSE Executive Director of Operations verifies the Chair’s signature on the Student
Building Pass form before signing the Student Pass Request. Note that his signature does not
constitute approval but instead provides a recognizable signature for Campus Police officers to
check.

Department Chairs must authorize all Student Building Pass Requests.
COLLEGE OF SCIENCE & ENGINEERING
STUDENT BUILDING PASS

_________________________________________ (________________________) can work in
Student Name Student ID #

_________________________________________ on weekends until 6 pm and weeknights until 12 am.
Building/Room #

From ____________________________ to ____________________________
Date Date

_________________________________________
Faculty Advisor

_________________________________________
Approved by Department Chair

-----------------------------------------------------------------------------------------------

COLLEGE OF SCIENCE & ENGINEERING
STUDENT BUILDING PASS

_________________________________________
DEPARTMENT

_________________________________________ (________________________) has Department Chair approval to work in
Student Name Student ID #

_________________________________________ on weekends until 6 pm and weeknights until 12 am.
Building/Room #

From ____________________________ to ____________________________
Date Date

_________________________________________
Executive Director of Operations

Rev. 5/02
COLLEGE OF SCIENCE & ENGINEERING
STUDENT BUILDING PASS

Student Name ( ) can work in

Student ID #

Building/Room #

weeknights after 10 PM and on weekends.

From to

Date Date

Faculty Advisor

Approved by Department Chair

COLLEGE OF SCIENCE & ENGINEERING
STUDENT BUILDING PASS

DEPARTMENT

Student Name ( ) has Department Chair approval to work in

Student ID #

Building/Room #

on weeknights after 10 PM and on weekends.

From to

Date Date

Executive Director of Operations

Rev. 6/02
Appendix B: Buddy System

**Reason for This Guide:**
Laboratory projects often involve hazardous materials, which could endanger life safety if controls should fail. It is imperative that emergency assistance be available within a reasonable time period to anyone who is injured or becomes ill, at any time of the day or night, during the course of laboratory work.

**Guideres:**
Persons working with hazardous materials such as flammables, toxic or corrosive chemicals, or detonatibles should never work alone. A “buddy system” can assure that someone is always nearby and available to:

1) check on and respond to calls from the persons working with the hazardous materials,
2) render and/or obtain first aid, and
3) contact emergency personnel.

The person performing the checking (i.e., the “buddy”) must be reasonably knowledgeable concerning the hazardous materials and the project of the person being checked on, and be aware of the location of applicable emergency equipment and the procedures used to summon emergency assistance.

The individual in charge of the laboratory is responsible for seeing that no person is left alone to work on a hazardous project.

## Forms

<table>
<thead>
<tr>
<th>Form Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-1</td>
<td>Prior Approval</td>
</tr>
<tr>
<td>D-2</td>
<td>Research Safety Agreement</td>
</tr>
<tr>
<td>D-3</td>
<td>Petition for Non-Hazardous Waste Status</td>
</tr>
<tr>
<td>D-4</td>
<td>Hazardous Waste ID Tag</td>
</tr>
<tr>
<td>D-5</td>
<td>New Hire Training Record</td>
</tr>
</tbody>
</table>

Note: Blank copies of these and other templates and forms may be obtained from the COSE Health & Specialist at x8-6892 or electronically by email: lvadura@sfsu.edu.
Prior Approval For Particularly Hazardous Activities

Research students and assistance must familiarize themselves with the hazards and safety precautions of particularly hazardous chemicals or laboratory tasks before they can protect themselves from inadvertent exposure. Principal Investigators are responsible for evaluating their work and determining the tasks or chemicals that require extra training or precautions.

- Particularly hazardous chemicals are those that are extremely toxic, carcinogenic, mutagenic, teratogenic, pyrophoric, and very unstable or reactive in a way that could cause injury if not handled very carefully.
- Work considered particularly hazardous are those that pose a risk of injury either significantly greater than normal lab work or tasks that require very careful handling and special precautions to avoid serious injury.

1. Name of person requesting approval: ____________________________ Date: ________
   (please print)

2. Location where hazardous activity is to occur: ____________________________ (e.g. room #, fume hood #)

3. Reason for request: □ Very Hazardous (Toxic or Reactive) Substance □ Unattended Work
   □ Very Hazardous Work □ Other ____________________________

4. What is the substance(s) or procedure(s) for which approval is being requested? ____________________________
   ____________________________
   ____________________________
   ____________________________

5. Please describe the activity or how the substance will be used. ____________________________
   ____________________________
   ____________________________
   ____________________________

6. What are the hazards associated with the activity or substance(s)? ____________________________
   ____________________________
   ____________________________

   (If applicable) a) Material Safety Data Sheet has been reviewed and is on file? □ YES □ NO
   b) List symptoms of overexposure:
      a) ____________________________
         ____________________________
         ____________________________
      b) ____________________________
         ____________________________
         ____________________________

7. What special precautions will you implement?
   ____________________________
   ____________________________
   ____________________________
   ____________________________
Prior Approval for Particularly Hazardous Activities (continued)

8. What kind of personal protective equipment will be required (if any)? ____________________________

(e.g. Check manufacturer charts for gloves rated as resistant to the substance, list type of eye protection)

9. Describe how you plan to prevent releases from the fume hood or other "designated area"?

__________________________________________________________________________________________

(e.g. keep containers covered, check seals on glove boxes, close hood sash when not using it, use secondary containers, use the right material to contain the substance to prevent container failure)

a. Is the "designated area" posted? □ YES □ NO, (why?) _________________________________

b. How will you prevent unauthorized access? ________________________________________________

__________________________________________________________________________________________

(e.g., where and how you will store the substance)

10. Is there any required medical surveillance or special first aid treatment? □ YES □ NO

If yes, please describe: _____________________________________________________________________

__________________________________________________________________________________________

(e.g. Some chemicals, like hydrofluoric acid, must have an antidote supplied with the material.

Substance Requestor/Lab Worker Signature: ___________________________ Date: __________

Principal Investigator Approval Signature: ___________________________ Date: __________

Notes/Comments: ____________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

Original to □ Stockroom Manager (or dept Safety Coordinator)

Photocopies to □ Principal Investigator
□ COSE Health & Safety Specialist (c/o Dean’s Office)

Page 2 of 2

Appendix D-1
Petition for Non-Hazardous Waste Status

Principal Investigator(s): ____________________________

Date Submitted to EHOS: ________________ Room(s) Affected: ____________________

Building & Room no.

To the best of your knowledge, list the make up of your wastestream below.

<table>
<thead>
<tr>
<th>Chemical/Product/Material Name</th>
<th>Approx. %</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Explain why you believe the waste is not hazardous and can be emptied in the sink or discarded in regular household trash.


Please check one.

☐ The waste was tested and did not have the “characteristics” of hazardous waste AND it is not prohibited by SFSU’s wastewater discharge permit AND is not listed in Cal-EPA regulations found in 22 CCR 66261.100 RCRA or 22 CCR 66261.101 Non-RCRA. Attach test results.
  ✗ Not Flammable
  ✗ Not Reactive
  ✗ Not Explosive
  ✗ Not Toxic to Humans
  ✗ Not Toxic to Fish

☐ Through my personal knowledge and experience, I have determined that this wastestream is not hazardous by its “characteristics” AND is not prohibited by SFSU’s wastewater discharge permit AND is not listed in Cal-EPA regulations as hazardous waste.


Signature of Principal Investigator

---

For Office Use Only

The SFSU Director of Environmental, Health, & Occupational Safety has reviewed this petition.

Based on the information presented, this petition is

☐ Approved

☐ Not-Approved

Reason: ________________________________

Signature: ________________________________ Date: ____________

Appendix D-2
Research Laboratory Safety Agreement

Good laboratory procedure is also safe laboratory procedure. Your instructor will discuss any special concerns before each experiment, however, you should know common operating practices for general laboratory work:

1. Inform your instructor of any special health concerns (e.g. asthma, allergies, etc.) or if you are pregnant or become pregnant. Health information will be kept confidential.
2. Do NOT perform unauthorized experiments.
3. Report all injuries, even minor ones, to your instructor as soon as possible.
4. Wear your approved splash goggles or safety glasses at all times in the laboratory.
5. Keep long hair pulled back or tightly secured. Hair will burn if it contacts the Bunsen flame. Also take off or secure necklaces, loose bracelets, etc. before starting work.
6. Avoid inadvertent contact with chemicals by not eating, drinking or applying makeup. Don’t taste any chemicals or place your nose directly into a beaker, tube or flask.
7. Don’t sit or lean on lab benches. You don’t know if residues of spilled materials are still there.
8. Know the location of the exits, safety shower, eyewash station and fire extinguisher.
9. If the evacuation alarm sounds, turn off all apparatus and leave the room for the nearest safe exit.
10. Note that spills could cause exposure problems and that many chemicals burn right through clothing. Unless instructed otherwise, wear a lab coat or apron, and shoes that cover your feet completely. (Wear long pants. Avoid shorts and short skirts in the lab.)
11. If you have a chemical spill, alert your instructor right away. He or she will either help you clean it up or show you how to clean it up safely. Wash off spilled materials promptly and thoroughly.
12. Use appropriate carts or chemical carriers when going to and from the stockroom.
13. Check glassware for cracks or damage. If glassware breaks, alert your instructor. Do not throw broken glassware into trash but rather in a sharps container or marked box.
14. Note that hot and cool glassware look the same so make sure your glassware is cool before you touch it or hand it to someone else.
15. Keep flammable liquids and ignition sources well separated. Many chemicals will burn and flammable vapors tend to flow across table and counter tops.
16. Place a clear and readable label identifying your reagents, products, etc. on each container.
17. Put unused reagents or products of reactions into appropriate labeled containers as directed. Do NOT pour chemicals down the drain unless specifically directed to do so by your instructor.
18. Wash your hands immediately after leaving the laboratory and after possible chemical contact.
19. Take off gloves and lab coat when leaving the lab (especially to use restrooms or elevators)
20. Return assigned equipment to the stockroom when finished. You will be charged a replacement fee for all lost or damaged items.

Course: CHEM 499 699 other ____________________________ Semester: ____________

Principal Investigator or Instructor(s): ________________________________

I have read and understand these safety rules for lab work and have been oriented to the hazards and safety features of the experiments and laboratory.

Student Name: ____________________________ Signature: ____________________________ Date: ____________

Appendix D-3
HAZARDOUS WASTE

State and Federal law prohibits improper disposal of hazardous waste. If found, please contact University Police Department at (415) 338-2222, the U.S. Environmental Protection Agency or the California Department of Toxic Substance Control.

ACCUMULATION START DATE 12 / 5 / 2002

1. Waste Generator:
   Generator Name Dr. J. Livingston
   Department Chemistry & Biochemistry Ext. 8-1449
   Generation Location:
   Building Hensill Hall Room 123
   Cabinet Hood Shelf (check one)

2. Type of Waste:
   a. Discarded (unmixed) chemical
   or
   b. Mixed chemical waste – List component(s) / % of mixture
      1. Water / 60%
      2. Ethanol / 20%
      3. Methanol / 10%
      4. Acetone / 10%
      5. /

3. Physical State (circle one):
   Solid Liquid Gas Sludge Slurry

4. Weight or Volume: ___ gm ___ kg ___ mL ___ liter ___ gal

5. Waste Properties: (circle all that apply)
   Flammable Oxidizer Toxic Corrosive Irritant
   Explosive Acid Base Carcinogen Mutagen
   Pyrophoric Reactive Heavy Metals Bio-Hazard Peroxide Forming
   Other hazard information
   pH

6. Preparer’s Signature Dr. Jordan Livingston

EH&OS SECTION ONLY

1. Date received at Hazardous Waste Shed: __ / ___ / ______
2. Waste Contractor: This waste was:
   ____ Lab Packed or ____ Bulk into Drum # ______
   Removed AS IS on __ / __ / ______

HAZARDOUS WASTE

 Appendix D-4
Appendix E: Particularly Hazardous Substances

Exposure to harmful chemicals can result in local toxic effects, systemic toxic effects, or both. Local effects involve injury at the site of first contact, for example skin, nose, and respiratory tract. Systemic effects, however, occur after the substance has been absorbed into the bloodstream and distributed throughout the body. Some terms are critical to understanding health effects and information from documents such as Materials Safety Data Sheets. For example, the term “acute exposure” refers to a local or systemic effect from a single exposure while the term “chronic exposure” refers to repeated or long-duration exposures.

### Irritant:
Non-corrosive chemical that causes reversible inflammatory effects (redness and swelling) on living tissue by chemical action at the site of contact.

<table>
<thead>
<tr>
<th>Acrylamide</th>
<th>Formaldehyde</th>
<th>Peracetic Acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetic anhydride</td>
<td>Propylamine</td>
<td>Ozone</td>
</tr>
</tbody>
</table>

### Corrosive:
Chemical that causes destruction of living tissue by chemical action at the site of contact. These can be solids, liquids, or gases.

<table>
<thead>
<tr>
<th>Sodium hydroxide</th>
<th>Perchloric acid</th>
<th>Trifluoroacetic acid (TFA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitric acid</td>
<td>Hydrochloric acid</td>
<td>Hydrofluoric acid</td>
</tr>
</tbody>
</table>

### Allergen:
A chemical that causes an adverse reaction by the immune system to a chemical resulting from a previous sensitization to that chemical or a structurally similar chemical. Once sensitization occurs, allergic reactions can result from exposure to extremely low doses of the chemical. Symptoms often include red, itchy, swollen skin or eyes, or difficulty breathing.

<table>
<thead>
<tr>
<th>Formaldehyde</th>
<th>Latex</th>
<th>Toluene diisocyanate</th>
</tr>
</thead>
</table>

### Asphyxiant:
A chemical that interferes with the transport of oxygen to the vital organs of the body leading to rapid collapse and death. Some asphyxiants simply displace oxygen in the air while others interact with hemoglobin in the blood to reduce the capacity of blood to carry oxygen.

<table>
<thead>
<tr>
<th>Nitrogen</th>
<th>Carbon monoxide</th>
<th>Halon</th>
</tr>
</thead>
</table>

### Neurotoxin:
A chemical that adversely affects the structure or function of the central and/or peripheral nervous system. Effects can be reversible or permanent. Confusion, slurred speech, and staggered gait are common symptoms of overexposure.

<table>
<thead>
<tr>
<th>Acrylamide</th>
<th>Dimethyl mercury</th>
<th>Phenol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hexane</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Target Organ Toxin:
Chemical that causes adverse effects to organs other than the reproductive or neurological systems. These organs typically include the liver, kidneys, blood producing organs, and lungs.

<table>
<thead>
<tr>
<th>Acrylonitrile</th>
<th>Carbon tetrachloride</th>
<th>Phenol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzene</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Highly Flammable Substances
A gas, liquid, or solid that readily catches fire and burns in air. A highly flammable substance has a flash point of less than room temperature. *The flashpoint is the lowest temperature at which a liquid has a sufficient vapor pressure to form an ignitable mixture with air near the surface of the liquid.*

<table>
<thead>
<tr>
<th>Acetone (-18°C)</th>
<th>Diethyl ether (-45°C)</th>
<th>Acetaldehyde (-37.8°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzene (-11.1°C)</td>
<td>Tetrahydrofuran (-14°C)</td>
<td>Potassium hydride (ignites on contact with moist air)</td>
</tr>
</tbody>
</table>
OSHA’s Definition of “Hazardous Substance”

OSHA defines “hazardous substance” as “a chemical for which there is statistically significant evidence based on at least one study, conducted in accordance with established scientific principals, that acute or chronic health effects may occur in exposed employees”. Classifications of “health hazards” include carcinogens, sensitizers, hepatotoxins (liver), nephrotoxins (kidneys), neurotoxins (CNS), hematopoietic toxins (blood), reproductive toxins (mutagens, teratogens), and agents which damage the lungs, skin, eyes, or mucous membranes.

Particularly Hazardous Substances

OSHA’s Laboratory Standard states that the employer must make “provisions for additional employee protection for work with “particularly hazardous substances”.

1. Establishment of a designated area;
2. Use of containment devices such as fume hoods or glove boxes;
3. Procedures for safe removal of contaminated waste; and
4. Decontamination procedures.

These chemicals include select carcinogens, reproductive toxins, and substances with a high degree of acute toxicity. But, according to “Prudent Practices in the Laboratory” (page 41), “in some circumstances, it may not be necessary to employ all of these special precautions, such as when the total amount of an acutely toxic substance to be handled is a small fraction of the harmful dose.” Review the individual MSDS for toxicity information.

Select Carcinogens:
A chemical that is capable of causing cancer, or the uncontrolled growth of cells. Often there is no immediately apparent harmful effect upon exposure.

Chemicals that are known to pose the greatest carcinogenic hazard are referred to as “select carcinogens” and must be handled as “particularly hazardous substances”. A select carcinogen is defined in the OSHA Laboratory Standard as a substance that meets one of the following criteria.

1. It is regulated by OSHA as a carcinogen in 29 CFR 1910, Subpart Z, Toxic and Hazardous Substances.
2. It is listed as “known to be a carcinogen” in the latest Annual Report on Carcinogens issued by the National Toxicology Program.
   - Group 1 – carcinogenic to humans
   - Group 2A – probably carcinogenic to humans
   - Group 2B – possibly carcinogenic to humans
   - Reasonably anticipated to be a carcinogen by the National Toxicology Program AND causes statistically significant tumor incidence in experimental animals.

Reproductive Toxins:
A chemical that affects reproductive capabilities, including chromosomal damage (mutations) and effects on fetuses (teratogenesis)

High Level Acute Toxins
Chemicals that can cause extremely harmful effects after a single exposure. “Prudent Practices in the Laboratory” indicates that substances with a toxicity rating of “highly toxic” or “extremely toxic”, based on an animal oral LD₅₀ of 50 mg per kg (or less), are considered to have a high level of acute toxicity.

(See Table 3.2 on page 42 of Prudent Practices for details.)
# Standard Operating Procedures

or Codes of Safe Work Practices

<table>
<thead>
<tr>
<th>No.</th>
<th>Sample Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-1</td>
<td>Mixing Aqueous Acid Solutions Sample #1</td>
<td>Example of a written Code of Safe Work Practice for general tasks.</td>
</tr>
<tr>
<td>F-2</td>
<td>Blank Template for Sample #1</td>
<td>A blank template for a Code of Safe Work Practice in the format of F-1.</td>
</tr>
<tr>
<td>F-3</td>
<td>Daily Cleaning of the Mass Spectrometer Sample #2</td>
<td>Example of a written Code of Safe Work Practice or Safe Operating Procedure for a specific task.</td>
</tr>
<tr>
<td>F-4</td>
<td>Blank Template for Sample #2</td>
<td>A blank template for a Code of Safe Work Practice or Safe Operating Procedure in the format of F-3.</td>
</tr>
<tr>
<td>F-5</td>
<td>Safe Use of Perchloric Acid Sample #3</td>
<td>Example of an “explanatory” form of describing safe work practices used at Michigan State University. To make this document more specific, you could add the particular procedure for digestion to the Process Description section and rename it. (Example, Using Perchloric Acid for Digestions)</td>
</tr>
<tr>
<td>F-6</td>
<td>Working with Strong Perchloric Acid (Using template in F-4)</td>
<td>Included is the content placed into a Code of Safe Work Practice template.</td>
</tr>
</tbody>
</table>

Note: Blank copies of these and other templates and forms may be obtained from the COSE Health & Specialist at x8-6892 or electronically by email: lvadura@sfsu.edu.
**Code of Safe Work Practice: Mixing Aqueous Acid Solutions**

**Version Date:**

**Principal Investigator:**

**Building & Room #:**

**Before you start, make sure you have the following materials or equipment available:**

<table>
<thead>
<tr>
<th>Material/Equipment</th>
<th>Distilled water</th>
<th>Recipe for acid/water proportion</th>
<th>Face shield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Splash Goggles</td>
<td></td>
<td>Optional</td>
<td></td>
</tr>
<tr>
<td>Splash Goggles</td>
<td></td>
<td>Optional</td>
<td></td>
</tr>
<tr>
<td>Gloves</td>
<td>Optional</td>
<td>Optional</td>
<td></td>
</tr>
<tr>
<td>Glass funnel</td>
<td></td>
<td>Optional</td>
<td></td>
</tr>
<tr>
<td>Glass or plastic container</td>
<td></td>
<td>Optional</td>
<td></td>
</tr>
</tbody>
</table>

**1. Process Description**

Mixing concentrated acids with water to produce varying concentrations of acid solutions.

- **Common acids:** acetic, hydrochloric, phosphoric, nitric, sulfuric

1. Put on eye protection and gloves.
2. Take the acid bottle from its storage cabinet to the fume hood.
3. Put the required amount of distilled water into a clean container.
4. Using a glass funnel, slowly pour acid into the water to make the desired concentration.
5. When finished, wipe down the acid container and return it to its storage cabinet.

**2. Potential Hazards**

Concentrated acids are corrosive so skin or eye contact can result in serious chemical burns. Acids are also reactive to organic solvents and bases.

- Avoid contact and practice diligent chemical hygiene.
- Handle concentrated acids only in rooms equipped with an eyewash and safety shower.
- Store mineral acids away from organic acids, oxidizing agents, and organic materials. Acids corrode metal containers, use resistant plastic or glass instead.

**3. Special Precautions**

- Wear chemical splash goggles with small quantities and goggles or safety glasses. If handling more than one gallon, use a faceshield in addition to glasses or goggles.

**4. Eye Protection**

Wear gloves made of nitrile, neoprene or PVC. Make sure the thickness (measured in “mils”) is sufficient to provide protection for the task.

**5. Gloves**

Wear clothes that cover legs and shoes that cover toes.

**6. Protective Clothing**

Wear clothes that cover legs and shoes that cover toes.

**7. Engineering/Ventilation**

Use concentrated acid in a fume hood.

**8. Spills and Accidents**

**Skin exposure:** Rinse affected area with plenty of water while removing contaminated clothing and shoes. Rinse for at least 15 minutes before seeing further medical attention.

**Eye exposure:** Splashes may cause tissue destruction. Wash eyes for at least 15 minutes, lifting the upper and lower eyelids. Someone should stay and assist the victim during the irrigation process. Report the incident and seek medical attention as soon as possible.

**Small spills:** Contain spill or cover with absorbent material. After removing absorbent, wash the contaminated area with a bicarbonate solution and collect the clean up materials in a bucket. 

*Do not attempt cleanup if you feel unsure about your ability to do so or you perceive the risk to be greater than normal laboratory operations.*

**Large spills:** Notify others in the area of the spill. Turn off ignition sources if it is safe to do so. Evacuate the area and post signs at all access points. During business hours, call EHOS at x8-1449 and 911. After hours, call 911. Restrict access to the spill area until cleanup is complete. Remain nearby in a safe location to assist responders.

---

**Appendix F-1**
Before you start, make sure you have the following materials or equipment available:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. **Process Description**

   Describe what you are doing. Include the major steps.

2. **Potential Hazards**

3. **Special Precautions**

4. **Eye Protection**

   Indicate type required or write in “None”

5. **Gloves**

   Indicate type required or write in “None”

6. **Protective Clothing**

   Indicate type required or write in “None”
7. Engineering/Ventilation

Indicate type required or write in "None"


8. Spills and Accidents

Skin exposure: Rinse affected area with plenty of water while removing contaminated clothing and shoes. Rinse for at least 15 minutes before seeing further medical attention.


Eye exposure: Splashes may cause tissue destruction. Wash eyes for at least 15 minutes, lifting the upper and lower eyelids. Someone should stay and assist the victim during the irrigation process. Report the incident and seek medical attention as soon as possible.


Small spills: Contain spill or cover with absorbent material. After removing absorbent, wash the contaminated area with a bicarbonate solution and collect the cleanup materials in a bucket. Do not attempt cleanup if you feel unsure about your ability to do so or you perceive the risk to be greater than normal laboratory operations.


Large spills: Notify others in the area of the spill. Turn off ignition sources if it is safe to do so. Evacuate the area and post signs at all access points. During business hours, call EHOS at x8-1449 and 911. After hours, call 911. Restrict access to the spill area until cleanup is complete. Remain nearby in a safe location to assist responders.


Notes/Comments:


Page 2 of 2

Appendix F-2
SAFE OPERATING PROCEDURE

Daily Cleaning of the Mass Spectrometer

The mass spectrometer is an instrument that determines the mass-to-charge ratio of ions derived from a sample allowing you to identify desired compounds in the sample. Because of the accuracy involved, you should wipe it down after each use or at least daily. In addition, the mass spectrometer must be thoroughly cleaned biweekly as part of standard maintenance. See the bi-weekly cleaning procedure for more information.

EQUIPMENT NEEDED:
- Distilled water in a squeeze bottle
- Methanol in a squeeze bottle
- Kimwipe tissues
- Fluid collection flask

PPE (Personal Protective Equipment):
Gloves

POTENTIAL HAZARDS:
Contact with methanol can cause dry, scaly skin and irritation with prolonged exposure. Methanol is also flammable. The interior of the injection port is very hot, in excess of 200°C so it is important to allow the unit to cool down before taking it apart.

OPERATING PROCEDURE:
1. Check the yellow STANDBY button on the computer screen to the left of the mass spectrometer to place it in STANDBY MODE.

2. Check the scan indicator light on the mass spectrometer to make sure it is dark. This means it is in STANDBY MODE.

3. Unscrew the black knobs on either side of the injection port to loosen them.

4. Pull out the injection port slowly.

5. Put on the gloves.

CAUTION! HOT! Avoid contact with the heated capillary.

6. Spray methanol liberally onto the metal surface of the heated capillary side, allowing the excess to drain into the collection flask.

7. Saturate a Kimwipe with methanol and wipe down the electrospray needle side.

8. Place the green cap on the opening of the heated capillary inside the exposed port.

CAUTION! Very hot.

9. Push the injection port back into place to close it.

10. Retighten the black screws clockwise until finger tight.

11. Check to make sure the vacuum indicator light is “ON”.

Appendix F-3
Title:  

Brief Description:  

EQUIPMENT NEEDED:  

PPE (Personal Protective Equipment):  

Gloves  

Lab Coat  

Lab Apron  

Splasch Goggles  

Safety Glasses  

Faceshield  

Welding/UV Goggles  

Laser Goggles  

wavelength  

Dust Mask  

Respirator  

Other  

POTENTIAL HAZARDS:  

Skin/Eye Contact  

Skin Absorbing  

Skin/Eye Irritation  

Skin/Eye Burns  

Hot Surfaces  

Cryogenic/Cold Surfaces  

Unstable/Reactive  

Carcinogen  

Mutagen/Teratogen  

Very Toxic/Acute  

Very Toxic/Chronic  

Eye Damage (Non-Ionizing Energy)  

Inhalation of Toxic Vapor/Mist/Fumes/Aerosols  

Respiratory Irritation  

Electric Shock  

Crushing By or Against  

Sharp Edges/Cuts  

Details:  

OPERATING PROCEDURE:  

1.  

CAUTION!  

2.  

3.  

4.  

5.  

6.  

Appendix F-4
Safe Use of Perchloric Acid

Perchloric acid is a strong acid used for complete digestions of organic material. It is normally supplied in bottles of up to one gallon in capacity at 70-72% strength. In many respects, its hazards are similar to those of nitric acid, as both are strong oxidants.

**WARNING!** Perchloric acid presents an additional hazard in that perchloric acid mist and vapor can condense in ventilation systems to form metallic perchlorates, which can be explosive.

Researchers using or anticipating using perchloric acid in their experiments should keep the following in mind:

1. Perchloric acid digestions of any size must be performed only in a fume hood. No open benchtop digestions may be performed.

2. Any hood which is used for perchloric acid digestions must be properly constructed for use with perchloric acid.

3. Perchloric acid digestions require a special perchloric acid hood with a washdown system, or if infrequent use of small quantities is more common, a hood fitted with a vapor trap apparatus similar to a micro-Kjeldahl.

4. Regardless of the size of the digestion, no organic solvents should be in the hood during the digestion. Solvents must never be stored or used in a designated perchloric acid hood at any time. These hoods should be posted with a label stating "Perchloric Acid Use Only. Organic Chemical Prohibited."

5. When diluting perchloric acid (or any other acid) always add ACID TO WATER, not the reverse.

6. Perchloric acid will attack researchers’ tissues as easily as it will attack sample tissue. To prevent injury, goggles of face shield, gloves, and apron should be worn when handling perchloric acid.

7. Because of the potential for explosion, no work should be done on a hood used for perchloric acid digestions until it has been thoroughly decontaminated. Contact EHOS at x8-1449.

8. Perchloric acid waste must not be mixed with any other waste. It should be put into acid-resistant bottles (preferably the original container), clearly labeled and treated as hazardous chemical waste.

9. Perchloric acid should be stored segregated from all other chemicals and inside secondary containment (such as a pyrex baking dish or plastic dish pan). It must not be stored near organic acids such as acetic acid, near bases, or near other organic or flammable material.

If you have any questions about safe use and handling of perchloric acid, or wish to have a fume hood approved for use with perchloric acid, please contact EHOS at x8-1449 or COSE Health & Safety Specialist at x8-6892.
Code of Safe Work Practice:  Working with Strong Perchloric Acid

Version Date: ____________________

Principal Investigator: ____________________ Building & Room #: ______

Before you start, make sure you have the following materials or equipment available:

- Gloves, lab coat, apron
- Splash goggles, and faceshield
- A working fume hood designated for perchloric acid
- Prior Approval Form/Documented Training
- Secondary containment (i.e., pyrex or plastic dish)
- Emergency eyewash and shower

1. Process Description

Perchloric acid is a strong acid used for complete digestions of organic material. It is normally supplied in bottles of up to one gallon in capacity at 70-72% strength. In many respects, its hazards are similar to those of nitric acid, as both are strong oxidants.

2. Potential Hazards

Highly corrosive to all tissues; reacts violently with many oxidizable substances; anhydrous form and certain salts are highly explosive. Causes severe burns on contact with eyes, skin and all mucous membranes.

Cold 70% perchloric acid is a strong acid but not a strong oxidizing agent. However, temperature increases the oxidizing power of perchloric acid.

WARNING! Perchloric acid presents an additional hazard in that perchloric acid mist and vapor can condense in ventilation systems to form metallic perchlorates, which can be explosive.

3. Special Precautions

- Perchloric acid digestions of any size must be performed only in a fume hood. No open benchtop digestions may be performed.
- Perchloric acid will attack researchers’ tissues as easily as it will attack sample tissue. To prevent injury, splash goggles with face shield, gloves, and apron should be worn when handling perchloric acid.
- Because of the potential for explosion, no work should be done on a hood used for perchloric acid digestions until it has been thoroughly decontaminated. Contact EHOS at x8-1449.
- Perchloric acid waste must not be mixed with any other waste. It should be put into acid-resistant bottles (preferably the original container), clearly labeled and treated as hazardous chemical waste.
- Perchloric acid should be stored segregated from all other chemicals and inside secondary containment (such as a pyrex baking dish or plastic dish pan). It must not be stored near organic acids such as acetic acid, near bases, or near other organic or flammable material.
- Regardless of the size of the digestion, no organic solvents should be in the hood during the digestion. Solvents must never be stored or used in a designated perchloric acid hood at any time. These hoods should be posted with a label stating “Perchloric Acid Use Only. Organic Chemical Prohibited.”
- When diluting perchloric acid (or any other acid) always add ACID TO WATER, not the reverse.
<table>
<thead>
<tr>
<th>4. Eye Protection</th>
<th>Splash goggles with faceshield</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Gloves</td>
<td>Acid resistant gloves</td>
</tr>
<tr>
<td>6. Protective Clothing</td>
<td>Lab coat with a lab apron on top.</td>
</tr>
<tr>
<td>7. Engineering/Ventilation</td>
<td></td>
</tr>
<tr>
<td>1. Any hood which is used for perchloric acid digestions must be properly constructed for use with perchloric acid.</td>
<td></td>
</tr>
<tr>
<td>2. Perchloric acid digestions require a special perchloric acid hood with a washdown system, or if infrequent use of small quantities is more common, a hood fitted with a vapor trap apparatus similar to a micro-Kjeldahl.</td>
<td></td>
</tr>
<tr>
<td>8. Spills and Accidents</td>
<td></td>
</tr>
<tr>
<td><strong>Skin exposure:</strong> Perchloric acid is highly corrosive to skin and mucous membranes. Rinse affected area with plenty of water while removing contaminated clothing and shoes. Rinse for at least 15 minutes before seeking further medical attention.</td>
<td></td>
</tr>
<tr>
<td><strong>Eye exposure:</strong> Splashes will cause tissue destruction. Wash eyes for at least 15 minutes, lifting the upper and lower eyelids. Someone should stay and assist the victim during the irrigation process. Report the incident and seek medical attention as soon as possible.</td>
<td></td>
</tr>
<tr>
<td><strong>Small spills:</strong> Contain spill or cover with absorbent material. After removing absorbent, wash the contaminated area with a bicarbonate solution and collect the clean up materials in a bucket. <strong>Do not attempt cleanup if you feel unsure about your ability to do so or you perceive the risk to be greater than normal laboratory operations.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Large spills:</strong> Notify others in the area of the spill. Turn off ignition sources if it is safe to do so. Evacuate the area and post signs at all access points. During business hours, call EHOS at x8-1449 and 911. After hours, call 911. Restrict access to the spill area until cleanup is complete. Remain nearby in a safe location to assist responders. <strong>Only small quantities used at a time.</strong></td>
<td></td>
</tr>
</tbody>
</table>

Notes/Comments:

Appendix F-6
A. Explanations

These guidelines are intended to help you create a plan relevant and helpful to your operation. The “TEMPLATE” is attached and you may fill it in by hand and attach SOP’s or other relevant instructions. Alternatively, you may use these guidelines and the TEMPLATE to help you develop your own CHP.

Each laboratory must have its own Chemical Hygiene Plan and Injury & Illness Prevention Program that describes its specific rules and procedures as a supplement to the full campus documents. The attached TEMPLATE of a Chemical Hygiene and Safety Plan fulfills both requirements and should be attached to the C.O.S.E. Chemical Hygiene Plan in each affected lab.

1. C.O.S.E. Chemical Hygiene Plan

All lab personnel should become familiar with the C.O.S.E. Chemical Hygiene Plan when they start work and it must be available to all lab personnel during working hours. For your information, below is a table of requirements for CHP’s specified in OSHA’s Lab Standard at 29 CFR 1910.1450 (e)(3) and the associated sections in the C.O.S.E. CHP.

<table>
<thead>
<tr>
<th>CHP Reg. Reference</th>
<th>Topics Required by OSHA’s Lab Standard</th>
<th>Clarification of Required Topics</th>
<th>Chapter in CHP</th>
</tr>
</thead>
<tbody>
<tr>
<td>(e)(3)(i)</td>
<td>Standard operating procedures for handling toxic chemicals</td>
<td>Availability of Codes of Safe Work Practices (SOPs) for work with hazardous chemicals.</td>
<td>2.1 4.4</td>
</tr>
<tr>
<td>(e)(3)(ii)</td>
<td>Criteria to be used for implementing measures to reduce exposures</td>
<td>Criteria for using control measures, such as engineering controls, administrative controls, or personal protective equipment.</td>
<td>2.2-2.4 4.1-4.3</td>
</tr>
<tr>
<td>(e)(3)(iii)</td>
<td>Fume hood performance</td>
<td>Measures to ensure proper operation of fume hoods and other protective equipment.</td>
<td>4.1</td>
</tr>
<tr>
<td>(e)(3)(iv)</td>
<td>Employee information and training (including emergency procedures)</td>
<td>Employee understanding about the hazards of the work area, including how to detect their presence or release, work practices and how to use protective equipment, and emergency response procedures.</td>
<td>2.4 3.3 4.2 5.2-5.4</td>
</tr>
<tr>
<td>(e)(3)(v)</td>
<td>Requirements for prior approval of laboratory activities</td>
<td>Circumstances under which a particular laboratory operation requires prior approval from the employer.</td>
<td>2.2 5.3</td>
</tr>
<tr>
<td>(e)(3)(vi)</td>
<td>Medical consultation and medical examinations</td>
<td>Provisions made for medical consultations and exams.</td>
<td>3.3</td>
</tr>
<tr>
<td>(e)(3)(vii)</td>
<td>Chemical hygiene responsibilities</td>
<td>Designation of a Chemical Hygiene Officer.</td>
<td>3.1-3.3</td>
</tr>
<tr>
<td>(e)(3)(viii)</td>
<td>Special precautions for work with particularly hazardous substances</td>
<td>Provisions for additional protection for work with “select carcinogens”, reproductive toxins, or substances with a high degree of acute toxicity</td>
<td>2.2 5.2-5.3</td>
</tr>
</tbody>
</table>

Has everyone who works for you had some documented training? 
Do you have copies?
Guidelines for Creating a Chemical Hygiene and Safety Plan for Your Laboratory Operations

2. Laboratory Instructors
Laboratory instructors are responsible for implementing the CHP in the classes they supervise and for
- Developing and/or implementing written procedures for every instructional experiment involving chemicals or biohazardous materials;
- Educating students in safe work practices, correct use of personal protective equipment, and proper waste disposal;
- Enforcing safe work practices and supervising student activities;
- Correctly labeling containers, filling out attached waste tags, and maintaining good storage practices.

3. Researchers
Faculty conducting research are responsible for implementing the CHP, Hazard Communication, Injury & Illness Prevention programs, and Hazardous Waste Management Program in their assigned laboratory space and for
- Making the written CHP and Standard Operation Procedures available to lab staff and students;
- Developing, monitoring and approving operating procedures for directed research involving chemicals or biohazardous materials;
- Maintaining a current chemical inventory and availability of MSDSs for each chemical.
- Purchasing only the amount of chemicals needed and the appropriate PPE for the hazards;
- Implementing and enforcing established safe work practices.
- Managing hazardous waste per campus policy.

B. Planning and Training Tips
Before you start, consider the questions below to help you get into the pre-planning and hazard evaluation mode.

1. Planning Questions
See if you can answer “YES” to these questions:
✓ Have I thought about what can go wrong?
✓ Is there an alternate way to do the experiment(s) that’s safer yet still teaches the same concept or produces the same result?
✓ What personal protective equipment should be available. Do I have it on hand?
✓ When do I expect my lab workers to wear the items? Is this written down anywhere?
✓ Are my lab workers aware of the dangers of every chemical they will use?
✓ Do they know what NOT to mix together?
✓ Do they know which tasks or materials MUST always be done in a fume hood?
✓ Do they know about major hazards from others’ research in a shared lab?
✓ Do they know what to do if something spills, reacts or splashes on them?
✓ Do they know how to shut down an experiment or equipment in an emergency?
✓ Do they know what to do with the waste they generate?

This is the kind of information everyone should know.
What other information is important in your lab?
2. Checking Lab Personnel Training

For example, how would your staff and students answer the following questions?

1. Do you wash your hands before leaving the laboratory? YES  NO  or  SOMETIMES
2. Do you wear appropriate gloves, lab coat and splash goggles whenever you work with chemicals in the lab? YES  NO  or  SOMETIMES
3. Are the appropriate hazard signs posted on cabinet doors and designated areas and are emergency numbers posted on the laboratory door? YES  NO  or  NOT SURE
4. Are all containers in your lab legibly labeled with identity and hazard warnings? (Do you know how to interpret the labels?) YES  NO  or  SOME OF THEM
5. Do you know where to find Material Safety Data Sheets for all chemicals in your lab? (Have you ever looked at any of them?) YES  NO  or  NOT SURE
6. Are the chemicals stored in your lab sorted by hazard class in appropriate shelves or cabinets? (Do you know what the different hazard classes are?) YES  NO  or  SOME OF THEM
7. Have you been instructed in the use and handling of the chemicals and equipment in your lab? YES  NO  or  SOME OF THEM
8. Have you been instructed in the location and use of safety devices such as eyewashes, safety showers and fire extinguishers? YES  NO  or  SOME OF THEM
9. Are you aware of emergency procedures in the event of a spill, uncontrolled chemical reaction, or building evacuation? YES  NO  or  SOME OF THEM
10. Do you know how to collect your waste, where the accumulation areas are, storage limits, and where to take full waste containers? YES  NO  or  SOMEONE ELSE DOES IT

3. Checking Effectiveness of Safety Efforts

For example, how are you ensuring that these compliance weaknesses are not occurring in your lab?

1. Unlabeled or improperly labeled containers
   - 8 CCR 5194 (f)(4); (f)(8)
   - 8 CCR 5191 (h)(1)(A)
   - 8 CCR 5164 (a)

2. Incompatibles stored together.
   - 8 CCR 5164 (a)

3. Improper use or lack of gloves, safety glasses, splash goggles, protective clothing, lab coats.
   - 8 CCR 3380 (c)

4. Respirator violations including lack of fit testing, training, medical, protocol
   - 8 CCR 5194 (i)
   - 8 CCR 5144 (c)(1)

5. Lack of available MSDSs or knowledge of where the MSDSs are kept.
   - 8 CCR 5194 (g)(1)
   - 8 CCR 5194 (h)(1)(B)

6. Eating and drinking in the laboratories or food/beverages in chemical/sample refrigerators.
   - 8 CCR 5194 (f)(4)(A)(3)

7. Defective or lack of guards such as the one on drive belts for vacuum pumps, overridden interlocks, coverings, or indicators.
   - 8 CCR 3320
   - 8 CCR 3328 (c)

8. Damaged electrical outlets and power cords (e.g., frayed insulation by plug)
   - 8 CCR 2510.4

9. Expired or untagged hazardous waste
   - 22 CCR 66265.16 (d); (e)

10. Inadequate or inconsistent training program
    - 8 CCR 5191 (f)(1)
    - 8 CCR 5194 (h)(1)
    - 8 CCR 3203 (a)(7)
    - 22 CCR 66265.16 (d); (e)

How do you think your lab personnel will answer these questions? Consider doing some refresher training on safe work practices.
C. Chemical Hygiene and Safety Plan Template

It is important to provide your lab personnel with the information below so they can find what they need. The attached TEMPLATE is intended to simplify the development of a CHP for YOUR lab. Called a Chemical Hygiene and Safety Plan, it serves as both a CHP and IIPP for your lab. If you have any questions, please contact the COSE Health and Safety Specialist at x8-6892.

1. CHP Administration and Information
   1. Name of Department Safety Coordinator: i.e. Stockroom manager or Office manager
   2. Contact person for reporting equipment failures:
   3. Contact person for reporting injuries or hazards?
   4. Contact number(s) for emergencies:
   5. Location of emergency poster or documents:
   6. Location of chemical inventory and MSDS’s:
   7. Location of written CHP, IIPP, and Hazard Communication Program.
   8. Location of written standard operating procedures:

II. Chemical Storage and Handling
   1. Location of extra secondary containers and labels. Describe labeling system:
   2. Describe where materials such as acids, solvents, gels, and equipment are stored.
      Show how incompatible chemicals are arranged by hazard class on shelves before arranging them alphabetically.
   3. Discuss how spilled materials should be cleaned up.
   4. Discuss chemical hygiene and housekeeping:

III. Very Toxic or Dangerous Materials
   1. Show the area(s) set aside and “DESIGNATED” for dangerous materials or tasks:
   2. Describe the special precautions and the protocol for obtaining prior approval.

IV. Work Practices
   1. Describe how to use and care for personal protective equipment:
   2. Indicate for which tasks specific equipment is required and recommended clothing:
   3. Describe how to correctly use fume hoods: (See Fume Hood Code of Safe Work Practice)
   4. Which tasks MUST be done in a fume hood, glove box, or other ventilated space?
   5. Discuss how to control exposure and inadvertent releases. For example by keeping containers closed:
   6. What carriers/carts are available for transporting chemicals?
   b. Describe how to correctly transport chemicals.
   7. Review written operating procedures for common or hazardous tasks or equipment use

VI. Hazardous Waste
   1. a. Show location of Satellite Accumulation Areas and note the designated waste area sign
   b. Show how waste types are segregated using secondary containment and labeled cabinets.
   c. Indicate how containers are kept closed when not in use
   2. Show where can new tags be obtained and how to fill out waste ID tags
   3. Note the 60 days storage limit and show where to take waste containers that are full or nearing expiration dates
   4. Describe the waste streams you generate and any special hazards associated with them:
Chemical Hygiene and Safety Plan

A. SCOPE
This chemical hygiene and safety plan applies to room _______ in _________________ at San Francisco State University, College of Science and Engineering.

B. NATURE OF RESEARCH
The responsible individual’s research focuses on the ________________

C. RESPONSIBLE INDIVIDUALS
has primary responsibility for this area. If this person is not in his or her office or lab, contact the stockroom manager or the department office. Telephone numbers for these and other pertinent individuals are listed below:

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<tr>
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The lab may be accessed during normal business hours by all personnel associated with the responsible individual’s research. During non-business hours (evenings and weekends), prior authorization from the department chair along with a signature from the COSE Director of Operations on a building pass is required.

F. MEDICAL TREATMENT

Personnel injured in the lab during normal business hours must be taken to the Student Health Center (SHC) for evaluation or treatment. The SHC will fill out an incident report and notify EHOS. If an injury or illness may be serious or an emergency after-hours, call University Police at 911 or x8-2222.

G. LOCATION OF IMPORTANT SAFETY ITEMS

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<tr>
<th>Item</th>
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<tr>
<td>Department Chemical Hygiene Plan</td>
<td></td>
</tr>
<tr>
<td>Safety glasses and/or goggles</td>
<td></td>
</tr>
<tr>
<td>Lab coats, aprons, gloves</td>
<td></td>
</tr>
<tr>
<td>First Aid Kit or Spill Cleanup Kit</td>
<td></td>
</tr>
<tr>
<td>Hazardous Waste Satellite Accumulation Area(s)</td>
<td></td>
</tr>
<tr>
<td>Material Safety Data Sheets (MSDS)</td>
<td></td>
</tr>
<tr>
<td><a href="http://www.hazard.com/msds2">www.hazard.com/msds2</a></td>
<td></td>
</tr>
<tr>
<td><a href="http://www.ilpi.com/msds/index.html">www.ilpi.com/msds/index.html</a></td>
<td></td>
</tr>
</tbody>
</table>

(For example: where antidotes are stored or location of “Designated” areas for particularly toxic chemicals i.e., select carcinogens)

H. GENERAL SAFETY

Hygiene

Eating, drinking, and smoking are not permitted in the lab or anywhere hazardous materials are used or stored. Wash hands before leaving the lab and after contact with hazardous materials. Store glasses, goggles, dust masks, and gloves in a clean secure location to prevent soiling or contamination.

Apparel

A lab coat and eye protection must be worn whenever chemicals or harmful light sources are being used in the lab, regardless of whether there is direct involvement with hazardous materials. **Shorts and sandals are not acceptable apparel in the lab** but may be permitted under special circumstances by the responsible individual. Guidelines for choosing gloves: [http://www.safety.fsu.edu/chp.html#appendix6](http://www.safety.fsu.edu/chp.html#appendix6)

Hazardous Materials

Chemicals must be carried in a secure container to prevent spills or dropping onto counters or floors. Compressed gas cylinders must be secured with straps or chains to the wall or heavy counters or furniture. Screw caps on cylinders being stored or moved. Keep containers closed when not in use. Segregate hazardous materials by class in appropriate LABELLED secondary containers and cabinets.

Defective Equipment

Equipment that is broken or with damaged electrical cords must be taken out of service and not used. Cracked glassware and missing or inoperable guards, interlocks, and covers on equipment must be replaced. Vacuum pumps with missing belt guards, lasers set-ups with inadequate beam stops, corroded or leaking containers, and poorly functioning fume hoods must not be used until the problem is corrected. Report problems with equipment to the stockroom or department office promptly.
I. TRAINING
All personnel working in this lab are required to receive training from the responsible individual about standard laboratory practices, must demonstrate competence before performing a new procedure or operating an instrument with which they are unfamiliar, show they know the correct procedures for handling, labeling and disposing of chemicals, and know how to review MSDSs for chemicals before using them.

The responsible individual will require all lab personnel to read the C.O.S.E. Chemical Hygiene Plan and will emphasize the sections on compressed gas cylinders, materials storage, and waste disposal. Newly hired personnel must have an initial safety orientation as soon as possible but at least within 30 days of starting work. In addition, the following information will be provided to all lab personnel:

J. LAB EQUIPMENT
The equipment used in this lab includes ____________________________________________________________________________
__________________________________________________________________________

All users will be trained and authorized by the responsible individual before using this equipment. Repair or maintenance of this equipment will be made by the responsible individual, his/her designee, or the manufacturer. Operation manuals and/or operating procedures are located in ____________________________________________________________________________

Additional instructions or comments: ____________________________________________________________________________

K. HAZARDOUS MATERIALS
Lab personnel will be informed of the chemical hazards during their initial assignment and as new exposure situations arise. An inventory of chemicals used in the lab is available for review.

<table>
<thead>
<tr>
<th>Type</th>
<th>Main Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic solvents</td>
<td></td>
</tr>
<tr>
<td>Alcohols</td>
<td></td>
</tr>
<tr>
<td>Mineral acids</td>
<td></td>
</tr>
<tr>
<td>Organic acids</td>
<td></td>
</tr>
<tr>
<td>Nitric acid</td>
<td></td>
</tr>
<tr>
<td>Oxidizers</td>
<td></td>
</tr>
<tr>
<td>Carcinogens</td>
<td></td>
</tr>
<tr>
<td>Extremely toxic</td>
<td></td>
</tr>
<tr>
<td>Compressed gases</td>
<td></td>
</tr>
<tr>
<td>Cryogenic materials</td>
<td></td>
</tr>
<tr>
<td>High Voltage/Electrical</td>
<td></td>
</tr>
</tbody>
</table>
### L. SPECIAL HAZARDS OR PRECAUTIONS

<table>
<thead>
<tr>
<th>Task</th>
<th>Is a fume hood required?</th>
<th>Type of gloves required for task</th>
<th>Type of eye protection required</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>YES NO</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>YES NO</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>YES NO</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>YES NO</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Other Information or Reference to Codes of Safe Work Practices (SOP’s)**

---

### L. EMERGENCY PROCEDURES

In a life-threatening emergency, first call University Police at x8-2222 or 911 then a department representative (either the responsible individual, stockroom staff, or a professor). If an evacuation is necessary, lab personnel should turn off all instruments and lights (if circumstances permit), close the door, and exit the building in an orderly manner. See Appendix C in the Dept Chemical Hygiene Plan for detailed information on emergency procedures. Listed below, are select emergencies and associated recommended actions excerpted from the C.O.S.E. Chemical Hygiene Plan (Chapter 2, page 8&9).

<table>
<thead>
<tr>
<th>Nature of Emergency</th>
<th>Recommended Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small (Incipient) Fire</td>
<td>For small fires in the incipient stage, use a fire extinguisher to put it out. Break the small plastic seal on the handle. Remember to point the nozzle at the base of the fire and sweep back and forth. <strong>Don't put yourself in danger!</strong> For information on fighting fires in a laboratory, check this web site: <a href="http://www.ilpi.com/safety/extinguishers.html">http://www.ilpi.com/safety/extinguishers.html</a></td>
</tr>
<tr>
<td>Spreading Fire</td>
<td>Evacuate the room and close the door</td>
</tr>
<tr>
<td>Evacuation Alarm Sounds</td>
<td>Leave the building using the nearest safe stairwell and wait outside until the building is cleared for re-entry by police or evacuation team.</td>
</tr>
<tr>
<td>Minor Chemical Spill</td>
<td>If the spill is small and you know how to clean it up, do so promptly. If unsure contact the PI or Stockroom. Wear protective equipment (i.e. gloves) and avoid breathing vapors from spill. Use appropriate kit to neutralize and absorb inorganic bases and acids or other chemicals. Collect residue into a container and dispose as chemical waste.</td>
</tr>
<tr>
<td>Spill Is Larger Than You Are Comfortable Handling</td>
<td>Isolate the spill area. Remove ignition sources and shut down equipment. Open windows (if safe to do so). Evacuate the room and close the door. Call 911 and alert the stockroom and nearby labs.</td>
</tr>
<tr>
<td>Uncontrolled Chemical Reactions</td>
<td>Leave the area promptly and close the door. Call 911. Alert the stockroom and nearby labs. If you believe there is a serious and immediate danger to others, pull the fire alarm in the main hallway to evacuate the building.</td>
</tr>
<tr>
<td>Chemical Splash on Face</td>
<td>Take person(s) from spill area to nearest emergency eyewash. Hold eye lids open. Flood affected area for at least 15 minutes or longer if pain persists. (Don't worry about making a mess.) Take person to Student Health Center AFTER flushing the affected area. Call 911 if the injury is too serious to move the victim. Ask someone to alert the stockroom and EHOS.</td>
</tr>
</tbody>
</table>
Appendix G-1: Guidelines for Developing an Effective CHP

A. Explanations

These guidelines are intended to help you create a plan relevant and helpful to your operation. The “TEMPLATE” is attached and you may fill it in by hand and attach SOP’s or other relevant instructions. Alternatively, you may use these guidelines and the TEMPLATE to help you develop your own CHP.

Each laboratory must have its own Chemical Hygiene Plan and Injury & Illness Prevention Program that describes its specific rules and procedures as a supplement to the full campus documents. The attached TEMPLATE of a Chemical Hygiene and Safety Plan fulfills both requirements and should be attached to the C.O.S.E. Chemical Hygiene Plan in each affected lab.

1. C.O.S.E. Chemical Hygiene Plan

All lab personnel should become familiar with the C.O.S.E. Chemical Hygiene Plan when they start work and it must be available to all lab personnel during working hours. For your information, below is a table of requirements for CHP’s specified in OSHA’s Lab Standard at 29 CFR 1910.1450 (e)(3) and the associated sections in the C.O.S.E. CHP.

<table>
<thead>
<tr>
<th>CHP Reg. Reference</th>
<th>Topics Required by OSHA’s Lab Standard</th>
<th>Clarification of Required Topics</th>
<th>Chapter in CHP</th>
</tr>
</thead>
<tbody>
<tr>
<td>(e)(3)(i)</td>
<td>Standard operating procedures for handling toxic chemicals</td>
<td>Availability of Codes of Safe Work Practices (SOPs) for work with hazardous chemicals.</td>
<td>2.1 4.4</td>
</tr>
<tr>
<td>(e)(3)(ii)</td>
<td>Criteria to be used for implementing measures to reduce exposures</td>
<td>Criteria for using control measures, such as engineering controls, administrative controls, or personal protective equipment.</td>
<td>2.2-2.4 4.1-4.3</td>
</tr>
<tr>
<td>(e)(3)(iii)</td>
<td>Fume hood performance</td>
<td>Measures to ensure proper operation of fume hoods and other protective equipment.</td>
<td>4.1</td>
</tr>
<tr>
<td>(e)(3)(iv)</td>
<td>Employee information and training (including emergency procedures)</td>
<td>Employee understanding about the hazards of the work area, including how to detect their presence or release, work practices and how to use protective equipment, and emergency response procedures.</td>
<td>2.4 3.3 4.2 5.2-5.4</td>
</tr>
<tr>
<td>(e)(3)(v)</td>
<td>Requirements for prior approval of laboratory activities</td>
<td>Circumstances under which a particular laboratory operation requires prior approval from the employer.</td>
<td>2.2 5.3</td>
</tr>
<tr>
<td>(e)(3)(vi)</td>
<td>Medical consultation and medical examinations</td>
<td>Provisions made for medical consultations and exams.</td>
<td>3.3</td>
</tr>
<tr>
<td>(e)(3)(vii)</td>
<td>Chemical hygiene responsibilities</td>
<td>Designation of a Chemical Hygiene Officer.</td>
<td>3.1-3.3</td>
</tr>
<tr>
<td>(e)(3)(viii)</td>
<td>Special precautions for work with particularly hazardous substances</td>
<td>Provisions for additional protection for work with “select carcinogens”, reproductive toxins, or substances with a high degree of acute toxicity</td>
<td>2.2 5.2-5.3</td>
</tr>
</tbody>
</table>

Has everyone who works for you had some documented training? Do you have copies?
Appendix G-1: Guidelines for Developing an Effective CHP

2. Laboratory Instructors
Laboratory instructors are responsible for implementing the CHP in the classes they supervise and for
- Developing and/or implementing written procedures for every instructional experiment involving chemicals or biohazardous materials;
- Educating students in safe work practices, correct use of personal protective equipment, and proper waste disposal;
- Enforcing safe work practices and supervising student activities;
- Correctly labeling containers, filling out attached waste tags, and maintaining good storage practices.

3. Researchers
Faculty conducting research are responsible for implementing the CHP, Hazard Communication, Injury & Illness Prevention programs, and Hazardous Waste Management Program in their assigned laboratory space and for
- Making the written CHP and Standard Operation Procedures available to lab staff and students;
- Developing, monitoring and approving operating procedures for directed research involving chemicals or biohazardous materials;
- Maintaining a current chemical inventory and availability of MSDSs for each chemical.
- Purchasing only the amount of chemicals needed and the appropriate PPE for the hazards;
- Implementing and enforcing established safe work practices.
- Managing hazardous waste per campus policy.

B. Planning and Training Tips
Before you start, consider the questions below to help you get into the pre-planning and hazard evaluation mode.

1. Planning Questions
See if you can answer “YES” to these questions:
✓ Have I thought about what can go wrong?
✓ Is there an alternate way to do the experiment(s) that’s safer yet still teaches the same concept or produces the same result?
✓ What personal protective equipment should be available. Do I have it on hand?
✓ When do I expect my lab workers to wear the items? Is this written down anywhere?
✓ Are my lab workers aware of the dangers of every chemical they will use?
✓ Do they know what NOT to mix together?
✓ Do they know which tasks or materials MUST always be done in a fume hood?
✓ Do they know about major hazards from others’ research in a shared lab?
✓ Do they know what to do if something spills, reacts or splashes on them?
✓ Do they know how to shut down an experiment or equipment in an emergency?
✓ Do they know what to do with the waste they generate?

This is the kind of information everyone should know.
What other information is important in your lab?
Appendix G-1: Guidelines for Developing an Effective CHP

2. Checking Lab Personnel Training
For example, how would your staff and students answer the following questions?

1. Do you wash your hands before leaving the laboratory
   
   YES NO or SOMETIMES

2. Do you wear appropriate gloves, lab coat and splash goggles whenever you work with chemicals in the lab?
   
   YES NO or SOMETIMES

3. Are the appropriate hazard signs posted on cabinet doors and designated areas and are emergency numbers posted on the laboratory door?
   
   YES NO or NOT SURE

4. Are all containers in your lab legibly labeled with identity and hazard warnings?
   (Do you know how to interpret the labels?)
   
   YES NO or SOME OF THEM

5. Do you know where to find Material Safety Data Sheets for all chemicals in your lab?
   (Have you ever looked at any of them?)
   
   YES NO or NOT SURE

6. Are the chemicals stored in your lab sorted by hazard class in appropriate shelves or cabinets?
   (Do you know what the different hazard classes are?)
   
   YES NO or SOME OF THEM

7. Have you been instructed in the use and handling of the chemicals and equipment in your lab?
   
   YES NO or SOME OF THEM

8. Have you been instructed in the location and use of safety devices such as eyewashes, safety showers and fire extinguishers?
   
   YES NO or SOME OF THEM

9. Are you aware of emergency procedures in the event of a spill, uncontrolled chemical reaction, or building evacuation?
   
   YES NO or SOME OF THEM

10. Do you know how to collect your waste, where the accumulation areas are, storage limits, and where to take full waste containers?
    
    YES NO or SOMEONE ELSE DOES IT

3. Checking Effectiveness of Safety Efforts
For example, how are you ensuring that these compliance weaknesses are not occurring in your lab?

1. Unlabeled or improperly labeled containers
   
   8 CCR 5194 (f)(4); (f)(8)
   8 CCR 5191 (b)(1)(A)
   8 CCR 5164 (a)

2. Incompatibles stored together.
   
   8 CCR 5164 (a)

3. Improper use or lack of gloves, safety glasses, splash goggles, protective clothing, lab coats.
   
   8 CCR 3380 (c)

4. Respirator violations including lack of fit testing, training, medical, protocol
   
   8 CCR 5144 (c)(1)

5. Lack of available MSDSs or knowledge of where the MSDSs are kept.
   
   8 CCR 5194 (b)(1)(B)

6. Eating and drinking in the laboratories or food/beverages in chemical/sample refrigerators.
   
   8 CCR 5194 (f)(4)(A)(3)

7. Defective or lack of guards such as the one on drive belts for vacuum pumps, overridden interlocks, coverings, or indicators.
   
   8 CCR 3320
   8 CCR 3328 (c)

8. Damaged electrical outlets and power cords (e.g., frayed insulation by plug)
   
   8 CCR 2510.4

9. Expired or untagged hazardous waste
   
   22 CCR 66262.34 (e)(1)(c); (f)

10. Inadequate or inconsistent training program
    
    8 CCR 5191 (f)(1)
    8 CCR 5194 (b)(1)
    8 CCR 3203 (a)(7)
    22 CCR 66265.16 (d); (e)

How do you think your lab personnel would answer these questions?
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   2. Contact person for reporting equipment failures:
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   4. Which tasks MUST be done in a fume hood, glove box, or other ventilated space?
   5. Discuss how to control exposure and inadvertent releases. For example by keeping containers
      closed or using volatile solvents in a fume hood:
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   1. a. Show location of Satellite Accumulation Areas and note the designated waste area sign
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Chemical Hygiene and Safety Plan

________________________Laboratory; Room _____, Bldg: ________________

Prepared by: ___________________________ Revision Date: ________________

Principal Investigator/Responsible Individual

A. SCOPE

This chemical hygiene and safety plan applies to room _______ in ____________________
at San Francisco State University, College of Science and Engineering.

B. NATURE OF RESEARCH

The responsible individual’s research focuses on the ____________________________

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<td>Hazardous Materials Coordinator</td>
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<td>Dept. of Environmental Health &amp;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Occupational Safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr. Robert Shearer</td>
<td>SFSU CHO/Director of Dept of</td>
<td></td>
<td>x8-1449</td>
</tr>
<tr>
<td></td>
<td>Environmental Health &amp; Occupational Safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>University Police</td>
<td>Dept of Public Safety</td>
<td></td>
<td>(emergency) 911 or (bus) x8-7200</td>
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Personnel injured in the lab during normal business hours must be taken to the Student Health Center (SHC) for evaluation or treatment. The SHC will fill out an incident report and notify EHOS. If an injury or illness may be serious or an emergency after-hours, call University Police at 911 or x8-7200.

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<th>Item</th>
<th>Location</th>
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<tr>
<td>Safety glasses and/or goggles</td>
<td></td>
</tr>
<tr>
<td>Lab coats, aprons, gloves</td>
<td></td>
</tr>
<tr>
<td>First Aid Kit or Spill Cleanup Kit</td>
<td></td>
</tr>
<tr>
<td>Hazardous Waste Satellite Accumulation Area(s)</td>
<td></td>
</tr>
<tr>
<td>Material Safety Data Sheets (MSDS)</td>
<td></td>
</tr>
<tr>
<td><a href="www.hazard.com/msds2">www.hazard.com/msds2</a></td>
<td></td>
</tr>
</tbody>
</table>

(For example: where antidotes are stored or location of “Designated” areas for particularly toxic chemicals i.e., select carcinogens)

H. GENERAL SAFETY

Hygiene
Eating, drinking, and smoking are not permitted in the lab or anywhere hazardous materials are used or stored. Wash hands before leaving the lab and after contact with hazardous materials. Store glasses, goggles, dust masks, and gloves in a clean, secure location to prevent soiling or contamination.

Apparel
A lab coat and eye protection must be worn whenever chemicals or harmful light sources are being used in the lab, regardless of whether there is direct involvement with hazardous materials. Shorts and sandals are not acceptable apparel in the lab but may be permitted under special circumstances by the responsible individual.

Hazardous Materials
Chemicals must be carried in a secure container to prevent spills or dropping onto counters or floors. Compressed gas cylinders must be secured with straps or chains to the wall or heavy counters or furniture. Screw caps on cylinders being stored or moved. Keep containers closed when not in use. Segregate hazardous materials by class in appropriate LABELED secondary containers and cabinets.

Defective Equipment
Stop using and take out of service any equipment that is broken or with damaged electrical cords. Cracked glassware and missing or inoperable guards, interlocks, and covers on equipment must be replaced. Vacuum pumps with missing belt guards, lasers set-ups with inadequate beam stops, corroded or leaking containers, and poorly functioning fume hoods must not be used until the problem is corrected. Report problems with equipment to your stockroom or department office promptly.
I. TRAINING
All personnel working in this lab are required to receive training from the responsible individual about standard laboratory practices, must demonstrate competence before performing a new procedure or operating an instrument with which they are unfamiliar, show they know the correct procedures for handling, labeling and disposing of chemicals, and know how to review MSDSs for chemicals before using them.

The responsible individual will require all lab personnel to read the C.O.S.E. Chemical Hygiene Plan and will emphasize the sections on compressed gas cylinders, materials storage, and waste disposal. Newly hired personnel must have an initial safety orientation as soon as possible but at least within 30 days of starting work. In addition, the following information will be provided to all lab personnel:

J. LAB EQUIPMENT
The equipment used in this lab includes

All users will be trained and authorized by the responsible individual before using this equipment. Repair or maintenance of this equipment will be made by the responsible individual, his/her designee, or the manufacturer. Operation manuals and/or operating procedures are located in

Additional instructions or comments:

K. HAZARDOUS MATERIALS
Lab personnel will be informed of the chemical hazards during their initial assignment and as new exposure situations arise. An inventory of chemicals used in the lab is available for review.

<table>
<thead>
<tr>
<th>Type</th>
<th>Main Hazards of Overexposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic solvents</td>
<td>Usually flammable. Can affect function of central nervous system and cause damage to liver,</td>
</tr>
<tr>
<td></td>
<td>kidney, and blood-producing organs. Often causes defatting of skin, headaches, and dizziness.</td>
</tr>
<tr>
<td></td>
<td>Some are carcinogenic. Many can absorb through intact skin.</td>
</tr>
<tr>
<td>Alcohols</td>
<td>Usually flammable. Can damage internal organs, defat the skin and cause irritation to eyes.</td>
</tr>
<tr>
<td>Mineral acids</td>
<td>Usually very corrosive and can cause burns on eye and skin contact. Inhalation of vapors can</td>
</tr>
<tr>
<td></td>
<td>injure respiratory tract. Often strongly reactive with metals.</td>
</tr>
<tr>
<td>Organic acids</td>
<td>Usually very corrosive and can cause burns on eye and skin contact. Inhalation of vapors can</td>
</tr>
<tr>
<td></td>
<td>injure respiratory tract. Reactions with strong oxidizers can cause fires.</td>
</tr>
<tr>
<td>Nitric acid</td>
<td>Highly corrosive to eyes, skin, and mucous membranes. Powerful oxidizing agent that ignites on</td>
</tr>
<tr>
<td></td>
<td>contact or reacts explosively with many organic and inorganic substances.</td>
</tr>
<tr>
<td>Oxidizers</td>
<td>Can ignite on contact or react explosively with many organic and inorganic substances</td>
</tr>
<tr>
<td>Particularly toxic</td>
<td>Typically describes a substance with acute toxicity. This is the ability of a chemical to cause</td>
</tr>
<tr>
<td></td>
<td>a harmful effect after a single exposure. Many are also carcinogenic.</td>
</tr>
<tr>
<td>Compressed gases</td>
<td>Health hazards from exposure include asphyxiation and toxic effects. Physical hazards include</td>
</tr>
<tr>
<td></td>
<td>explosions and impact from a sudden release of pressure.</td>
</tr>
</tbody>
</table>
L. SPECIAL HAZARDS OR PRECAUTIONS

<table>
<thead>
<tr>
<th>Task</th>
<th>Is a fume hood required?</th>
<th>Type of gloves required for the task</th>
<th>Type of eye protection required</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>YES NO</td>
<td>YES NO</td>
<td>YES NO</td>
</tr>
<tr>
<td></td>
<td>YES NO</td>
<td>YES NO</td>
<td>YES NO</td>
</tr>
<tr>
<td></td>
<td>YES NO</td>
<td>YES NO</td>
<td>YES NO</td>
</tr>
</tbody>
</table>

Other Information or Reference to Codes of Safe Work Practices (SOP’s)

M. EMERGENCY PROCEDURES

In a life-threatening emergency, first call University Police at x8-2222 or 911 then a department representative (either the responsible individual, stockroom staff, or a professor) If an evacuation is necessary, lab personnel should turn off all instruments and lights (if circumstances permit), close the door, and exit the building in an orderly manner. See Appendix C in the Dept Chemical Hygiene Plan for detailed information on emergency procedures. Listed below, are select emergencies and associated recommended actions excerpted from the C.O.S.E. Chemical Hygiene Plan (Chapter 2, page 8&9).

<table>
<thead>
<tr>
<th>Nature of Emergency</th>
<th>Recommended Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small (Incipient) Fire</td>
<td>For small fires in the incipient stage, use a fire extinguisher to put it out. Break the small plastic seal on the handle. Remember to point the nozzle at the base of the fire and sweep back and forth. Don't put yourself in danger! For information on fighting fires in a laboratory, check this web site: <a href="http://www.ilpi.com/safety/extinguishers.html">http://www.ilpi.com/safety/extinguishers.html</a></td>
</tr>
</tbody>
</table>
| Spreading Fire      | • Evacuate the room and close the door  
                      • Pull the fire alarm or call 911 |
| Evacuation Alarm Sounds | • Leave the building using the nearest safe stairwell and wait outside until the building is cleared for re-entry by police or evacuation team. |
| Minor Chemical Spill | • If the spill is small and you know how to clean it up, do so promptly. If unsure contact the PI or Stockroom.  
                           • Wear protective equipment (i.e. gloves) and avoid breathing vapors from spill. Use appropriate kit to neutralize and absorb inorganic bases and acids or other chemicals. Collect residue into a container and dispose as chemical waste. |
| Spill Is Larger Than You Are Comfortable Handling | • Isolate the spill area  
                                                      • Remove ignition sources and shut down equipment  
                                                      • Open windows (if safe to do so)  
                                                      • Evacuate the room and close the door  
                                                      • Call 911 and alert the stockroom and nearby labs |
| Uncontrolled Chemical Reactions | • Leave the area promptly and close the door  
                                         • Call 911.  
                                         • Alert the stockroom and nearby labs  
                                         • If you believe there is a serious and immediate danger to others, pull the fire alarm in the main hallway to evacuate the building. |
| Chemical Splash on Face | • Take person(s) from spill area to nearest emergency eyewash.  
                                • Hold eye lids open.  
                                • Flood affected area for at least 15 minutes or longer if pain persists. (Don’t worry about making a mess.)  
                                • Take person to Student Health Center AFTER flushing the affected area. Call 911 if the injury is too serious to move the victim.  
                                • Ask someone to alert the stockroom and EHOS staff at x8-1449. |
SUPPLEMENT #1
Classification of Flammable and Combustible Liquids

FLAMMABLE LIQUIDS

"Class I" FLAMMABLE LIQUID refers to any liquid having a flash point below 100°F and is subdivided into three classes with some examples listed below:

Class IA Flash point below 73°F, boiling point below 100°F
- acetaldehyde
- collodion
- chloroethane
- ethylamine
- ethylene oxide

Must ALWAYS be stored in approved* flammable storage cabinet.

Class IB Flash point below 73°F, boiling point at or above 100°F
- acetone
- acrolein
- acrylonitrile
- acetonitrile
- benzene
- butyl alcohol

Should be stored in approved* flammable storage cabinet.

Class IC Flash point at or above 73°F and below 100°F
- amyl acetate
- amyl alcohol
- dibutyl ether

Should be stored in approved* flammable storage cabinet or container.

COMBUSTIBLE LIQUIDS

"Combustible liquid" refers to any liquid having a flash point at or above 100°F and are subdivided as follows:

Class II Flash point at or above 100°F and below 140°F
- acetic acid (glacial)
- camphor oil
- cyclohexane

Class IIIA Flash point at or above 140°F and below 200°F
- aniline
- benzaldehyde
- carbolic acid

*Note:
An approved flammable storage cabinet is one which has self-closing doors and is in compliance with OSHA 29 CFR 1910.106(d)(3), NFPA 30, and UFC 79.
Classification of Flammable and Combustible Liquids (CONTINUED)

Containers for flammable and combustible liquids shall not exceed the maximum capacities listed in the OSHA standards shown below. Follow the size limitations for containers to prevent ignition of flammable liquids by sparks from static discharge during pouring operations.

<table>
<thead>
<tr>
<th>Container Liquids Type</th>
<th>Flammable Liquids</th>
<th>Combustible</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class 1A</td>
<td>Class 1B</td>
</tr>
<tr>
<td>Glass or approved plastic*</td>
<td>1 pt</td>
<td>1 qt</td>
</tr>
<tr>
<td><strong>Exception No. 1 Glass</strong></td>
<td>1 gal</td>
<td>1 gal</td>
</tr>
<tr>
<td>Metal</td>
<td>1.1 gal</td>
<td>5 gal</td>
</tr>
<tr>
<td>Safety Cans</td>
<td>2.6 gal</td>
<td>5 gal</td>
</tr>
</tbody>
</table>

*Approved means approved or listed by either Underwriter's Laboratories or Factory Mutual Engineering Corporation.

**Exception No. 1:** Glass containers as large as 1.1 gal shall be permitted to be used if needed and if the required purity would be adversely affected by storage in a metal or an approved plastic container, or if the liquid would cause excessive corrosion or degradation of a metal or an approved plastic container.

<table>
<thead>
<tr>
<th>Types of Space and Containers</th>
<th>Room Size</th>
<th>Class I Liquids</th>
<th>Class I, II, III Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory ( instructional)</td>
<td>&gt; 600 ft²</td>
<td>6 gal</td>
<td>10 gal</td>
</tr>
<tr>
<td>(Liquids in containers per Table 1)</td>
<td>Glass, approved plastic, or metal safety can</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laboratory ( research)</td>
<td>&lt; 600 ft²</td>
<td>6 gal</td>
<td>12 gal</td>
</tr>
<tr>
<td>(Liquids in containers per Table 1)</td>
<td>Glass, approved plastic, or metal safety can</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shop (Departmental, instructional and similar size)</td>
<td>&gt; 600 ft²</td>
<td>10 gal</td>
<td>20 gal</td>
</tr>
<tr>
<td>(Liquids in containers per Table 1)</td>
<td>Glass, approved plastic, or metal safety can</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: Quantity limits are for rooms without sprinklers. (NFPA 45)
Chemical Group: **HALOGENATED SOLVENTS**  

<table>
<thead>
<tr>
<th>Chemical Name (1)</th>
<th>Chemical Name (2)</th>
<th>Formula</th>
<th>CAS #</th>
<th>*PEL/TLV Exposure Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methylene chloride</td>
<td>Dichloroethane</td>
<td>(CH2Cl2)</td>
<td>75-09-2</td>
<td>TWA: 25 ppm STEL: 25 ppm</td>
</tr>
<tr>
<td>Chloroform</td>
<td>Trichloromethane</td>
<td>(CHCl3)</td>
<td>67-66-3</td>
<td>TWA: 10 ppm STEL: 5 ppm</td>
</tr>
<tr>
<td>Carbon tetrachloride</td>
<td>Tetrachloromethane</td>
<td>(CCl4)</td>
<td>56-23-5</td>
<td>TWA: 5 ppm STEL: 10 ppm</td>
</tr>
<tr>
<td>Ethylene dibromide</td>
<td>1,2-dibromoethane</td>
<td>(C2H4Br2)</td>
<td>106-93-4</td>
<td>TWA: 20 ppm STEL: 30 ppm</td>
</tr>
</tbody>
</table>

**Hazard Summary:** DANGER! POISON! Suspect CARCINOGEN - High chronic toxicity hazard. May be fatal if inhaled, swallowed, or absorbed through skin. Target Organs: liver, kidney, central nervous system, blood, and cardiovascular system. Irritant to eyes, skin and respiratory tract. Absorbs easily through intact skin.

**Personal Protective Equipment**
- Change gloves frequently.
- Closed toe shoes should be worn when handling halogenated solvents

**List PPE Details Below:**
- **Incidental Contact:** Double gloves with heavier weight neoprene
- **Extended Contact:** Viton or PVA over disposable gloves

**Body:**
- Lab Coat

**Face/Eyes:**
- Chemical splash goggles

**Feet:**
- Closed-toe shoe

**Other:**
- Change gloves frequently.

Remember - dust masks and safety glasses provide little protection against vapors. All work with halogens must be conducted in a fume hood to prevent exposure by inhalation.

**Engineering & Ventilation Controls**
- Chemical Fume Hood Required
- Work on absorbent paper or secondary containment tray
- Other: Limit quantities to smallest amount necessary to complete experiment

**Transportation**
- Use secondary containment such as carriers
- Use least trafficked areas

**Storage**
- Avoid storing with amines, aluminum, sodium, and magnesium metals
- Do not store with flammable liquids such as alcohols, hexane, acetone, etc.
- Label containers with chemical name, hazard warnings, and a “Carcinogen” sticker
- Store in tightly sealed containers and place in secondary containment

**Accidental Skin/Eye Contact**
- Symptoms: irritation, drying of skin  
  - Change gloves immediately once contact is noted  
  - Wash hands—absorbs easily through intact skin with toxic effects  
  - Flush eyes for 15 min. with emergency eyewash if splash to eyes  
  - Utilize emergency drench shower for exposures to body  
  - Report incident right away and get medical attention if necessary

**Inhalation/Ingestion Exposure**
- Symptoms: unsteadiness, muscle weakness, numbness in feet or hands, slurred speech  
  - Remove to fresh air  
  - Give one or two glass of water if ingested  
  - Get medical attention immediately and contact campus 911
### Spill/Accident Procedures

Follow established spill clean-up protocols:
- Wear gloves (at least 2 pairs)
- Turn off equipment if necessary (and safe)
- If unsure try to isolate and get help
- Waste bag must be sealed and labeled

#### Small Spills:
Soak up with paper towels, “universal-type” absorbent hazmat pads or inert sorbent powder and place in an appropriately labeled waste container or bag.
(i.e., vermiculite, “universal” gel sorbent, Spillfyter SuperSorbent—avoid raising dust)

#### Large Spill:
1. remove all persons from the area
2. place absorbent material around edges of spill (if safe to do so)
3. close doors to affected area
4. call Stockroom and/or 911 (for campus police and hazmat response)

### Waste Disposal
Halogen-containing waste should be placed in a tightly sealed, labeled container and submitted to the stockroom. **Do not contaminate** other solvent waste with halogens, i.e., solvents containing chlorine, bromine, etc. because of disposal regulations.

### Designated Area

- Post a sign on the restricted area indicating the name of the material used
- Note the type of hazard:
  - ‘extremely toxic’;
  - ‘carcinogen’
  - ‘absorbs through skin’
- Indicate where MSDS/SOPs are located

- Designate an area for the use of “particularly” hazardous materials.

Where will this material be stored? ________________

- Chemical fume hood #
- Cabinet
- Lab benchtop
- Glove box

- Only trained and authorized personnel are permitted access to the designated area while it contains the hazardous material.

Describe how you will prevent unauthorized access to the material.

Approval Required: NONE
No special authorization needed after SOP training and reviewing MSDS

---

I have reviewed the SOP and the associated MSDS for this material with the people who report to me and/or share the restricted work area.

Signature of P.I. or Designated Lab Manager

---

<table>
<thead>
<tr>
<th>First Name</th>
<th>Last Name</th>
<th>Date</th>
<th>Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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