CHEMICAL HYGIENE PLAN

HARVEY MUDD COLLEGE

Prepared with the cooperation and assistance of:

The Office of Environmental Health and Safety Claremont University Consortium
and
The Facilities and Maintenance Department Harvey Mudd College

Revised 2017
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Foreword

Harvey Mudd College is committed to providing a safe working environment in our academic research laboratories. All employees who either direct the operations of and/or perform work in any laboratory where chemicals are used must become familiar with the requirements of the Chemical Hygiene Plan. This plan is required by the State of California pursuant to Title 8, Section 5191 of the California Code of Regulations, Occupational Exposure to Hazardous Chemicals in the Laboratory (http://www.dir.ca.gov/title8/5191), and is enforced by CAL-OSHA.

The Chemical Hygiene Plan is written to protect the health and safety of HMC faculty, staff, and students. It outlines safe work practices in the handling and storage of hazardous chemicals, requirements for safety equipment, training, and the handling of hazardous waste.

Every laboratory employee is responsible for his/her own safety and is required to minimize the risks of potential over-exposure and the uncontrolled release of hazardous materials while working in the laboratory. Employees should report unsafe conditions to their supervisor.

Notify Campus Safety if emergency medical or fire assistance is needed: Extension 72000, or, from mobile phone dial (909) 607-2000.

The following is a link for the employee accident report form: https://www.hmc.edu/human-resources/wp-content/uploads/sites/23/2013/12/accidentformsfillable.pdf

The following is a link for the student or visitor accident report form: https://drive.google.com/file/d/0BzR_KHZNACM_VmRRbDg2WFdaT1E/edit

Report any uncontrolled release to laboratory supervisor and Chemical Hygiene Officer immediately.

An uncontrolled release is an unexpected release of a hazardous material that due to its configuration, nature, or volume poses a threat to human health or the environment.
College President
Maria Klawe

College Administrative Officer
Lisa Sullivan

Chemical Hygiene Officer
Penny Manisco

Effective Date: July 1, 2017

Chemical Hygiene Officer: Penny Manisco
Office: Jacobs 2306
Extension: Extension 74217
Home Phone: (909) 982-3673

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Office: Olin 258A
Extension: 74143

Chemistry Laboratory Manager: Daniel Guerra
Office: Jacobs 2310
Extension: 72957

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Extension 72760

HMC Chemical Hygiene Plan, Revised 11 October 2017
Chemical Hygiene Plan – Designations

Chemical Hygiene Officer

Chemical Hygiene responsibilities rest with the Chemical Hygiene Officer. The CHO:

- Works with faculty and staff to develop and implement appropriate chemical hygiene policies and practices.
- Calibrates and uses specific chemical surveillance devices.
- Reviews the storage, use, and disposal of laboratory chemicals.
- Conducts industrial hygiene audits of laboratories.
- Provides technical and regulatory guidance to faculty and staff.
- Provides laboratory safety training to faculty, staff, and students.
- Assists in the annual review and revision of the Chemical Hygiene Plan.

Department Chair

Department Chairs are responsible for providing a safe and healthy work environment and for maintaining safety programs in their departments.

- Promote a strong safety and health culture within their department.
- Provide support necessary to implement the Chemical Hygiene Plan.
- Ensure department compliance with applicable codes and regulations.

Laboratory Supervisor

The principal investigator of record shall be acting supervisor in his or her laboratory, and must ensure that individuals in his or her lab have received proper safety training in that laboratory’s specific procedures, and when particularly hazardous chemicals are used. This training must be documented.

The instructor of record in the teaching laboratories must ensure that the Chemical Hygiene Plan is implemented in his or her laboratory course.

The Laboratory Supervisor has direct day-to-day responsibility for:

- Implementation of the Chemical Hygiene Plan in his/her lab(s).
- Develop laboratory specific standard operating procedures. An outline for developing laboratory specific SOPs may be found in Appendix R.
• Ensuring that employees receive CHP/Laboratory Safety training before beginning work with hazardous chemicals, equipment, or procedures.
• Training of other laboratory personnel in the standard operating procedures specific to their duties and maintaining records of that training.
• Providing regular oversight of proper chemical hygiene and housekeeping practices.
• Ensuring that hazards and risks are assessed prior to beginning work. Assessment should include a plan for hazard minimization and worst-case scenarios.
• Inspection of safety equipment such as eye wash stations and safety showers. Eyewash stations should be run and inspected monthly for functionality. Inspections must be documented. (8 CCR 5162(e))
• Knowledge of current legal requirements concerning regulated substances used in their labs.
• Maintaining and updating a chemical inventory (8 CCR 5194)
• Reporting employee accidents or injuries to HR within 2 days of incident, and serious accidents or injuries immediately.
• Reporting student injuries to the Dean of Students office using the injury report form. Accident/Injury report forms for employees, students, and visitors may be accessed using the following link: www.hmc.edu/emergency-preparedness/employee-safety/
• Directing the use of the required levels of protective apparel and equipment.
• Establishing a designated area when appropriate.

Laboratory Employee

The laboratory employee is responsible for:

• Under the direction of the Laboratory Supervisor or Lead Scientist, planning and conducting each operation in accordance with the Chemical Hygiene Plan and laboratory specific standard operating procedures (SOPs).
• Utilizing appropriate engineering controls and personal protective equipment.
• Developing good chemical hygiene habits, including keeping a neat, uncluttered work area.
• Reviewing procedural changes with supervisor.
• Becoming knowledgeable about the hazard potential of each raw material used in the laboratory and the safe handling thereof.
• Reporting all accidents, near misses, and injuries to the supervisor.
• Reporting any unsafe conditions to the supervisor.
Laboratory Safety & Chemical Hygiene Committee

This committee is to be comprised of members whose laboratories are directly affected by the Chemical Hygiene Plan and is scheduled to meet once per semester to discuss safety and chemical hygiene issues.

The Claremont University Consortium's Office of Environmental Health & Safety is an ex-officio member of this committee and participates as needed to assist with program and regulatory issues.

Standard Operating Procedures

Basic First Aid – Chemical Exposure

- Eye contact: Promptly flush eyes with normal saline or tap water for a minimum of 15 minutes. Seek immediate medical attention.
- Ingestion: Call Campus Safety (security) and request emergency medical assistance. Do not induce vomiting. Rinse mouth with water. If unconscious, turn head to side to avoid choking hazard if vomiting occurs.
- Skin Contact: Remove any contaminated clothing. Promptly flush the affected area with water and; use a safety shower if drenching is necessary. Rinse for a minimum of 15 minutes. Rinse contaminated clothing prior to removing from laboratory. Clothing contaminated with acute toxins or highly hazardous chemicals must be bagged and disposed as hazardous waste. Launder contaminated clothing before wearing. Seek medical attention.
- Inhalation: Move to fresh air. Seek medical attention.
- Injection: Wash injection site thoroughly. Seek immediate medical attention.
- **EMERGENCIES:** DIAL EXTENSION 7-2000 FROM CAMPUS PHONE or (909) 607-2000 from mobile phone.

Uncontrolled Releases

Do not attempt to clean up a spill of 1 liter or larger of liquid or 1 kg or larger of solid material. Do not attempt to clean a spill of larger than 100 ml or 50 g of a particularly hazardous or highly reactive material. Dike material if it is safe to do so. Spills that occur outside of the fume hood may be too hazardous or complicated to clean up without proper respiratory protection. Call individuals on the call list (Appendix A) for guidance.
Gases:

Shut down the supply system, exit the lab, and allow the fume hood ventilation system to exhaust the material. If the release is large and/or toxic and cannot be contained by the fume hood system, building evacuation may be necessary. Pull fire alarm to evacuate building. Contact F & M to shut down ventilation system in the event of a toxic release. **Do not place yourself at risk trying to shut down the leak.** Flammable gases in enclosed areas create a threat of flash fire or explosion. Extinguish open flames. Do not touch electrical switches as arcing may trigger an explosion. For minor leaks of a nontoxic, nonflammable cylinder, remove the cylinder to a well-ventilated area and call vendor for pickup. **Notify your supervisor, Chemical Hygiene Officer, and Campus Safety Officer (Appendix A).**

Liquids:

Do not attempt to clean a spill of 1 liter or larger. Do not attempt to clean a complicated spill that occurs outside of the fume hood, or a spill of a material of which you are unfamiliar. Consult SDS for disposal information or special precautions. Contain spill if possible using diking materials or booms. Evacuate the lab and alert others in the area to do the same. Notify your supervisor, Chemical Hygiene Officer, and the Campus Safety Officer. (Appendix A). For small spills follow SDS information to contain the material. Dike spill or plug drains to prevent spills from entering the sanitary sewer system. Neutralization may be used in some circumstances to reduce the potential for injury in some cleanup efforts. Do not use paper towels to absorb flammable liquids. This increases vapor concentration. Dispose of absorbent materials as hazardous waste. Rinse cleaned area and any non-disposable implements with detergent and water.

Solids:

Do not attempt to clean a spill of 1 kg. or larger. For smaller spills, consult the SDS for cleanup and disposal information. Dry sweep small spills, using anti static broom, and place them in an appropriate waste container. If dust presents a respiratory hazard, wet the material unless contraindicated by the label or SDS. **WARNING:** if material is shock sensitive, do not dry sweep. **Consult Laboratory Supervisor and Chemical Hygiene Officer for assistance.**
Report any uncontrolled release to the Lab Supervisor, Chemical Hygiene Officer, and the Office of Environmental Health & Safety (EH&S) immediately (See Appendix A). **Notify Campus Safety (Security) EXTENSION 72000 if emergency medical or fire assistance is needed, or if an evacuation is necessary.** Uncontrolled releases that exit the property may require special notification procedures. Contact EH&S for directions on this issue. Do not dispose of any chemical waste in the sanitary sewer or in conventional refuse. (See Hazardous Waste section for more details)

Refer to general SOPs for Flammables (Appendix B), Corrosives (Appendix C), Particularly Hazardous Chemicals (Appendix D), and Highly Reactive/Unstable Materials (Appendix E) and to the HMC Spill Policy for specific spill information on these hazard classes.

**General Methods**

- An employee engaging in work with hazardous, caustic, flammable, or pyrophilic reagents or solutions should never work alone. Use the buddy system when performing hazardous reactions or procedures.
- Every chemical storage container including temporary containers (e.g. beakers, flasks) must be properly labeled to identify its contents and hazards. The chemical name should be written out. Chemical formulas should not be used on labels. This does not apply to temporary containers which will be used in the course of a single work period.
- Novel chemicals must be labeled with the name of the producing chemist.
- Unknowns used in teaching laboratories must have an identification key stored with them. A hazardous materials label must describe the most toxic of the unknowns.
- If the hazards of a chemical are unknown, the container should have a label indicating that it is “undergoing evaluation.”
- Hazardous wastes held in containers in Laboratory Satellite Accumulation Areas (LSAA) must also include the date accumulation began, and the approximate amount of each compound of the waste.
- Waste Containers must be capped when not in use and at the end of the work period.
- Return flammables and other hazardous chemicals to their proper storage at the end of each workday.
- Provide appropriate warnings about experiments in process and restrict laboratory entry to authorized personnel only.
- The Laboratory Supervisor should provide signage and guidelines for any unattended, overnight, or weekend process. A response procedure should be established prior to beginning the work. Signage should include the name and phone number of the person(s) conducting the unattended procedure.
• Consult the necessary reference materials (including SDSs) about potential chemical hazards. Pre-plan appropriate protective procedures, equipment usage and process design before beginning any new operation. Leave the laboratory lights on and provide for containment of toxic substances in the event of a failure of a utility service (such as cooling water) in an unattended operation.
• Dispose of broken glass or contaminated glass in appropriate containers.
• Containers for broken glass should be labeled “Glass Only”.
• Hypodermic needles and syringes must be disposed of in rigid red plastic biohazard “sharps” receptacles. Needles and syringes contaminated with hazardous chemicals must be disposed of in a sharps receptacle to which a proper chemical hazardous waste label has been affixed. Biohazard sign must be covered.
• Keep the work area neat and uncluttered. Clean up the work area after the completion of an experiment or procedure, or at the end of the day if feasible.
• Use care when handling and working with glassware to avoid breakage. Do not use damaged glassware. Specialized components (such as Dewar flask) or vacuum glassware may require extra care when handled. Shield or wrap evacuated glassware, where feasible, to protect against injury from implosion.
• Validate the integrity of partial containers of ether and other peroxide formers for peroxide contamination prior to use (See appendix F). Make a record of the date for any storage container of a peroxide former when it is received and when it is first opened.
• When chemicals are hand carried from the stockroom to the laboratory, they should be placed in a secondary container or bucket.
• Use secondary containment, such as a Pyrex or rubber tray for procedures involving particularly hazardous materials.
• Inspect glassware for cleanliness prior to use to prevent cross contamination and/or mixture of incompatibles.

**Personal Exposure Minimization**

• Do not smell or waft chemical containers.
• Avoid eating, drinking, smoking, chewing gum, or applying cosmetics or lip balm in areas where laboratory chemicals are present. Decontaminate by washing your hands, and then exit the lab before conducting these activities.
• Consumption of food or beverages in the laboratory, preparation rooms, or chemical storage areas is prohibited. Laboratory refrigerators designated for chemicals and raw materials storage, glassware, and utensils are not to be used to hold or store food or beverages.
• Skin contact should be avoided as a general rule. Avoid underestimation of risk.
• Wash areas of exposed skin thoroughly before leaving the laboratory, even when gloves have been worn.
• Avoid practical jokes or other behavior that might confuse, startle, or distract another worker.
• Do not pipette or start a siphon by mouth.
• Confine long hair and loose clothing.
• Footwear must be worn while in the laboratory, and in buildings where chemicals are in use or transported. Sandals, open-toed, open-heeled, and perforated shoes are prohibited in the laboratory.
• Appropriate attire must be worn in the laboratory. Shirt must cover abdomen. Halter tops and tank tops are not allowed. Shorts and skirts must cover the thigh. Leggings are not appropriate lab wear and may increase risk of injury in the event of a spill due to close skin contact. Long pants are recommended and must be worn when working with highly toxic, highly flammable, or pyrophoric materials.
• Wear appropriate eye protection (goggles, safety glasses, face shields, etc.) when working in settings where chemical hazards exist.
• OSHA and the American National Standards Institute (ANSI) agree; “wearers of contact lenses shall be required to wear appropriate eye covering and face protection devices in a hazardous environment. It should be recognized that dusty and/or chemical environments may represent an additional hazard to contact lens wearers.” Employees who wear contact lenses should be provided a pair of non-ventilated chemical splash goggles.
• Routinely inspect the laboratory for incompatible storage situations. (See Appendix K)
• Chemicals should not be stored in the fume hoods. Excessive storage of materials in the hood may impede airflow.
• Fume hood sash must be kept at the lowest level at which procedure can be performed.
• Work in fume hood should be conducted at least six inches from the front.

Personal Protective Equipment

All personal protective equipment (PPE) must be approved for use by the National Institute for Occupational Safety and Health (NIOSH), and meet the applicable American National Standards Institute (ANSI) requirements regarding exposure limits. The need for PPE must be reviewed and specified prior to beginning any chemical handling procedure. Safety glasses and chemical splash goggles must meet ANSI Z87.1 requirements. PPE must be used where engineering controls are unable to provide the required level of safety. PPE must be provided and maintained by the employer.

CAUTION: The compatibility of the PPE materials with the chemical hazards to be encountered must be evaluated prior to selecting the protective equipment.
Refer to the PPE manufacturers’ specifications and the material safety data sheet for the chemical to verify proper use application.

- Any employee who must use either a negative air respirator or a powered air-purifying respirator (PAPR), alone or in conjunction with engineering controls, to comply with OSHA established permissible exposure limits (PELs) is required to have an annual pulmonary function test, be fit tested, and otherwise comply with the requirements of CCR Title 8 Section 5144, and of the Claremont Colleges’ Respiratory Protection Program, which may be viewed by clicking on the following link:  

- Employees are required to wear gloves when there is the potential for direct skin contact with hazardous chemicals, blood, or infectious materials. (See Appendix G for glove material compatibility information)

- Lab coats are to be worn only in laboratory areas and should be buttoned to protect the employees’ clothing from contamination. Lab coats are provided and maintained by the employer.

- All personal protective equipment and contaminated lab wear must be removed immediately upon leaving the laboratory areas and placed in designated control areas to minimize the potential for cross contamination or personal exposure.

- Remove and replace lab coat upon significant contamination.

- Lab coats contaminated with acute toxins or carcinogens must be disposed of as hazardous waste.

- Do not wear lab coats or gloves into “clean” areas such as restrooms, offices, or where food is consumed.

- Safety glasses or chemical splash goggles must be worn while working in areas where chemicals are in use or chemical hazards exist. Visitors and maintenance workers must also wear safety glasses in these areas.

- The Center for Disease Control recommends that safety glasses be worn in laboratories of all designations of biosafety levels.

- Face shields may be used in addition to, not in place of, safety glasses or goggles.

**Engineering Controls**

- Chemical fume hoods are to be used where feasible to minimize exposure of employees to emissions from flammable, volatile, toxic, or malodorous chemical processes. Fume hoods provide barrier protection from physical hazards such as fires, explosions, etc. Fume hoods must comply with CCR title 8 Section 5154, *Ventilation Requirements for Laboratory Type Hood Operations* [www.dir.ca.gov/title8/5154_1.html](http://www.dir.ca.gov/title8/5154_1.html)
• Each fume hood is to be inspected and certified annually for proper face velocity and the hood's doorframe marked at maximum opening for the required face velocity, per standards set forth by the American National Standards Institute (ANSI) and the American Society for Heating, Refrigerant, and Air-Conditioning Engineers (ASHRAE). In process use is to be verified by an in-place gauge, calibrated in feet per minute (f/m) that can be easily read by the operator/scientist during the use of the fume hood.

For Example:

Standard fume hood velocity = minimum 100 f/m average with no point less than 70f/m.

Actual face velocities for any hazardous material must be verified by reviewing State and Federal safety regulations, if any, for that material.

• Laboratory fume hoods shall be labeled as to their f/m rating, date of last inspection, and any special use approvals (e.g. perchloric acid, carcinogens, or radioisotopes).
• All materials and apparatus must be at least six inches from face of fume hood. Work in the fume hood should be conducted six inches from the plane of the hood face.
• Keep hood sash at lowest possible level for performance of work, keeping glass between worker and chemical source. View work through the glass.
• Do not lean in to the hood so that head passes the plane of the hood face.
• Do not use fume hood for storage of chemicals or equipment.
• Keep baffle slots free from obstruction.
• Avoid rapid or sudden movements outside of hood as this may cause air turbulence sufficient enough to draw contaminated air from the hood.
• Keep hood sash closed when not in use.
• Perchloric acid fume hoods shall comply with section 6-12 of the National Fire Protection Association Code, No 45. (See appendix I)

**Warning:** Where perchloric acid is heated above ambient temperature, process vapors should be scrubbed or trapped prior to exhausting to the hood. Uncaptured perchloric acid vapors can condense in fume hoods and duct work to form explosive perchlorates.

• Perchloric acid hoods should be washed down after each use and the final rinsate inspected using a 0.4% (v/v) solution of methylene blue in water. (A violet precipitate will form in the presence of perchlorates. See Appendix I)
• Evacuated systems capable of imploding and resulting in significant quantities of glass fragments or other flying debris must be protected
using a cage, a shield, or other appropriate solid barrier. Smaller systems may be wrapped in tape/foil.

- Centralized vacuum systems must be inspected annually and should be protected from contamination using appropriate process equipment.
- Environmental rooms have re-circulated atmospheres. Precautions must be taken to prevent the release of toxic substances into the air in these areas.

**Safety Devices**

- Eyewash fountains and safety showers must be activated monthly to flush line and verify proper operation. (CCR 8 Section 5162)
- Safety showers and eyewashes are inspected, tested and flushed annually. (CCR 8 Section 5162)
- Fire Extinguishers are inspected monthly and tested annually. (8CCR 6151)
- All chemical stockrooms/storerooms are adequate and well ventilated.
- Environmental rooms must have provisions for escape in the event of an emergency or electrical failure.
- Airflow through the laboratory should be relatively uniform and be exhausted to the exterior of the building. Quality and quantity of ventilation are to be monitored and verified annually.
- Chemical Hygiene related equipment shall be recommended by the CHO and/or the CUC Office of Environmental Health and Safety, in conjunction with faculty needs.

**Administrative Controls**

Administrative controls are procedural and policy measures to be taken in order to reduce or eliminate hazards. Administrative controls may include development of standard operating procedures, training requirements, and institutional policy regarding chemical use.

SOPs for general hazard classes of chemicals may be found in Appendices B, C D, E, and F. SOPs for chemical use procedures and equipment are available on request by contacting the Chemical Hygiene Officer.

**Personal Monitoring & Environmental Surveillance**

Laboratory Supervisors are responsible for safety within their areas. Potentially hazardous chemical processes and/or procedures should be reviewed by the Chemical Hygiene Officer, the department chairperson, or the CUC Office of Environmental Health & Safety prior to implementation.
Personal monitoring is conducted to determine exposure levels or for the need for medical consultation, examination and/or surveillance.

The college shall measure personnel exposure to any chemical regulated by a standard which requires monitoring or if there is reason to believe that exposure levels for that substance may exceed the action level or permissible exposure limit (PEL). The PEL is an OSHA-enforced legal standard. PELs for a given chemical are a concentration level of exposure determined to be safe for most workers. PELs are based on a time-weighted average (TWA) over an eight-hour work day and forty-hour work week for a lifetime of work. The action level (AL) is typically one half of the PEL.

A list of chemicals for which OSHA PELs have been established may be viewed by clicking the following link: https://www.dir.ca.gov/title8/ac1.pdf

Examples where personal monitoring may be conducted include when (1) chemicals are not used in a fume hood and/or (2) personnel develop signs or symptoms associated with exposure to hazardous chemicals.

- If the action level or PEL is exceeded during the initial monitoring, personal monitoring will be repeated per the relevant regulatory standards or consensus guidelines.
- Monitoring may be terminated in accordance with relevant regulatory standards or consensus guidelines.
- Monitoring results will be provided to personnel per the time requirements of the relevant regulation or within 15 days of the Chemical Hygiene Officer’s receipt of monitoring results.

Where exposure monitoring reveals an exposure above the action level (or in the absence of an action level, the permissible exposure limit (PEL) for a Cal-OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements, medical surveillance will be established as prescribed therein.

**Medical Surveillance & Overexposure**

All staff and faculty working with hazardous chemicals will be provided with the opportunity to have a medical examination, and a follow-up examination, if necessary, under any of the following circumstances:

- Development of signs or symptoms of overexposure associated with the chemicals to which they have been exposed in the laboratory. For specific substances regulated by Cal-OSHA (e.g. carcinogens) where environmental monitoring demonstrates routine exposure above the Action level, or PEL if no action level is given.
• In the event of an uncontrolled release of a hazardous material where there is a likelihood that the individual may have been overexposed to that hazardous material.

The employer shall provide the following information to the physician in the event of a possible exposure:

• The identity of the hazardous chemical(s) to which the employee may have been exposed.
• A description of the conditions under which the exposure occurred including, if available, quantitative exposure data.
• A description of the signs and symptoms of exposure.
• A copy of the SDS for the chemical(s) involved.

The physician will provide a written opinion that will not reveal specific findings or diagnosis unrelated to the exposure, but will include:

• Any recommendation for further medical follow-up.
• Results of the medical examination and any associated tests.
• Any medical conditions that may be revealed in the course of the examination that may place the employee at increased risk as a result of exposure to a hazardous chemical found in the workplace.
A statement by the physician that the employee has been informed of the consultation/examination results and any medical condition that may require further examination or treatment.

**Chemical Inventory**

An inventory must be maintained (hard copy or PC based) listing all chemicals in the laboratory and storerooms. Chemicals should be listed alphabetically by location according to the most commonly used name. The inventory records should also include the average quantity on hand, the physical state (e.g. solid, liquid, gas) of the material, the NFPA classification, if known, and the manufacturers name and complete address. (See Appendix J for more information on HMC Chemical Inventories). In order to ensure accuracy of the chemical inventory, the Chemistry Department Stockroom must be notified when chemicals are acquired, disposed of, or used up.

**Safety Data Sheets**

SDSs provide information necessary for the safe handling of chemicals. SDSs should be consulted before working with an unfamiliar chemical. Formatting of SDSs adheres to policy set forth by the Globally Harmonized System (GHS) of classification and labeling of chemicals and CCR title 8 Section 5194, Hazard Communication www.dir.ca.gov/title8/5194.html. Explanation of SDS formatting and GHS classifications and pictograms may be found in Appendix B.
SDSs for chemicals on hand are available to each laboratory and stockroom with MSDS Online. The chemical inventory for the college is also kept on this system.

Laboratories rely on the chemical manufacturers’ information to ascertain the hazards of a particular chemical. SDSs and chemical location may be viewed by clicking on the following link:

http://tinyurl.com/hmccheminventory

**Laboratory Hazard Designations**

Chemical Safety Levels, as defined in “Identifying and Evaluating Hazards in Research Laboratories,” American Chemical Society 2013 are intended to enhance the management and control of each lab. This Chemical Hygiene Plan addresses, where necessary, specific hazard concerns in the higher risk labs.

The general designations are as follows:

**CSL 1**
Minimal chemical risk or physical hazard. No concentrated acids, bases, toxics, carcinogens, or teratogens. Ability to work safely with all necessary materials on open benches. No fume hood is required. Typical examples include undergraduate science or demonstration labs with minor chemical use, laser labs (below Class 2B), and microscopy rooms.

**CSL 2**
Low chemical or physical hazard. Small amounts, less than one liter of concentrated acids or bases, limited amounts of toxic or high hazard chemicals. Less than 40 liters of flammable chemicals in use. May need a fume hood for some activities. Typical examples include chemistry/biochemistry teaching and demonstration labs, and standard biomedical labs.

**CSL 3**
Moderate chemical or physical hazard. Lab contains concentrated acids, bases, toxics, other high hazard chemicals or cryogenic liquids. Carcinogens or reproductive hazards are handled. Corrosive, flammable, or toxic compressed gases in cabinets or fume hoods. Larger volume of flammable liquids. Special hazards in limited quantities. Labs are fume hood or local exhaust ventilation intensive. Some use of a glove box for air reactive chemicals or quality control. Examples include chemical research or chemical engineering labs.

**CSL 4**
High chemical or physical hazard. Work with explosive or potentially explosive compounds, frequent use or larger quantities of pyrophoric chemicals. Use of
large quantities of high hazard materials with significant potential for IDLH (Immediately dangerous to life and health) conditions in the event of uncontrolled release or foreseeable incident. Use of glove box for pyrophoric or air-reactive chemicals.

The ACS publication “Identifying and Evaluating Hazards in Research Laboratories” may be viewed by clicking the following link:

www.acs.org/content/dam/acsorg/about/governance/committees/chemicalsafety/publications/identifying-and-evaluating-hazards-in-research-laboratories.pdf

**Designated Area**

When working with particularly hazardous chemicals, such as acute toxins, reproductive toxins (mutagens, teratogens) or carcinogens, a designated area shall be established where entry is controlled. This may be a lab, bench, fume hood, or an entire lab. The designated area must be marked with a sign (i.e. Warning! Reproductive toxins in use! No unauthorized access!).

**Chemical Storage**

Proper storage of chemicals and the avoidance of incompatible mixtures present an ongoing safety issue. Quantities of chemicals should be kept as small as practical. Long-term storage of chemicals on working bench tops or in fume hoods may increase the risk of fires or spills and is discouraged. In addition, long-term routine storage of chemicals in fume hoods should not be permitted as the presence of non-process containers can disrupt the airflow in portions of the hood, which could compromise the performance of the engineering control. Appropriate laboratory cabinets and special laboratory refrigerators are to be used for chemicals storage where feasible. Flammable liquids may be stored in flammable storage cabinets or rooms equipped with appropriate ventilation; safety cans with flame-arrested, spring-loaded spouts, or specially designed refrigerators. Safety cans should be used for transporting flammable liquids in bulk. Flammables requiring refrigeration must be stored in flame-proof refrigerators built for that purpose.

Toxic chemicals (including but not limited to carcinogens, teratogens, mutagens or poisons) should be stored in access-controlled areas. Whenever possible these materials should be held in break resistant, chemically resistant secondary containers. All chemical storage containers must be appropriately labeled as to their content and hazards. See Appendix K for more information on storage.
Gas Cylinder Handling

Compressed gas cylinders must be stored, handled, and used as outlined in CCR Title 8 Section 4650 Storage, Handling, and Use of Cylinders. Cylinders of compressed gases, whether empty or full, are required to be stored upright and tightly strapped or chained to a wall or bench top by a noncombustible, two-point system, with one strap at the upper and one at the lower third of the cylinder. The valve stem must be capped when not in use so as to assure stability of the cylinder and prevent accidental damage to the tank and valve assembly. Cylinders must be strapped onto cylinder carts for transporting. Additional information on the safe use of compressed gas cylinders may be found in Appendix G.

Cryogenics

Cryogenics are defined as materials with extremely low boiling points (at or below -150 °C, for example). Cryogenic materials include liquid nitrogen, liquid helium, liquid oxygen, and dry ice. They have a high-volume expansion in liquid to gas phase, thus having the potential to displace oxygen. Hazards include skin burn, frostbite, and asphyxiation due to oxygen deficient atmosphere. Cryogenic SOPs may be found in Appendix H.

Labeling

All chemical containers that are stored or shipped must be properly labeled. Labels must not be removed or defaced. An SDS attached to a container (e.g. a carboy) is acceptable in lieu of an actual label. Labels may be printed using the MSDS Online link. For the purposes of storage, “properly labeled”, according to 2012 hazard communication regulation (CCR Title 8, Section 5194) means the label must state:

- The identity of the chemical.
- GHS pictogram
- Signal word (Danger, or Warning)
- Hazard statements
- Precautionary Statements
- The name and address off the chemical manufacturer.

An example label is shown below:
• For laboratory prepped solutions, include the name of preparer and date of preparation.
• Any container that is left out of the immediate control of the user must include the full chemical name, (not in formula), and its hazards if any. This requirement applies to containers of water as well.

Carcinogens, Reproductive Hazards, and Acute Toxins (Particularly Hazardous Chemicals)

Management programs for carcinogens, reproductive hazards, and acute toxins are specific to the material(s) being used.

In general, environmental and personal monitoring shall be conducted to determine in process and use base line levels for regulated carcinogens and toxics. Carcinogens are materials known or suspected to cause cancer in humans. Refer to Appendix E for the complete definition. Reproductive hazards include teratogens, mutagens, and materials that can, through biochemical means, cause harm to a developing fetus. Toxins can induce sickness in, or cause the death of, living organisms. Situations where the process, experiment, or research can be expected to result in exposures below the Action Level, which is calculated as an eight-hour time weighted average (TWA), will not require additional monitoring unless there are material changes in the laboratory protocols, Records should be maintained which describe the amount and context of use.

The need for a written Engineering and Work Practices Controls Program (EWPCP) for a particular material process is evaluated on a case-by-case basis. For example: When using cadmium, if an employee/scientist is exposed above the permissible exposure limit (PEL) of 30 or more days during a calendar year, an EWPCP is required. This may be encountered during a research project but is generally unlikely in the course of laboratory instruction of students. Where EWPCPs are required, medical/biological surveillance shall be governed by the appropriate current regulations.
SDSs or current Cal-OSHA tables can provide action level, PEL, and TWA data as required. Consultation with the CHO or the CUC Office of Environmental Health and Safety is recommended to ensure appropriate regulatory compliance.

**Cal-OSHA Regulated and Select Carcinogens**

Title 8 CCR 5209 (Carcinogens) is superseded by Section 5191 (a)(2) - “Occupational Exposure to Hazardous Chemicals in Laboratories”, except for Section 5209(c)(6) – “Laboratory Activities.” Therefore, this section of the CHP does not address any other sections of 5209. Note that Cal-OSHA allows exceptions to the carcinogen standard if the compound is used at or below the exempt carcinogen levels (i.e., the compound may be diluted to below the exempt concentration as measured by weight or volume, as indicated in the table below).

### Carcinogens Subject to Title 8 CCR 5209

<table>
<thead>
<tr>
<th>CARN</th>
<th>Not Regulated If Less Than (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>53963</td>
<td>1.0</td>
</tr>
<tr>
<td>92671</td>
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</tr>
<tr>
<td>92875</td>
<td>0.1</td>
</tr>
<tr>
<td>91941</td>
<td>1.0</td>
</tr>
<tr>
<td>60117</td>
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<tr>
<td>134327</td>
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<tr>
<td>91598</td>
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<tr>
<td>92933</td>
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<tr>
<td>62759</td>
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<tr>
<td>57578</td>
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<td>107302</td>
<td>0.1</td>
</tr>
<tr>
<td>151564</td>
<td>1.0</td>
</tr>
</tbody>
</table>

It is the policy of the college not to stock, order, or use any of the above-mentioned Cal-OSHA Carcinogens. If you believe that you will need to use one or more of these chemicals, please see the Chemical Hygiene Officer well in advance of your anticipated use.

There are additional requirements that shall be observed for laboratories that handle Cal-OSHA Regulated Chemical Carcinogens subject to individual standards. Pursuant to 8 CCR title 5200-5220. Requirements may include standard operating procedure training, establishment of a designated area, and exposure monitoring. For a listing of Cal-OSHA Regulated Carcinogens subject to individual standards, refer to Appendix N.
Select carcinogens include those regulated by Cal-OSHA. Additionally included are those listed as a known human carcinogens in the Annual Report on Carcinogens published by the National Toxicology Program (NTP), and chemicals listed under Group 1 (carcinogenic to humans), Group 2A or 2B (reasonably anticipated be carcinogens) by the International Agency for Research on Cancer Monographs (IARC).

**Nanoparticles**

Nanoparticles are defined as a material or particle with any external dimension having a diameter of between 1 and 100 nanometers. They may be engineered or naturally occurring. Because effects of nanoparticles are still being reviewed, scientists working with nanoparticles must assume that the particles are toxic on a cellular level. Fume hoods, glove boxes, or biosafety cabinets should be used. Respirator use may be required when handling powdered nanomaterials. The small size of the particles may allow them to escape the containment of the fume hood. Refer to the section titled “Personal Protective Equipment” for information on respirator use. Gloves resistant to the solvents being used should be worn. Work surfaces should be wet wiped at the end of each workday. Waste materials, including contaminated gloves, wipes, and lab coats should be double bagged and labeled as “nanoscale.” More information on nanoparticle safety may be found in the “Nanotoolkit” published by the California Nanosafety Consortium of Higher Education. (https://www.hmc.edu/chemistry/safety-resources/)

**Hazardous Waste: Storage & Disposal**

**Laboratory Satellite Waste Accumulation**

Hazardous waste is a waste with properties that make it potentially dangerous or harmful to human health or the environment. Hazardous waste is defined by the Resource, Conservation, and Recovery Act of 1976 (RCRA) and enforced by the Environmental Protection Agency and the California Department of Toxic Substance Control. Hazardous waste is defined as having one of the following characteristics: ignitable, corrosive, toxic, or reactive. RCRA also specifically lists certain chemicals that must be disposed of as hazardous waste. Characteristics of waste streams are defined in Appendix P.

Laboratories may accumulate hazardous wastes in satellite accumulation area provided the following criteria are met:

- Waste containers must be appropriately labeled. Labels must include the words “hazardous waste.” If a mixture of compatibles, each container
must also have a method for recording each material as it is introduced, its associated hazard(s), and the approximate quantity. Official HMC Waste Labels are available from the Chemistry Department Stockroom.

- The initial date that hazardous waste is placed in the container must be clearly marked and visible.
- Establish protocols to prevent the accidental mixing of incompatible chemical wastes. (See mixing for treatment exception California Health & Safety Code 25200.3.1 (c))
- Hazardous waste must be stored in secondary containment. Containers must be capped and free of drips.
- May not accumulate more than fifty-five gallons of a hazardous waste or more than one quart of any single extremely or acutely hazardous waste.
- College operational maximum accumulation time even if quantity limits are not reached is nine months. Wastes must then be moved to the waste accumulation area (Jacobs 2314) where it is inventoried and prepared for removal. It is removed from the waste accumulation area by a waste contractor within ninety days. Call the Chemistry Department Stockroom (ex 72957) to arrange a pickup.
- The waste accumulation area is managed and under the direct control of “one or more designated personnel who have received training commensurate with their responsibilities and authority for managing laboratory hazardous wastes…” (California Health & Safety Code, section 25200.3.1) This training is also required for unsupervised access to the hazardous waste area within a lab. Contact the Chemical Hygiene Officer regarding Hazardous Waste Training.
- Storage space is adequate for the quantities and types of wastes present.
- Waste that is contaminated with both biological and chemical hazards must be disposed as chemical hazardous waste.

**IMPORTANT:** When stock chemicals are no longer needed and are “designated” a waste, removal must occur within ninety days, as laboratory/satellite accumulation rules do not apply. Laboratories are encouraged to inquire whether or not a raw material may have value within another laboratory area on campus prior to designating the unneeded material a hazardous waste. Chemicals with damaged, unlabeled, mislabeled, or do not contain adequate hazard warnings are also considered hazardous waste if not corrected within ten days. Contact the Chemistry Department Stockroom to dispose of stock chemicals.

**Disposal**

All disposal of hazardous, regulated, and bio-hazardous waste is to be handled by commercial haulers and Treatment, Storage, and Disposal Facilities (TSDFs) licensed by the State of California and/or other appropriate regulatory agency. In
general, hazardous waste may not be disposed of in unregulated trash bins or released in to the sanitary sewer system via laboratory sinks.

### Sharps

Sharps are defined as any device having acute rigid corners, edges, or protuberances capable of cutting or piercing, including but not limited to hypodermic needles, broken glass items such as Pasteur pipets and vials, and plastic pipet tips. Sharps must be placed in a rigid puncture resistant container that when sealed is leak resistant and cannot be reopened without great difficulty.

Sharps disposal containers in which the contents are contaminated with hazardous chemicals must be properly labeled as hazardous waste. See Appendix P for more information on sharps disposal.

### Prior Approval

The responsibility for approval of the acquisition and use of particularly hazardous chemicals as defined in Appendix E rests with the laboratory supervisor. Researchers are encouraged to select less hazardous chemicals whenever possible. All needed approval must be obtained before experiments are performed. Chemicals classified as acute toxins, reproductive toxins and those with an NFPA health rating of 4 are kept under controlled access.

### Training

Training is a necessary and important part of the Chemical Hygiene Plan. All employees who work with or who may be exposed to hazardous chemicals receive Hazard Communication, and/or Laboratory Safety Training depending on duties, at the time of initial assignment to work areas where hazardous chemicals are present and before assignment involving new exposure situations. Refresher information and in-service training sessions are also held as necessary. The Laboratory Supervisor, the Chemical Hygiene Officer, or the CUC Office of Environmental Health & Safety may conduct training. Laboratory supervisors must provide training on standard operating procedures specific to the hazards in their laboratories. All training must be documented according to attendance, date provided, subject matter and name of the person providing the training. Training records are kept by the Chemical Hygiene Officer and laboratory supervisors.

A general training outline is provided in Appendix Q.
Housekeeping

Floors are to be cleaned regularly by housekeeping. All affected employees of the housekeeping department must be formally introduced to and trained in the risks associated with cleaning laboratory areas.

The housekeeping supervisor will conduct a quarterly inspection of the lab areas to assess whether:

1. Stairwell and hallways are free of obstruction.
2. Waste is deposited in appropriate receptacles and properly removed from the laboratory.
3. Chemical spills which occur during housekeeping operations are reported and addressed according to established protocols.
4. Proper storage of housekeeping materials is accomplished to minimize clutter.

Record Keeping

- Accurate records regarding personal monitoring, environmental monitoring, and medical surveillance shall be maintained according to the CCR, Title 8. These records are to be maintained by the Environmental Health & Safety Office or Chemical Hygiene Officer.
- The department supervisor and/or the Environmental Health & Safety Office conduct accident investigations.
- Issues regarding Worker’s Compensation should be directed to the HMC Worker’s Compensation Administrator in Human Resources, Kingston Hall.
- Questions regarding high-risk substances (i.e., CSL-4 on the campuses of the Claremont Colleges) should be directed to the Chemical Hygiene Officer.
- Training attendance records shall be maintained in each department.
- All medical surveillance records are kept, transferred, and made available in accordance with 8 CCR 3204.
Appendix A: Call List

Report any uncontrolled release to the laboratory Supervisor and the Chemical Hygiene Officer immediately (see names, locations, extensions below). 
**Notify Campus Safety (security) at extension 72000** if emergency medical or fire assistance is needed. Uncontrolled releases that exit the property may require special notification procedures. Contact EH&S for directions on this issue. Do not dispose of any chemical waste in the sanitary sewer or in conventional trash receptacles.

*Note: An uncontrolled release is an unexpected release of a hazardous material that due to its configuration, nature, or volume poses a threat to human health or the environment.*

Chemical Hygiene Officer: Penny Manisco  
Office: Jacobs 2314  
Extension: 74217  
Google Voice: (909) 547-7238

Biology Laboratory Manager: Elaine Guerra  
Office: Olin 1258A  
Extension: 74143

Chemistry Laboratory Manager: Daniel Guerra  
Office: Jacobs 2310  
Extension: 72957

Engineering Laboratory Manager: Sam Abdelmuati  
Office: Parsons B174  
Extension: 73530

Physics Laboratory Manager: BJ Haddad  
Office: Jacobs B122  
Extension: 73940

Claremont University Consortium  
Office of Environmental Health and Safety  
Jay Brakensiek/Manager EH&S  
Extension 18538

Harvey Mudd College  
Facilities and Maintenance, Platt  
Theresa Lauer/Senior Director of Operations and Emergency Preparedness  
Extension 72760
Appendix B: Globally Harmonized System of Labeling and Classification of Chemicals

The GHS system of labeling and classification requires that chemical suppliers provide safety data sheets (SDS). The safety data sheets must be published in a standardized sixteen section format as outlined below.

Section 1: Product and Company Information, including product name, CAS and emergency phone numbers
Section 2: Hazards Identification, including hazard class based on a numerical classification of 1-4. The number 1 classification is indicative of the most severe hazard class. Number 4 is the least hazardous classification. Also included are pictograms, a signal word, either “warning” or “danger” depending on the severity of the hazards, hazard statements and precautionary statements.

Section 3: Composition and Ingredient Information.

Section 4: First Aid Measures

Section 5: Fire Fighting Measures, including suitable extinguishing media and hazardous products of combustion.

Section 6: Accidental Release Measures

Section 7: Handling and Storage

Section 8: Exposure Control/Personal Protection, including most suitable glove material.

Section 9: Physical and Chemical Properties

Section 10: Stability and Reactivity including incompatible materials and hazardous decomposition products.

Section 11: Toxicological information including LD50 studies, mutagenicity and carcinogenicity

Section 12: Ecological Information

Section 13: Disposal Considerations

Section 14: Transportation Information, including Department of Transportation packing group, class, and UN number.

Section 15: Regulatory Information including Superfund Amendment and Reauthorization Act (SARA) listings.

Section 16: Other information. National Fire Protection Association (NFPA) hazard ratings may often be found here.

Signal words: “Warning” is used on labels and SDSs for chemicals with less severe hazards. “Danger” appears on labels and SDSs for chemicals with more severe hazards.
Appendix C: (SOP) Flammable and Combustible Liquids

Application:
This SOP is intended as general guidance for use of flammable or combustible liquids. The SDS should be consulted for safety information on specific chemicals. This is not intended as a Laboratory Specific SOP. Laboratory Specific SOPs are the responsibility of the Principal Investigator. Certain chemicals may be flammable and particularly hazardous so SOPs for both categories of hazards would apply. Benzene is both flammable and carcinogenic.

Definition:
Flammable liquids have a flash point of less than 100°F. Combustible Liquids have a flash point of between 100°F and 200°F. A flash point is the minimum temperature at which flammable or combustible liquids produce enough vapor to form an ignitable mixture with air. No ignition source is needed to flash.

General Methods:
Perform work with flammable chemicals in a fume hood. Do not work with or pour chemicals near an open heat source. Vapors are generally heavier than air and can travel large distances and flash back to heating source. Minimize the volume of flammable chemicals on the workbench. Use the smallest quantities possible for need. Keep containers closed except for transfer. Large open-mouthed containers should not be used. Non-sparking, explosion-proof, or intrinsically safe electrical devices (i.e. stirring devices, motors) should be used. Never heat with open flame. Preferred methods of heating include heating mantles, steam baths, oil, salt, or sand baths. Store chemicals in flammables cabinet and return to storage when not in use. Flammables that require refrigeration should be stored in flame-proof refrigerators built for that purpose. When transferring flammable liquids from a bulk container (5-gallon drum or larger) the containers must be electrically bonded and grounded. Transfer materials from smaller containers in fume hood.

Engineering Controls:
Flammables and combustible chemicals should be used in a fume hood or other well-ventilated area. Some flammable chemicals that are also particularly hazardous or toxic must be used in a fume hood.

Personal Protective Equipment:
Safety glasses must be worn at all times. Goggles that meet ANSI standard z87.1.1989 with side shields are preferred. Safety glasses without side shields do not provide adequate protection from splashes. Select gloves that are the most impervious to the chemical being used. Consult glove manufacturers’ chart and SDS. Inspect gloves for tears or holes prior to use. Face shield use is appropriate where splash or spray may occur. Lab coats must be worn and an apron should also be worn when handling materials that are toxic with skin contact. Wear long pants or skirts made of cotton or natural fabric. Synthetic fabrics may melt onto skin in fire. Do not wear loose, dangling sleeves or jewelry. Wear closed toed shoes which are not made of canvas, cloth, or absorbent material. Tie back long hair.

Uncontrolled Release:
Anticipate spills in advance and have containment materials nearby. Turn off possible ignition sources. Do not attempt to clean a spill of 1 liter or larger, or of a chemical with which you are not familiar. Notify Chemical Hygiene Officer or Campus Safety Officer in the event of a large spill. Do not use paper towels to absorb flammable chemicals. This concentrates vapors and increases fire risk. Absorb spill with commercial adsorbents or spill pillows. Sand or vermiculite also works well. Absorbed material may be dry swept into an appropriately labeled hazardous waste container. Spill pillows should be disposed of as hazardous waste. Wash area with detergent and water, and wash any tools such as scrapers, brooms and reusable gloves.

First Aid:
In the case of eye contact, use eyewash to rinse eyes for 15 minutes. Hold eyelids open and move eyes. In the case of skin contact, remove contaminated clothing and rinse skin for 15 minutes, using safety drench shower if necessary. In the event of burn, cool with cold water and seek medical attention. Do not apply ice to burns. In the event of ingestion, do not induce vomiting. Give water and call for immediate medical attention. If victim is vomiting, turn head to side to minimize choking hazard. Provide responder/physician with a copy of SDS. Dial Extension 72000 from campus phone for emergency response.
Appendix D: (SOP) Corrosive Chemicals

Application:
This SOP is intended as general guidance for the use of corrosive chemicals. The SDS should be consulted for safety information on specific chemicals. **This is not intended as a Laboratory Specific SOP. Laboratory Specific SOPs are the responsibility of the Principal Investigator.** Certain chemicals may be classified in more than one hazard category. In these cases more than one SOP would apply. For example, hydrofluoric acid is both corrosive and toxic.

Definition:
Corrosive chemicals cause visible destruction of, or irreversible alterations in living tissue by chemical action at the site of contact, including the respiratory tract when corrosive vapors are inhaled. Corrosives have a pH of less than or equal to 2, or greater than or equal to 12.5, according to the Environmental Protection Agency (EPA) definition. Examples of corrosives include acids such as hydrochloric, nitric, or sulfuric, bases such as sodium hydroxide or potassium hydroxide, solids such as phenol or phosphorus, or gasses such as chlorine or ammonia. Strong oxidizers such as hydrogen peroxide or bromine are also corrosive.

General Methods:
Corrosives with harmful vapors must be handled in a fume hood.
Only heat resistant glassware should be used.
Slowly add acid to water only. Never add water to acid.
Store acids separately from bases, and below eye level.
Do not store on high shelves or cabinets.
Employ secondary containment when hand carrying from the stockroom to laboratory.

Engineering Controls:
Corrosive chemicals should be handled in a fume hood if they produce harmful vapors.

Personal Protective Equipment:
Safety glasses or goggles must be worn at all times. Eye protection must meet ANSI standard Z87.1-1989. Goggles with side shields are preferred as they afford the most protection from splashes entering the eye area.
Face shield use is appropriate where splash or spray may occur.
Select gloves that are the most impervious to the chemical being used.
Nitrile disposable gloves provide adequate protection for exposure to small amounts of corrosives in laboratory use, but should be changed when they become contaminated. Consult manufacturers’ charts and SDS for the most appropriate gloves.
Lab coats should be worn to protect against skin contact.
Do not wear clothing with loose or dangling sleeves.
Wear closed toed shoes which are not made of canvas or cloth, or absorbent material.
Tie back long hair.

Uncontrolled Release:
Anticipate spills in advance and have containment materials nearby.
Do not attempt to clean a spill of 1 liter or more of a liquid or 1 kg or more of a solid.
In the event of a large spill, contact the Chemical Hygiene Officer or Campus Safety Officer and your supervisor.
Do not attempt to clean a spill of a chemical with which you are not familiar.
Consult the SDS for appropriate clean up information.
Acids spills may be neutralized with sodium bicarbonate. Bases may be neutralized with citric acid. Commercial neutralizers are available. Do not attempt to neutralize with water.
Very large volumes of water are needed to neutralize a relatively small amount of corrosive, which will only result in a larger spill, amplifying the hazard.
Neutralized material may be absorbed with pillows or dry swept into an appropriately labeled hazardous waste container.
Tools used in cleanup may be wiped with a laboratory tissue (Kimwipe). Deposit the tissue in the hazardous waste container.
Wash the spill area with detergent and water.
Wash any non-disposable brooms or scrapers, and gloves with detergent and water.

First Aid:
In case of eye contact, use eyewash for 15 minutes. Hold eyes open and move eyeballs.
In case of skin contact, remove contaminated clothing and rinse skin for 15 minutes, using safety drench shower if necessary.
In the event of inhalation, move to fresh air and call for medical assistance.
In the event of ingestion, do not induce vomiting. Give water unless SDS instructs otherwise.
If victim is vomiting, turn head so to reduce choking hazard. Immediately call for medical attention.
**Dial extension 72000 from campus phone for emergency assistance.**
Appendix E: (SOP) Particularly Hazardous Chemicals

Application:
This SOP is intended as general guidelines for the use of particularly hazardous chemicals. Particularly hazardous chemicals include those that are highly toxic, carcinogens, or reproductive hazards including teratogens, mutagens. This SOP is not intended to be a Laboratory Specific SOP. Laboratory Specific SOPs are the responsibility of the Principal Investigator.

Definition:
OSHA defines a highly toxic chemical as one with a median lethal dose (LD50) of 50 mg or less per kg of body weight when administered orally to albino rats weighing between 200 and 300 grams each. Or with a median lethal dose (LD50) of 200 mg or less per kg of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between 2 and 3 kg each. Or a lethal concentration (LC50) in air of 200 ppm by volume or less of a gas or vapor, or 2 mg per liter or less of mist, fume, or dust when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to albino rats weighing between 200 and 300 gm each.

Cal OSHA defines carcinogen as a chemical that is regulated by CalOSHA as a carcinogen (Refer to Appendix I). Or, it is categorized as “known to be carcinogens” in the Annual Report on Carcinogens published by the National Toxicology Program (NTP). Or it is listed under Group 1 (“carcinogenic to humans”) by the International Agency for Research on Cancer (IARC). Or it is listed in either Group 2A or 2B by IARC or under the category “reasonably anticipated to be carcinogens” by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria: a) After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m3. b) After repeated skin application of less than 300 mg/kg of body weight per week; or c) after oral dosages of less than 50 mg/kg of body weight per day.

Reproductive hazards are defined as chemicals that affect the reproductive capabilities including causing chromosomal damage (mutagen) or adversely affect fetal development (teratogen). A complete list of reproductive toxins may be found at: www.oehha.ca.gov/prop65/prop65_list/Newlist.html#files.

General Methods:
Access to particularly hazardous chemicals should be controlled. Conduct sound and thorough planning, including apparatus, layout, waste containment, clean up materials, and first aid.
Use the smallest amount of chemical possible, and substitute less hazardous chemicals if possible. Avoid powders if possible. Order premade solutions to avoid excess handling. If powders must be used they should be weighed in a fume hood, unless this would pose additional hazard due to turbulent airflow. Surround balance area with wetted paper towels. Perform work in a fume hood or glove box. Lay down plastic backed bench paper under apparatus. Employ secondary containment for apparatus and glassware where possible. Label all containers with correct chemical name. Formulas and chemical structures are not to be used as labels. Decontaminate workbench and equipment when work is complete. Wash hands and forearms with soap and water. Dispose of bench paper and other disposable equipment as hazardous waste.

Designated Area:
Designated area with limited access shall be established. This may be an entire lab, a specific workbench, or hood. Designated area should be marked with signs (i.e. Warning! Hydrofluoric Acid Work Area, Highly Toxic Material). Specific lab benches may be demarcated with hazard tape. Remove personal protective equipment before leaving area and thoroughly wash hands and forearms.

Engineering Controls:
Particularly hazardous chemicals must be used in a fume hood. Ensure that the fume hood is working properly before use. Air flow should be at a face velocity of 100 lfm, averaged over the face of the hood. Sash must be kept at the lowest possible level. Inspect hood before use to make sure that airflow is sufficient. Hoods must be inspected and certified annually.

Personal Protective Equipment:
Safety glasses must be worn at all times. Goggles that meet ANSI Z87.1-1989 with side shields offer more protection from splashes and sprays, and are preferred over those without. Face shields are appropriate where sprays or splashes may occur.
Lab coats should be worn. Lab coats contaminated with a particularly hazardous chemical should be disposed of as hazardous waste. Disposable lab coats are commercially available.

Select gloves that are most impervious to the chemical being used. Consult glove manufacturers’ charts and MSDS for information on the most protective glove material.

Inspect gloves for holes or tears before use.

Wear long pants and closed toed shoes which are not made of canvas or cloth.

Tie back long hair.

**Uncontrolled Release:**

Anticipate spills in advance and have containment materials nearby.

Consult SDS for spill cleanup information prior to beginning work.

Do not attempt to clean a spill of 100 ml or more of a particularly hazardous liquid chemical, or 50 g, or more of a solid.

Do not attempt to clean up a material with which you are unfamiliar.

Dike area, if it is safe to do so, using booms to prevent material from entering sanitary sewer via sinks and floor drains.

Evacuate area and restrict access with signs and barriers. Close laboratory doors.

Call Campus Safety (ex 72000), Chemical Hygiene Officer, and Campus Emergency Preparedness Coordinator.

For small, incidental spills, don personal protective equipment including safety goggles, gloves, lab coats, and shoe covers.

Use commercially prepared absorbent materials, such as pillows and towels. Dispose of these as hazardous waste.

Dry sweep any material that has been absorbed with powdered neutralizers into a hazardous waste container.

Label waste container with the appropriate warning. (Particularly Hazardous Material, Carcinogen, Reproductive Hazard, etc.)

Clean spill area with detergent and water. Dispose of any wipes, etc. as hazardous waste.

Decontaminate any non-disposable personal protective equipment with detergent and water.

**First Aid:**

In case of eye contact, use eyewash to rinse eyes for 15 minutes. Hold eyelids open and move eyes.

In the case of skin contact, remove contaminated clothing and rinse skin for 15 minutes, using safety shower if necessary.

Any exposure with a particularly hazardous chemical requires medical attention! Report exposures to Chemical Hygiene Officer and Campus Safety Coordinator.

For emergency medical response, dial extension 72000 from a campus phone. Provide responder/physician with a copy of the SDS.
Appendix F: (SOP) Highly Reactive and Unstable Materials

Application:
This SOP is intended as general guidance for the use of highly reactive or unstable materials. The SDS should be consulted for safety information on specific chemicals. This is not intended as a Laboratory Specific SOP. Laboratory Specific SOPs are the responsibility of the Principal Investigator. Certain chemicals may be classified in more than one hazard category. In these cases, more than one SOP would apply. For example, perchloric acid may be corrosive and unstable, depending on the concentration.

Definition:
Highly reactive materials are defined as those that when subject to heat, friction, detonation or other suitable initiation undergoes rapid chemical change with a sudden release of pressure, gas, and heat. Examples include peroxides, perchloric and picric acids. Pyrophorics ignite spontaneously when exposed to air at temperatures of 130°F (54.4°C) or below. Examples include Grignard reagents and metal powders, and organolithiums. Water Reactive materials react violently with water to produce toxic, corrosive, or flammable gases and liberation of heat. Examples include Alkali metals, alkali metal hydrides, alkali metal nitrides, calcium carbide, phosphorus pentoxide, metal and non-metal halides, organic acid halides, anhydrous metal hydrides

General Methods:
Perform hazard analysis. Determine risks and mitigation in advance (emergency procedures). Have sand or other neutralizing media nearby. Have proper fire extinguishing equipment nearby. (Class D fire extinguisher for metals) Do not use water or CO2 extinguisher. Develop and follow written procedures. Use blast shield in combination with fume hood sash. Minimize quantity of reactive materials used and stored. Keep other chemicals away from reaction area. Limit access to reaction area. Label containers with date of receipt and upon opening. Do not use past expiration date. Seek prior approval before using highly reactive materials or making procedural changes. Decontaminate work surfaces at the end of each procedure and at the end of the day. Decontaminate reaction equipment before removing from designated area. Decontaminate personal protective equipment. Remove gloves after decontamination, and wash hands and arms with soap and water.

Engineering Controls:
Conduct procedures in a fume hood, or under inert conditions in a glove box as appropriate.

Personal Protective Equipment:
Long pants and shoes that completely cover the foot must be worn. Canvas and cloth fabric athletic shoes do not provide adequate protection. Clothing must be made of natural and not synthetic material that may melt and stick to skin in the event of fire. Utilize personal protective equipment including goggles (not safety glasses), face shield with throat protector, heavy gloves if material is toxic or may be absorbed through skin, consult MSDS and glove manufacturers’ guides for glove selection. Flame resistant lab coat with snap closures (to facilitate quick removal) must be worn.

Uncontrolled Release:
All spills of air and water reactive materials are emergencies. Dike and cover spill with sand or vermiculite if it is safe to do so. For spills of reactive metals a class D fire extinguisher (yellow) may be used. Alert others in the area and evacuate. Notify others in the building. Contact Campus Safety (ex 72000) and persons on emergency contact list. Be prepared to provide emergency responders with nature, extent, and location of spill, along with a copy of the MSDS.

First Aid:
In case of eye contact, use eyewash to rinse eyes for 15 minutes. Hold eyes open and move eyeballs. Seek medical attention. In the event of skin contact, remove contaminated clothing and flush with water for at least 15 minutes, using safety shower if necessary. In the event of inhalation exposure, move victim to fresh air and seek medical assistance. In the event of ingestion, immediately seek medical assistance. If victim is vomiting, turn head to reduce choking hazard. Provide emergency responders with a copy of SDS. Dial 72000 from campus phone for medical assistance.
Appendix G: Compressed Gas Cylinder Safety

Storage

- Compressed gas cylinders must be stored and used according to California Code of Regulations Title 8 Section 4650, Compressed Gas and Air Equipment.
- Compressed gas cylinders must be double chained or strapped at points one at the upper third, and one at the bottom third of the cylinder. The two-point restraint affords extra security in the event of an earthquake.
- Flammable gasses must be separated from oxidizing gases by a minimum distance of 20 feet or by a non-combustible barrier of at least five feet high.
- Storage inside buildings must be in well-ventilated areas.
- Store away from combustibles, flammable solvents, oils, flames, electrical equipment and other sources of ignition.
- Cylinders not in use or attached to equipment must have the regulator removed and the valve cap in place.
- Cylinders must be tagged indicating whether they are full, in use, or empty.

Handling

- Compressed gas cylinders must be used only by those who have been properly trained. Training may be performed by laboratory supervisors as part of the laboratory specific standard operating procedures.
- Inventory of compressed gas cylinders must be reviewed annually.
- Read the SDS for the particular gas you are handling. Gases may be explosive, flammable, toxic, corrosive, oxidizing, or simple asphyxiants.
- When handling compressed gas cylinders, ANSI approved safety glasses must be worn. Closed toe shoes must be worn. Additional PPE may be required depending on the hazards of the particular gas. For example, use of corrosive or toxic gases may require self-contained breathing equipment availability in case of emergency. Use of respirators requires special pulmonary evaluation, training, and fit testing. Contact the Chemical Hygiene Officer for assistance.
- Cylinders must be transported on a cart specifically designed for that purpose. They must be transported with the valve closed and cap in place. The valve stem must be protected as it is the most fragile part of the cylinder. Cylinders must not be rolled or dragged.
- Inspect cylinders for damage prior to use. Do not use cylinders that appear damaged (cracks, dents, bulging) or that do not indicate contents. Color of the cylinder is not indicative of its contents. Do not accept cylinders that are past due for hydrostatic testing. Hydrostatic testing must be performed by the vendor every 5 years per Department of Transportation (DOT) regulations and dates must be indicated on cylinder. A star indicates that the cylinder testing may extend to 10 years.
- Do not attempt to repair a damaged cylinder. Only an authorized vendor may refill a compressed gas cylinder.
• Use only regulators that are designated for the specific gas you are using. Use only a CGA approved regulator. Match the number on the regulator with that on the valve stem. Regulators must be free of dirt, grease and other contaminants. Do not use Teflon or plumbers tape to correct a poor fit. Tape may disintegrate and contaminate the regulator fittings.

• Regulator and cylinder valve must be closed when attaching regulator. Do not over-tighten valves. Hand tighten only.

• Stand to the side of the cylinder when opening the regulator. Open valves only enough to allow a flow of gas necessary for the desired pressure.

**Leaks and Uncontrolled Release**

• Use a leak detector such as “Snoop” to detect leaks on cylinder valves and regulators. Do not use a leaking cylinder or regulator. Do not attempt to repair a leaking cylinder valve. If it is safe to do so, move leaking cylinder, to loading dock or other well-ventilated area where it may be safely secured. Call vendor for replacement.

• If leaking gas is flammable post signs in area that warn of potential fire hazards and importance of the elimination of ignition sources. If leaky flammable gas cylinder cannot be moved safely, extinguish any open flames and evacuate area. Do not turn off lights or other electrical equipment as this may cause arcing, therefore creating a source of ignition. If ignition occurs do not try to extinguish flame unless gas source may be shut off safely. If gas source may not be stopped, evacuate area and call for emergency assistance.

Leaks of corrosive and toxic gases require immediate evacuation of the area. If possible, direct leaking gas in to a fume hood. If building evacuation is necessary, fire alarms may be activated.

**Emergency**

An emergency is defined as a release of gas that cannot be stopped by closing the cylinder valve. An emergency may require assistance of fire department and hazardous materials teams. It may involve the rescue of injured people by specially trained responders who are equipped with proper PPE, including self-contained breathing apparatus.

**First Aid**

For inhalation exposure move victim to fresh air. Seek medical assistance if symptoms continue. For exposure to toxic or corrosive gasses, seek medical attention immediately.

*Any exposure with a particularly hazardous chemical requires medical attention! Report exposures to Chemical Hygiene Officer and Campus Safety Coordinator. For emergency medical response, dial extension 72000 from a campus phone. Provide responder/physician with a copy of the SDS.*
Appendix H: Cryogen Safety

Cryogenic materials are defined as solidified or liquid gases at extremely low temperatures. Cryogenic liquids boil at temperatures at or below -150°C. Examples include liquid nitrogen, liquid helium, and liquid oxygen. Small amounts of cryogenic liquid can expand into large volumes of gas. The volume of gas to liquid expansion volume ranges from 650 to 1500 units of volume gas to 1 volume liquid (1500:1). Sublimation of cryogenic solids (solid to gas phase) occurs from -78.5°C to -109.3°C. Dry ice (carbon dioxide) is an example of a cryogenic solid.

Hazards

Hazards of cryogens include tissue damage similar to thermal burns. Eyes are extremely susceptible to cryogen damage. If the liquid boils to the gas phase and is released into the air in a confined space, oxygen displacement may occur resulting in asphyxiation. Cryogens stored in pressurized containers must be equipped with pressure release valves to prevent container failure due to rapidly expanding gas and pressure build up.

Use cryogenic materials in well-ventilated areas.

Cryogenic baths should be open to the atmosphere to avoid pressure build up.

When transporting liquid cryogens use a dewar with a cap that allows for the escape of built-up pressure but keeps air and moisture out. Special transport dewars are built for this purpose. Fill only to 80% capacity.

Dewars should be wrapped in heavy tape to shield from possible explosion and propulsion of glass shards.

Liquid oxygen must be used away from open flames and combustible materials. Some cryogenic liquids such as helium and nitrogen have the potential to cause the accumulation and condensation of liquid oxygen from the atmosphere causing liquid oxygen enrichment. Enriched oxygen environments increase fire danger.

Do not tamper with, disable, or remove pressure relief devices on cryogen containers. Do not touch cryogenic materials or items cooled with cryogenic materials with bare hands. Use tongs or similar implements to handle cryogenically cooled items.

Personal Protective Equipment

Personal protective equipment includes safety glasses or chemical splash goggles and lab coat. Face shield must be worn when transferring cryogenic material from a pressurized dewar. Attire must include long pants that do not have cuffs. Cuffs may trap cryogenic material causing burns. Shoes must cover entire foot and must not be made of a fabric or mesh type material.

Wear thermal insulated gloves when handling cryogenics. These are intended for incidental contact and not for immersion.
Spills/Uncontrolled Release

If a large spill occurs or a dewar leaks uncontrollably, evacuate the area and notify campus safety ex 72000. Rapid gas expansion may create an oxygen deficient atmosphere.

Waste Disposal

Do not dispose of excess dry ice or cryogenic liquids in sinks. Thermal shock may damage pipe system. Allow small amounts of excess materials to evaporate naturally.

First Aid

For frostbite, warm area with warm, not hot water. Do not rub affected area. For splashes to the eyes use eyewash for 15 minutes to warm affected area. Safety showers may be used in the event of large body area contact. Remove affected clothing before using safety shower. Keep victim at normal body temperature until responders arrive. Report exposures to Chemical Hygiene Officer and Campus Safety Coordinator. For emergency medical response, dial extension 72000 from a campus phone. Provide responder/physician with a copy of the SDS.
Appendix I: Spill Response Procedures

CONSIDER SAFETY FIRST! DO NOT JEAPORDIZE YOUR SAFETY!

DO NOT ATTEMPT TO CLEAN A SPILL OF AN UNKNOWN MATERIAL OR IF YOU ARE NOT CERTAIN HOW TO PROCEED!

DO NOT ATTEMPT TO CLEAN A LARGE OR COMPLICATED SPILL, OR 100 ML OR MORE OF A PARTICULARLY HAZARDOUS LIQUID OR 50 G OR MORE OR A PARTICULARLY HAZARDOUS SOLID OUTSIDE OF FUME HOOD! ACUTELY HAZARDOUS MEANS HAVING AN LD50 OF 50 MG/KG BODY WEIGHT OR LESS FOR ORAL EXPOSURE, AN LC50 OF 200 PPM OR LESS FOR A GAS OR VAPOR, 200 MG/KG BODY WEIGHT OR LESS FOR SKIN CONTACT, A REGULATED, LISTED, OR SELECT CARCINOGEN, OR A REPRODUCTIVE HAZARD. THIS DEFINITION ALSO INCLUDES HIGHLY REACTIVE, PYROPHORIC, OR WATER REACTIVE CHEMICALS. CALL THE CHEMICAL HYGIENE OFFICER FOR ASSISTANCE IN THESE SITUATIONS.

CONTAIN SPILL, IF SAFE TO DO SO, USING DIKES OR SPILL PILLOWS!

NOTIFY OTHERS WHO MAY BE AFFECTED!

SEEK ASSISTANCE!

BASIC CLEANUP PROCEDURES

- Don appropriate PPE, including shoe covers if spill is on floor.
- Contain material with spill pillows or dike tubes.
- Administer chemical exposure first aid, and call for emergency response, if warranted.
- Notify others in close proximity who may be affected by fumes or secondary hazard. Evacuate area if necessary. Notify your supervisor.
- Call Chemical Hygiene Officer or Laboratory Manager if spill is toxic or fumy and occurs outside of hood.
- If broken glass is involved, use tongs or scoop to place it in bag, then place bag in sturdy cardboard box or other rigid container. Glass must not be placed in laboratory broken glass bin unless free of contamination.
- Use appropriate media to absorb or neutralize spill.
- Use broom and dust pan to sweep absorbed or neutralized material, or use tongs to retrieve soaked spill pads.
- Place absorbent materials in hazardous materials bag.
- Clean spill area with detergent such as Simple Green, and water.
- All tools used in cleanup must be decontaminated using a wet paper towel or kimwipe. Place kimwipe in hazardous waste bag.
• Rinse tools and resusable gloves with copious amount of water, air dry, and return to spill kit.
• Place disposable personal protective equipment (PPE) such as shoe covers, gloves, and disposable lab coats in hazardous materials bag.
• Seal the hazardous materials bag with heavy tape and label appropriately as hazardous waste.
• Restock spill kit items.

Flammable liquids:
• Control ignition sources such as heating mantles, hot plates, open flames. Remember that vapors can travel a distance and flash back.
• Lay chemical spill pads over spill, or use adsorbent spill powder for flammables. Sand or vermiculite also work well. Begin by sprinkling powder on outside perimeter of spill, working your way towards the middle until it is completely covered.
• **DO NOT USE PAPER TOWELS TO ABSORB FLAMMABLE LIQUIDS!** Paper towels increase vapor pressure and therefore increase fire danger.
• If powdered adsorbent or sand has been used, sweep into dust pan and place in hazardous materials bag.
• Pick up soaked pad with tongs and place in hazardous materials bag.
• Wipe down area with detergent, water, and paper towel. Dispose cleanup materials in hazardous materials bag along with soaked pads or absorbent powder.
• Seal bag with tape and label with a proper hazardous waste label.

Solid Materials
• Use plastic scoop to place spilled material into hazardous materials bag. Care should be taken not to create dust or cause solid material to become airborne.
• After the bulk of the material has been cleaned up, sweep of the remaining material.
• Use a wet paper towel to wipe down the area. Dispose of the paper towel in the hazardous material bag.
• Seal the bag and label with the proper hazardous waste label.

**Mercury Spill Cleanup**

**Do not mix mercury waste with other waste streams.**

Most mercury spills occur when a thermometer is broken. Today non-mercury thermometers are readily available and their use is encouraged whenever possible. Spilled mercury typically forms bead-like droplets that roll and scatter. These droplets have the potential to hide in cracks and crevices, perhaps going unnoticed. Mercury vaporizes readily and is thus inhalable. Mercury is a known neurotoxin. Symptoms of acute mercury poisoning include tightness in chest, cough, headache, gastrointestinal
symptoms, and malaise. Chronic symptoms due to unchecked vaporization of spills include behavioral changes, fatigue, weight loss, gastrointestinal dysfunction, memory loss, and insomnia. Thorough cleanup of a mercury spill is crucial.

**Small Spills (i.e. Broken Thermometer)**

1. Set up a perimeter of at least 3 feet. Persons not involved in spill cleanup must be kept out of perimeter area to keep from tracking through spill and possibly spreading contamination. Determine if mercury was tracked away from spill site. Post chemical spill signs or barricade tape.

2. Remove all metal jewelry. Don disposable nitrile gloves. If spill is on the floor, don shoe coverings. Anyone who has walked through potential spill area, or whose clothing has become contaminated must remain in area. Contaminated clothing must not be washed in a home washing machine as this will contaminate the home with mercury. Contaminated clothing and footwear must be bagged and discarded as hazardous waste.

3. Shine a flashlight in many directions and angles to locate all beads of mercury. It may be helpful to turn off lights when this task is performed.

4. Using an index card, scrape together beads of mercury. Never use a household vacuum or broom to sweep up mercury. This would disperse mercury droplets into the air and cause more widespread contamination. Use care to avoid scraping mercury into cracks and crevices. Duct tape may also be used to collect mercury beads.

5. If broken glass is involved, carefully pick up glass using tongs. Place glass pieces on paper towel. Fold paper towel and place in zip lock bag. Collected mercury and contaminated glass must be disposed as hazardous waste. If cleanup involves broken glass, place zip lock bag containing broken glass into a rigid container such as a cardboard box such that glass does not poke through the plastic.

6. Beginning from outside of mercury pile, sprinkle mercury spill powder over mercury. Use a damp sponge or water from spray bottle to moisten mercury and powder. Scrub to make a paste. The powder and mercury will form a less hazardous amalgam. Scoop up amalgam into plastic zip lock bag or hazmat bag. Double the zip lock bag or place in a glass jar, as vapors may escape the through the plastic bag.

7. Label container with a hazardous waste label.

8. Store container in fume hood and arrange pickup with the Chemistry Department Stockroom, ex 74957.

**Large Spills**

For large spills of a pound or more of mercury (approximately 2 tablespoons), evacuate area and contact campus safety. Only persons wearing respirators equipped with mercury vapor cartridges may clean up large mercury spills. Open windows to ventilate area. Call F&M to shut down any recirculating ventilation. Do not re-enter area until it has been determined that vapor concentrations are under the permissible exposure limit (Cal OSHA 0.025mg/m3)
In the event of a mercury spill on carpet, the carpet may have to be removed and disposed as hazardous waste. This is dependent on mercury vapor determinations in the contaminated area.
Appendix J: Peroxides Formers

The following is a list of chemicals known to form explosive peroxides and hydroperoxides when exposed to air over time. Peroxides may form upon concentration during laboratory activities, evaporation, or polymerization. These chemicals must be dated upon arrival in the laboratory, and again when initially opened. Bottles should be visually inspected for crystallization, discoloration, or liquid stratification before each opening. A flashlight should be used to inspect amber bottles. Bottles with obvious crystal formation should not be opened or moved. In this case, notify the Chemical Hygiene Officer for assistance. Test for peroxide formation prior to performing distillation or evaporation procedures. Bottles in use should be periodically tested for peroxides using test strips. Test strips are available in the Chemistry Stockroom. There should never be an attempt to force open a stuck cap. Only bottles of which the age and identity is known should be opened and tested. Order chemicals with inhibitors whenever possible. Ethers should be purchased in iron containers. Never dispose of peroxide formers down the drain!

Peroxide Formers Upon Concentration (Test or dispose within 12 months)

<table>
<thead>
<tr>
<th>Acetal</th>
<th>Ethylene Glycol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetaldehyde</td>
<td>Diethyl Ether</td>
</tr>
<tr>
<td>Benzyl Alcohol</td>
<td>Furan</td>
</tr>
<tr>
<td>2-Butanol</td>
<td>Methyl Isobutyl Ketone</td>
</tr>
<tr>
<td>Cyclohexene</td>
<td>Methyl Cyclopentane</td>
</tr>
<tr>
<td>Cumene</td>
<td>4-Pentene-1-ol</td>
</tr>
<tr>
<td>Decahydronaphthalene</td>
<td>Tetrahydrofuran</td>
</tr>
<tr>
<td>Dicyclopentadiene</td>
<td>Tetrahydronaphthalene</td>
</tr>
<tr>
<td>Diethyl Ether</td>
<td>Isopropyl Ether</td>
</tr>
</tbody>
</table>

Auto Polymerization due to Peroxide Formation (Test or dispose within 24 hours if not inhibited, 12 months if inhibited)

| Acrylic Acid      |
| Styrene           |

Forms Explosive Polymerization Without Concentration (Dispose of within 3 months)

| Potassium Metal   |

This list is not exhaustive. Investigators should check the SDS on any chemical used for information on chemical stability and peroxide formation.
## Appendix K: Protective Gloves/Chemical Compatibility

<table>
<thead>
<tr>
<th>Material (nondisposable)</th>
<th>Generally suitable for:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butyl rubber</td>
<td>aldehydes, carboxylic acids, glycols and ethers, hydroxyl compounds and alcohols, peroxides, ethyl acetate halogenated hydrocarbons (methylene chloride), ketones</td>
</tr>
<tr>
<td>Latex</td>
<td>water soluble/miscible substances, weak acids, weak alkalis, however not recommended for use due to allergenicity.</td>
</tr>
<tr>
<td>Natural Rubber</td>
<td>acetone, alcohols, acids and caustics, ammonium fluoride, dimethyl sulphoxide (DMSO), phenol, plating solutions</td>
</tr>
<tr>
<td>Neoprene</td>
<td>alcohol, alkalis and caustics, allosolve, degreasing solvents, mineral acids, oils, plating solutions</td>
</tr>
<tr>
<td>Nitrile rubber</td>
<td>alcohols, ammonium fluoride, freons, hexane, hydrofluoric and hydrochloric acid, perchloric acid, potassium and sodium hydroxide</td>
</tr>
<tr>
<td>Nomex</td>
<td>Phyrophoric chemicals and temperature extremes. Disposable nitrile gloves may be worn under Nomex gloves.</td>
</tr>
<tr>
<td>Poly vinyl alcohol (PVA)</td>
<td>methylene chloride</td>
</tr>
<tr>
<td>Silvershield ™</td>
<td>Most hazardous chemicals, highly toxic materials, materials that may be absorbed through skin. May be worn under butyl gloves for more dexterity.</td>
</tr>
<tr>
<td>Vinyl (PVC)</td>
<td>General prevention of contamination, medical examination, nuisance materials</td>
</tr>
<tr>
<td>Viton ™ (Fluorinated Rubber)</td>
<td>Chlorinated (methylene chloride) and aromatic solvents (benzene).</td>
</tr>
</tbody>
</table>

Known suppliers of protective gloves such as Ansell provide information in their product catalogs regarding chemical compatibility of various types of protective gloves. Visit [www.ansellpro.com](http://www.ansellpro.com) for information on chemical resistance of gloves. **For most laboratory use, gloves provide a barrier only. Disposable gloves should be discarded immediately after contamination. Extra protection may be provided by double gloving disposables.**
Appendix L: Perchloric Acid Fume Hoods and Test Procedures

Perchloric Acid Fume Hoods shall comply with section 6 – 12 of the National Fire Protection Association Code, no 45.

For access to NFPA codes and standards go to the National Fire Protection Association’s website at www.nfpa.org.

Warning! Where perchloric acid is heated above ambient temperature, process vapors should be scrubbed or trapped prior to exhausting to the hood. Perchloric acid vapors that have not been captured can condense in a fume hood's ductwork and form explosive perchlorates.

Perchloric acid should be heated only in hoods where the ducts are clean and free of organic materials and there is no possibility of the contamination of the solution.

Chemical Hood Perchloric Acid Test Procedures

To avoid the possibility of explosive perchlorates forming in fume hood ductwork, perchloric acid hoods should be washed down after each use and the final rinsate inspected using a 0.4 % (v/v) solution of methylene blue in water.

Note: Upon testing the rinsate with the 0.4% solution of methylene blue (if perchlorates are present) a violet precipitate will be formed.
Appendix M: Chemical Inventories

Chemical Inventories are maintained using the service provider MSDS Online. Chemical inventory may be accessed by contacting the Chemical Hygiene Officer at extension 74217. Newly acquired chemicals will be added to the inventory upon receipt by the Chemistry Department Stockroom Manager. Laboratory supervisors should reconcile their inventories annually. Inform the Chemistry Department stockroom manager at ex 72057 when a chemical has been used up or is to be disposed as hazardous waste.

For additional information on chemical inventory in each department, contact:

- Biology Department: Elaine Guerra/Laboratory Manager, Olin1258A
- Chemistry Department: Daniel Guerra/Laboratory Manager, Jacobs 2310
- Engineering Department: Sam Abdelmuati, Department Manager, Parsons B174
- Physics Department: BJ Hadad, Laboratory Manager, Jacobs B122
Appendix N: Chemical Storage

Certain chemicals may react with each other and create hazards, such as fire or generation of toxic gases. Separate storage areas **must** be provided for incompatible chemicals. The following are guidelines only. Consult container labels and SDSs for further information on chemical incompatibilities and storage.

<table>
<thead>
<tr>
<th>Chemical Class</th>
<th>Keep out of contact with:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Sulfuric, Nitric, Perchloric*)</td>
<td></td>
</tr>
<tr>
<td>(Hydrochloric Acid, Hydrofluoric Acid,</td>
<td></td>
</tr>
<tr>
<td>Phosphoric Acid)</td>
<td></td>
</tr>
<tr>
<td>Organic Acids</td>
<td>Mineral Acids (oxidizing and non-oxidizing), Alkalis, Oxidizers, Water Reactives</td>
</tr>
<tr>
<td>(Acetic, Butyric, Formic, Propionic)</td>
<td></td>
</tr>
<tr>
<td>(Sodium Hydroxide, Ammonium Hydroxide,</td>
<td></td>
</tr>
<tr>
<td>Gluteraldehyde)</td>
<td></td>
</tr>
<tr>
<td>Oxidizers</td>
<td>Organic Acids, Organic Solvents</td>
</tr>
<tr>
<td>(Hydrogen Peroxide, Permanganates,</td>
<td></td>
</tr>
<tr>
<td>Persulfates, Chlorates, Perchlorates)</td>
<td></td>
</tr>
<tr>
<td>Organic Solvents</td>
<td>Mineral Acids (oxidizing and non-oxidizing), Alkalis, Oxidizers,</td>
</tr>
<tr>
<td>(Acetone, Ethyl Acetate, Methanol,</td>
<td>overhead fire sprinklers</td>
</tr>
<tr>
<td>Hexanes, Toluene)</td>
<td></td>
</tr>
<tr>
<td>Water/Air Reactives</td>
<td>Organic Acids, Mineral Acids, Alkalis, Oxidizers,</td>
</tr>
<tr>
<td>(Sodium Borohydride, Calcium Hydride,</td>
<td>overhead fire sprinklers</td>
</tr>
<tr>
<td>Lithium Aluminum Hydride, Ammonium</td>
<td></td>
</tr>
<tr>
<td>Nitrate, sodium metal, potassium</td>
<td></td>
</tr>
<tr>
<td>metal)</td>
<td></td>
</tr>
<tr>
<td>Toxic/Poisonous Compounds</td>
<td>Organic Acids, Mineral Acids, Alkalis, Oxidizers,</td>
</tr>
<tr>
<td>(Heavy Metals, chloroform, carbon</td>
<td>Flammables</td>
</tr>
<tr>
<td>Tetrachloride, Ethidium Bromide)</td>
<td></td>
</tr>
</tbody>
</table>

*Perchloric Acid must be isolated from combustibles such as wood and paper. Never store on wooden shelves. Provide secondary containment such as a polyethylene tub.*
Appendix O: Personal Monitoring

Personal Monitoring is to be performed wherever processes may involve potential exposures at or above the Cal-OSHA established PELs (permissible exposure limits)

Where carcinogens are involved in the process the Cal-OSHA action level (AL) must be evaluated. If the process remains unchanged and exposure does not meet or exceed the AL, no further monitoring is required.

Ordinarily the PEL (permissible exposure limit), the TLV (threshold limit value) and STEL (shorter-term exposure limit) for a particular chemical may be found by referring to the material safety data sheet for that chemical.

Cal-OSHA Regulated Carcinogens and Action Levels

Acrylonitrile 1 part per million
Arsenic, Inorganic 0.005 milligrams per cubic meter
Benzene 0.5 ppm
1,3-Butadiene 0.5 part per million where concentrations are 0.1% or more by volume
Cadmium 2.5 micrograms per cubic meter
Chromium (VI) 2.5 micrograms per cubic meter
Coke Oven Emissions
1,2 Dibromo-3-Chloropropane 1.0 parts per billion
Ethylene Oxide 1 part per million
Ethylene Dibromide 15 parts per billion
Formaldehyde 0.5 parts per million
Lead 50 micrograms per cubic meter
Methylene Chloride 12.5 parts per million
4,4 Methylenebis (2 Choroanilinilne) urine conc. of 100 micro grams per liter
Methylenedianiline 5 parts per billion
Vinyl chlorde 0.5 parts per million
Appendix P: Hazardous Waste Characteristics

The Environmental Protection Agency and the California Code of Regulations, Title 22 address characterizations of waste streams. Title 22, Appendix X lists hazardous wastes and materials. A waste is defined as hazardous if it is listed by the California Code of Regulations or the Environmental Protection Agency; shown through testing or experience to be a carcinogen, mutagen, teratogen, chronic toxin, bioaccumulative or environmentally persistent; or it exhibits one of the following characteristics:

Ignitable: A liquid with a flash point lower than $60^\circ$ C, or if not liquid but capable of causing fire through friction, absorption, or moisture, or spontaneous chemical changes, or is an oxidizer, or an ignitable compressed gas.

Corrosive: Has a pH of less than or equal to 2.0 or greater than or equal to 12.5, or is not aqueous, but when mixed with an equivalent weight of water produces a pH of less than or equal to 2.0 or greater than or equal to 12.5, or corrodes steel at the rate of 6.35 mm (0.250 inch) per year at a test temperature of 55°C.

Reactive: Reacts violently with water or generates toxic gases when mixed with water, or is capable of detonation if subject to strong initiating source or heated under confinement, or is capable of detonation at standard temperature and pressure.

Toxic: As determined by Toxic Characteristic Leaching Procedure (TCLP) or contains substances listed as toxic by the EPA in concentrations greater than or equal to the soluble threshold limit as defined in 22 CCR 66261.24, or has been shown through experience or testing to pose a hazard to human health or environment because of its carcinogenicity, acute or chronic toxicity, bioaccumulative properties, or persistence in the environment.

Used petroleum or lubricating oil or materials that are contaminated with oil are hazardous waste in the State of California.

Waste is always presumed to be hazardous unless it can be proven otherwise via process knowledge or laboratory evaluation of the waste product.
Appendix Q: Sharps Disposal

Definition: Sharp waste is defined by the State of California as “any device having acute rigid corners edges, or protuberances capable of cutting or piercing.” This includes, but is not limited to hypodermic needles, hypodermic needles with syringes, needles with attached tubing, and blades. Also included are broken glass items, Pasteur pipets, pipet tips, and slides.

Non-Contaminated (non-regulated) Sharps
Non-contaminated sharps are any item defined as a sharp that has not been contaminated with a biohazard or a hazardous chemical.

Non-contaminated sharps must be disposed of in a rigid container. Biohazard labels on the container must be obscured. Label should read “non-regulated sharps.” When container is ¾ full it should be sealed with tape and disposed in regular trash.

Hypodermic needles and syringes must be disposed of in a rigid sharps disposal container, even if they have no hazardous contaminants. They may not be placed in the regular trash bins.

Clean glass for disposal should be placed in a cardboard glass collection bin. Pasteur and serological pipets are considered “clean” if they have been triple rinsed with a material capable of removing contamination. Containers from chemical suppliers must be triple rinsed and the label defaced before placing in the clean glass bins Chemically contaminated rinsate should be placed in a hazardous waste container. When full the glass collection bin must be securely taped on all sides including the bottom for increased support. Glass collection bins may be disposed in the regular trash bins.

Chemically Contaminated Sharps
Any sharp such as syringe, needle, or pipet tip which has contained a hazardous chemical must be disposed of as chemical hazardous waste. Chemically contaminated sharps must be disposed of in a rigid plastic sharps container with the biohazard label covered. Sharps contaminated with biological and chemical hazards must be disposed of as hazardous chemical waste. A hazardous waste label must be secured on the container listing the full chemical names of materials held within the sharps as well as the date that the container was started. Chemical hazardous waste containers must be closed when material is not being added. When the container is ¾ full, contact the Chemistry Department Stockroom for pickup. Containers for collection of chemically contaminated sharps should be located in the vicinity of the work being performed. All hazardous waste regulations apply.

Biohazard Contaminated Sharps
Any sharp contaminated with a biohazard must be disposed of in a rigid plastic sharps container labeled with a biohazard sign. When the container is ¾ full notify Elaine Guerra, Biology Department Lab Manager. The container will be rendered noninfectious and disposed of as solid waste.
Appendix R: Training Outline/Basic Chemical Hygiene Program Orientation

Identifying the Chemical Hygiene Officer by name and title.
1. A general overview of the chemical hygiene program.
2. Contents of CCR Title 8 Section 5191, *Occupational Exposure to Hazardous Chemicals in the Laboratory*, (The Lab Standard).
3. A review of general laboratory safety procedures as outlined in Chemical Hygiene Plan.
4. Hazard communication including routes and symptoms of chemical exposure.
5. Explanation of safety data sheets and where to locate them.
6. A review of program appendices and specialized information sections.
7. Identification of personal protective clothing and PPE requirements.
8. Instructions on the proper use of PPE.
9. Instruction on proper use of fume hoods.
10. A review of personal and environmental monitoring requirements
11. General first aid for chemical exposure including the use of safety equipment and evacuation procedures.
12. Spill cleanup procedures
13. Spill cleanup procedures

Additional trainings may be performed as requested. These may include GHS Hazard Communication Training, Respirator Fit Testing, Radiation Safety Training, Autoclave Training, and Hazardous Waste Training. Contact the Chemical Hygiene Officer for information on these trainings.

Laboratory supervisors are responsible for laboratory specific standard operating procedure training. This training must be documented with signatures. Records will be maintained by the laboratory supervisor.

All introductory and in-service training will be documented and the training records for each HMC employee will be maintained by the Chemical Hygiene Officer and individual supervisors.
Appendix S: Developing Laboratory Specific Standard Operating Procedures

It is the responsibility of principal investigators to train researchers under their supervision in standard operating procedures (SOPs) specific to the materials and equipment used. PIs must carefully perform hazard analyses in the course of research planning. Risks must be mitigated through establishment of laboratory administrative controls, training, and proper use of protective equipment. SOPs consist of written instructions that clearly identify hazards, and include step by step instructions for safe performance of tasks with chemicals or equipment. SOPs may be developed for specific chemicals, equipment, or entire procedures. SOP training must be documented with signatures and be kept available in the laboratory for reference.

The American Chemical Society has published “Identifying and Evaluating Hazards in Research Laboratories.” This guide for hazard assessment and sop development may be accessed by the following link:


A template for SOP development follows. However, any format that includes the information as outlined is acceptable.

A library of chemical SOPS has been developed and is maintained by the Chemical Hygiene Officer. The Chemical Hygiene Officer may assist in SOP development upon request.
Laboratory Specific Standard Operating Procedure

(Photocopy as needed)

For: (specify experiment, chemical, or instrument/equipment)

________________________________________________________________________

Department: __________________________ Room: ______________________

Laboratory Supervisor: _________________________________________________

SOP Type (Check all that apply)

Procedure____  Hazardous Chemical____  Instrument or equipment____

List chemicals to be used, physical hazards (corrosive, ignitable, reactive, toxic), and health hazards (i.e. hepatotoxin, reproductive toxin, hemotoxin, neurotoxin, irritant, sensitizer). Indicate GHS classifications.

Other hazards (moving parts, pinch points, heat, noise)

Frequency and duration of chemical use, if applicable:
Protective Equipment (goggles, gloves, lab coat, fume hood)

*Specify most suitable gloves as indicated in SDS:*

Describe any special handling procedures for the above listed chemical(s)
(attach extra page if necessary):

Process, experiment description (Attach separate page if necessary)
ACCIDENTAL RELEASE MEASURES:
For spills of 1 liter or less, notify lab occupants, evacuate lab area if spill is outside of fume hood. Don appropriate personal protective equipment. Place diking tubes around spill if there is a danger of chemical entering floor drains or sinks. Absorb with spill pillows. Using tongs, place contaminated spill pillows in hazardous waste bag and label appropriately. Clean spill area with detergent and water.

For incidental drips or spills in work area, clean promptly using a kim wipe. Dispose of cleaning materials as hazardous waste. Wipe area with detergent and water.

For complicated or large spills outside of the fume hood, dike spill if possible and evacuate lab. Contact your supervisor and Chemical Hygiene Officer. A contracted hazardous materials team will be called to clean spill.

DO NOT ATTEMPT TO CLEAN A SPILL OF A MATERIAL OF WHICH YOU ARE UNFAMILIAR, OR IF YOU ARE UNSURE OF CLEANUP PROCEDURE. CONTACT YOUR SUPERVISOR OR CHEMICAL HYGIENE OFFICER.

FIRST AID MEASURES:
Call ext. 72000 from campus phone, or (909) 607-2000 from a mobile phone if immediate medical attention is required. For employee injury, which is not an emergency, obtain authorization from the Workers Comp & Disability Office Ext 18847 or 77946. Seek treatment at Concentra Medical, 9405 Fairway View Place, Rancho Cucamonga, (909) 481-8661 or US Healthworks, 801 Corporate Center Dr. #130, Pomona, (909) 623-1954. An accident report must be filed within 48 hours. For student injuries, notify DOS (ext. 18125). An accident form may be found at the following link: https://www.hmc.edu/emergency-preparedness/employee-safety/

SKIN EXPOSURE:
Minor skin contact, wash with soap and water, rinsing for 15 minutes. For major skin exposure, remove contaminated clothing and wash under safety shower for 15 minutes. Seek medical attention.

Seek medical assistance in case of large body exposure.
**EYE EXPOSURE:**
Remove contact lenses. Rinse eyes using eyewash or sterile saline for 15 minutes. Seek medical attention.

**INGESTION:**
Rinse mouth with water. Do not give anything by mouth to an unconscious person. Do not induce vomiting. Seek medical assistance.

**INHALATION:**
Remove victim to fresh air. Seek medical attention.

**INJECTION:**
Wash injection site thoroughly. Seek immediate medical attention.

Specific chemical antidotes, if any:

**WASTE DISPOSAL PROCEDURES:**
Dispose of as hazardous waste in a container that has been appropriately tagged with an HMC waste label. Obtain label from the Chemistry Department stockroom. Do not dispose of materials contaminated with chemicals in the sink or regular trash cans. Contaminated glassware must be triple rinsed with rinsate capable of removing the chemical and rinsate poured in to waste bottle. Triple rinse glass Pasteur pipets into waste container before discarding in glass waste bin. Contaminated lab debris such as pipet tips and wipes must be bagged and tagged with hazardous waste label.
# STANDARD OPERATING PROCEDURE TRAINING

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HMC Chemical Hygiene Plan, Revised 11 October 2017
### Annual Review: Chemical Hygiene Plan

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