Chemical Hygiene Plan

Santa Clara University (SCU)
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Program Review Record

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Program Approval

Signature on file in EHS office	9/30/2014
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Chemical Hygiene Plan

1. Purpose

The Chemical Hygiene Plan describes procedures, equipment, personal protective equipment, and work practices for protecting employees from the potential health hazards in Santa Clara University (SCU) laboratories. This Plan is primarily intended to meet the requirements of the California Occupational Safety and Health Administration (Cal-OSHA), California Code of Regulations, Title 8, Section 5191, "Occupational Exposure to Hazardous Chemicals in Laboratories." A copy of the standard is available for review in the EHS Office or at http://www.dir.ca.gov/Title8/5191.html.

A significant goal of this Chemical Hygiene Plan is to safely limit employees' exposure to OSHA-regulated substances through inhalation, ingestion, or dermal exposure[1]. The Plan is also designed to meet the following requirements:

- Fire Prevention Programs (8 CCR 3221), as the regulation applies to laboratories;
- Injury and Illness Prevention Plan inspection requirements (8 CCR 3203(a)(4)), as they apply to laboratories.
- Qualification of laboratory managers and employees to use laboratory chemical hoods and biological hoods and cabinets, as per 8 CCR 5154.1 and 5154.2.

2. Applicability

Employees. This plan applies to employees, including student employees, who work where "laboratory use" of hazardous chemicals occurs. Laboratory use of hazardous chemicals means handling or use of such chemicals in which all of the following conditions are met:

- The handling or use of chemicals occurs on a "laboratory scale," that is, the work involves containers that can easily and safely be manipulated by one person.
- Multiple chemical procedures or chemical substances are used, and
- Protective laboratory practices and equipment are available and in common use to minimize the potential for lab employee exposures to hazardous chemicals.

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[1] Specifically, Employees must not be exposed to substances in excess of the limits established by the California Code of Regulations, Title 8, Article 109, "Hazardous Substances and Processes" and the Permissible Exposure Limits (PEL) specified by 8 CCR 5155 "Toxic and Hazardous Substances." The list of Permissible Exposure Limits (PEL) for regulated substances is available for review in the EHS Department or at http://www.dir.ca.gov/Title8/5155.html. Permissible Exposure Limits refer to airborne concentrations of substances and are averaged over an eight-hour day. A few substances also have "action levels" that, if exceeded, trigger air monitoring and/or additional control measures. The potential for these levels to be exceeded are assessed through a Risk and Hazard Assessment process, which is used to evaluate the effectiveness of engineering controls (such as hoods) and/or to determine the need for additional protective measures.

In addition, employees must use proper Personal Protective Equipment (PPE) to prevent short-term exposure of skin or eye to chemicals. PPE equipment requirements are determined through an assessment process and are discussed in 8 CCR 3203 and 8 CCR 3380 – 3400.

Students. Students working in a laboratory where the laboratory use of hazardous chemicals occurs should be informed of and required to follow the General Laboratory Standards (Attachment 1) and any laboratory-specific operating procedures.

Non-Santa Clara University Employees. The SCU Office of Risk Management has policies concerning non-Santa Clara University employees working in University laboratories. Before persons from other universities, outreach programs, or similar operations are permitted to work in Santa Clara laboratories, Risk Management must be contacted to determine under what conditions such work is to be allowed. Any non- SCU employees working in a laboratory where the laboratory use of hazardous chemicals occurs should be informed of and required to follow the General Laboratory Standards (Attachment 1) and any laboratory-specific operating procedures. Visitors should also be required to follow the General laboratory Standards (Attachment 1) and not be left unattended in the laboratories.

3. Definitions

NOTE: The most pertinent definitions for all users are contained in Attachment 2. Review and use as necessary.

4. Roles and Responsibilities

The following are the SCU Roles and Responsibilities in regards to personnel working in laboratories subject to the Chemical Hygiene Standard:

Group	Responsibilities
Employees and Student Employees	Plan and conduct each operation in accordance with SCU's Chemical Hygiene Plan. Particularly, ensure that: ▪ Chemicals are stored, used, and disposed of as per standard operating procedures; ▪ PPE, as per the results of the PPE Assessment, is available and is worn. ▪ Appropriate handling and control mechanisms, as per the results of the Risk and Hazard Assessment, are employed. ▪ Potential sources of ignition and fuel are controlled as per this plan.
Supervisor (The direct supervisor of an employee who works where there is the use of hazardous chemicals. A supervisor cannot be a student employee.)	Ensure that employees know and follow the procedures in the chemical hygiene plan. ▪ Train employees in the specific work practices and procedures of their laboratory (as a good practice, keep records of this training). ▪ Ensure that PPE and other protective equipment defined in the PPE assessment and Risk and Hazard Assessment is available, in working order, and is used when required. ▪ Identify clearly to employees the circumstances and procedures that require prior approval of the supervisor. ▪ Approve student employees working alone in the laboratory.

Laboratory Supervisor (The individual who is in charge of a laboratory. It may be a Principal Investigator (PI), laboratory instructor, laboratory manager, or laboratory technician, or other designated personnel. The laboratory supervisor is appointed by the Department Chair.)	Ensure that any necessary **PPE Assessments** and **Risk and Hazard Assessments** have been conducted and any changes defined in the assessment have been implemented. ▪ Conduct semi-annual inspections of the laboratory and equipment. ▪ Participate in the semi-annual inspections by Chemical Hygiene Officer ▪ Ensure that all identified issues from these inspections are corrected expeditiously and that a record is kept of the identified issue and follow up actions. ▪ Provide custom **Standard Operating Procedures (SOP)** for any procedures not covered by the SOPs in this plan (Model SOP and SOP Template is provided in Attachments 5 and 6). ▪ Ensures that signage installed in the laboratory is visible and maintained. ▪ Ensures that there is effective fire prevention procedures and equipment in their laboratory as identified by EHS. ▪ Review with the CHO any chemical with NFPA hazard rating of 4 to determine if the Restricted Substances requirements apply.
Academic Department Chairs	▪ Designate Laboratory Supervisors as needed for each laboratory under their jurisdiction. ▪ Ensure that laboratories within their department meet the standards specified in this plan. ▪ Coordinates with CHO to determine appropriate actions if a Laboratory Supervisor does not complete corrective and preventive actions in a timely manner.
Facilities Department	▪ Maintains laboratory facilities and infrastructure, as per regulation and manufacturer specifications (lab hoods, electrical outlets, eyewashes and safety showers, fire extinguishers, sprinklers). ▪ Responds to identified deficiencies in facilities and infrastructure and services in a timely manner. ▪ Installs signage as directed by Chemical Hygiene Officer
Chemical Hygiene Officer (CHO)	▪ Conducts inspections of laboratories governed by this standard (jointly with Laboratory Supervisor). ▪ Conducts Risk and Hazard Assessments and PPE Assessments upon lab setup, any significant change in lab practices, every three years, or as requested by the Laboratory Supervisor. ▪ Keeps records of the implementation of corrective actions from the Assessments. ▪ Ensures the availability and presentation of training for employees. ▪ Defines signage requirements for each laboratory door and coordinates with Facilities to ensure the appropriate signage is installed. ▪ Assures that exposure assessments are conducted as requested or when need is identified.

Chemical Hygiene Officer (CHO) cont'd	▪ Provides assistance on proper signage. ▪ Provides chemical inventory printout, as needed. ▪ Provide guidance and support in resolving EHS-related issues ▪ Spot checks inspections to ensure that corrective/preventive actions have been taken and are properly documented. ▪ Coordinates with Department Chair to determine appropriate actions if a Laboratory Supervisor does not complete corrective and preventive actions in a timely manner. ▪ Preserves all employee exposure records in accordance with recordkeeping requirements. ▪ Performs an annual review of the effectiveness of the Plan and ensures that this program is kept up-to-date with regulatory requirements. ▪ Works with HR, as appropriate, to arrange employee medical consultations when requested.
EHS Director	▪ Appoints the CHO ▪ Oversees the transportation of hazardous materials on public road. ▪ Oversees environmental monitoring, surveillance, and records. ▪ Certifies employees to wear respiratory protection. ▪ Designates areas, activities, and tasks that require specific types of personal protective equipment as described above.
HR Department	▪ Works with the CHO, as appropriate, to arrange employee medical consultations when requested. ▪ Keeps medical consultation records in accordance with recordkeeping requirements

5. Requirements

General Laboratory Standards

General standards for laboratory work are contained in Attachment 1. The laboratory supervisor must follow and enforce these standards unless they have been superseded as the result of the **Risk and Hazard Assessment** discussed below.

PPE Assessments, Risk and Hazard Assessments

Each laboratory, including teaching laboratories, will be assessed by the Chemical Hygiene Officer for hazards and risks, using the SCU **Hazard Assessment Program**. This assessment will be done initially when a laboratory is set up, when a laboratory undergoes a major change in operations, when a laboratory has successive poor inspection results, and when the Chemical Hygiene Officer determines that the previous assessment needs to be supplemented or redone. The output of this Assessment will be a list of required personal protective equipment (PPE) to be worn during various operations along with specific SOP or risk management requirements related to both chemical and non-chemical risks.

The Laboratory Supervisor is responsible for implementing the results of the Assessments, drawing on the resources of EHS and Facilities, as needed, and informing the CHO of when corrective actions are completed. The CHO is responsible for keeping records of the Assessments of the actions taken to resolve them.

A general guide to PPE requirements is given in Attachment 3; these general requirements, along with general chemical SOPs discussed later, should be used in the absence of an alternative lab-specific PPE assessment and **Risk and Hazard Assessment** until one can be completed.

Administrative Controls

Chemical Inventory

All locations where chemicals are stored and/or used must have an inventory of the chemicals maintained currently in the University designated program. Responsibilities for each department/laboratory are defined in the SCU's **Chemical Inventory Management Program**. Print outs of the inventory are available from the departmental inventory coordinator (if applicable) or the CHO.

Inspections

Inspections are conducted using the web-based inspection tool LabcliQ. (EHS Website: Laboratory Inspections). Utilizing either the Laboratory Inspections checklist or the Shop Inspection checklist, the SCU Laboratories and/or Shops will be inspected according to the schedule and assignments:

Laboratory Type	**Frequency**	**Laboratory Supervisor Inspections**	**Joint Inspections** (Laboratory Supervisor and CHO)
Chemistry and other Laboratories/Shops designated higher hazard (by the EHS)	Each quarter except summer	Fall Quarter and Winter Quarter	*Spring Quarter
Laboratories and Shops (not designated higher hazard)	Annually	None	*Spring Quarter

* If there are significant issues identified during the Spring quarter joint inspections, then follow-up re-inspection may be required for Summary Quarter.

The Inspection Schedule for each year with the specific inspection months will be posted on the EHS website. The Laboratory Manager/Owner has the responsibility of following up and completing all corrective and preventive actions, using resources from Facilities and EHS as appropriate. LabcliQ will automatically maintain the inspection records consisting of; completed inspection checklists, what corrective actions were taken, dates of completion and who performed the actions. Unless given an exception, all corrective actions are to be completed within 30 days.

If corrective actions are not taken within required times, the CHO will consult with Department Chair to determine proper actions, up to shutting down work in the lab until the lab has come into compliance with the Plan.

Working Alone

Working alone in a laboratory requires the prior approval of the Supervisor who will be responsible for the safety of the employee. Advance planning should be made in these cases to address emergency response procedures and informing outside parties of the employee's work plan and schedule.

Other University Safety Programs

Laboratory personnel who work with biological agents and radioactive sources or radiation producing devices, are subject to the requirements of the University's **Biosafety Program** and **Non-Ionizing Radiation Safety Program**.

Engineering Controls

The best way to prevent exposure to airborne hazards is to prevent their escape into the working atmosphere by use of laboratory fume hoods, biological safety cabinets and other ventilation devices. Operations such as running reactions, heating or evaporating solvents, and transfer of chemicals from one container to another should be performed in a hood when there is reasonable potential for hazardous material exposure. The specific need for an engineering control is included in the laboratory **Risk and Hazard Assessment** process.

Laboratory Fume Hoods

The laboratory fume hood is the major protective device available to employees. Details to the SCU fume hood installation and maintenance program are contained in SCU's **Hoods, Spray Booths, and Local Ventilation Program**.

Prior to use of the fume hood for operations that might result in release of hazardous chemical vapors, gases, mists or dusts, the user must confirm adequate hood performance. A worker should maintain the hood sash at a working height below the sash mark when working in the hood; keep materials stored in hoods to a minimum and do not allow them to block air flow. Sashes may be temporarily raised above this height to allow materials and equipment to be removed or added to the hood. All chemicals and wastes located in the hood must be kept closed unless actively in use.[2]

An alarm or indicator must be present to show when hood velocity drops below the allowable level. The hood cannot be used without the alarm on and functioning. In the event of ventilation hood alarm or failure, stop all experiments within the hood (if possible), lower the sash completely, notify EHS (through the Facilities Service Desk at 554-4742) and submit a work order to Facilities if appropriate. When appropriate, a notice should be placed on the fume hood closed sash indicating that it is not to be used until its performance is within the specified performance parameters.

Face velocity and airflow monitors will be evaluated by Facilities upon installation of laboratory fume hoods. Each laboratory fume hood is certified annually and re-checked periodically, as needed, for usage and performance. Where performance parameters fall outside specifications, Facilities will ensure performance standards are met after each inspection.

[2] SCU's exemption from air permitting explicitly forbids using a hood to evaporate any chemicals or wastes.

Non-venting hoods (e.g., laminar flow hoods with in-room venting) shall be clearly labeled as such. No work with solvents or other volatile hazardous chemicals shall be performed in hoods that do not vent outdoors.

Other Local Ventilation Devices

Exhaust air from glove boxes and isolation rooms should release into the hood exhaust system.

Special Ventilation Areas

Procedures involving radioactive aerosols, powders or gaseous products, or procedures that could produce volatile radioactive effluents must be conducted in an approved hood, glove box, biosafety cabinet or other suitable closed system. Such ventilation systems shall be designed with smooth, non-porous materials and possess adequate lighting to facilitate work within. The hoods shall have a minimum face velocity of 100 lfpm across the face of the hood. Contact the Radiation Safety Officer for further information on hoods for radioactive materials.

Safety Shields, Barriers or Other Containment Devices

Safety shields, such as the sliding sash of a fume hood, or Plexiglas barriers are appropriate when working with highly concentrated acids, bases, oxidizers, reducing agents or radioactive materials, all of which have the potential for causing sudden spattering, explosive release of material or radioactive energy. Reactions carried out at non-ambient pressures (vacuum or high pressure) also require safety shields, as do reactions that are carried out for the first time or are significantly scaled up from normal operating conditions.

Other devices include the following:

- Other containment devices, such as glove boxes or vented gas cabinets, may be required when it is necessary to provide an inert atmosphere for the chemical procedure, when capture of any chemical emission is desirable, or when the standard laboratory fume hood does not provide adequate assurance that overexposure to a hazardous chemical will not occur. The presence of biological or radioactive materials may also mandate certain special containment devices.
- High strength barriers coupled with remote handling devices may be necessary for safe use of extremely shock sensitive or reactive chemicals.
- High localized exhaust ventilation, such as is usually installed over atomic absorption units, and may be required for instrumentation that exhausts toxic or irritating materials to the laboratory environment.
- Ventilated chemical storage cabinets or rooms should be used when the chemicals in storage may generate toxic, flammable, or irritating levels of airborne contamination.

Other Safety Equipment

Emergency Eyewash and Shower Equipment

Plumbed eyewashes must be present in or near all lab areas in which there is a potential for hazardous chemicals to be splashed into the eyes. A safety shower must be present in or near all lab areas in which there is a potential for toxicologically significant quantity of a hazardous chemical to be splashed onto the body.

Eyewashes and safety showers are to be installed with equipment complying with ANSI Z358.1-2004 (see SCU's **Emergency Eyewash and Shower Program**). Emergency eyewash facilities and deluge showers must be in accessible locations that require no more than 10 seconds to access and must not cause the injured person to pass through doorways unless the door opens in the direction of travel and cannot be locked. If both an eyewash and shower are needed, they are located so that one person can use both at the same time. The area of the eyewash and shower equipment must be maintained free of items that obstruct their use.

Laboratories for which eyewashes & showers are required that do not currently meet the standard for eyewash location must have "helper bottles" installed (the need for such bottles will be identified in the Risk and Hazard Assessment). When corrosive chemicals are in use, the laboratory door must be unlocked. Depending on the results of the Risk and Hazard Assessment, multiple persons may be required to be present in the lab (or, alternatively, a full eyewash and shower may need to be installed in the lab). As such laboratories are renovated; eyewashes and showers will be installed in the proper location to ensure compliance with the ANSI code.

Fire Extinguishers

A fire extinguisher must be present in or near each laboratory area. The fire extinguisher must be appropriate for the classes of fires possible in a particular laboratory. Employees who have been trained to use extinguishers may, at their comfort, use them to fight incipient fires. Personnel who have not been trained in extinguishers should evacuate rather than attempting to fight fires. As evacuating, activate the fire alarm at the pull station. Once clear of danger, notify the Fire Department by dialing 911 on any telephone then dial Campus Safety at x4444.

Physical, Chemical, and Health Hazards and Controls

Generalized safe approaches and **Standard Operating Procedures** (SOPs) for physical hazards are contained in Attachment 5, Attachment 6 (SOP Template at EHS Website: Laboratory Safety) and Attachment 7 (Fire Prevention).

It is prudent to minimize all chemical exposures by any route, and to observe good laboratory practice by using an exhaust hood, wearing eye and hand protection, and a laboratory coat or chemical apron. All work with these materials in a laboratory should be performed in such a way that they do not enter the body by inhalation, absorption, ingestion or injection. Quantities of vapors or dust should be prevented from entering the general laboratory atmosphere. Because few laboratory chemicals are without hazards, general precautions for handling all laboratory chemicals have been adopted in addition to the specific guidelines contained in Attachment 5 (Model SOPs). Supervisors may either use these model procedures or define and document their own procedures (Attachment 6 contains a SOP Template).

These general hazards for handling chemicals in the laboratory may be classified broadly as physical or chemical.

Certain chemical hazards are sub-classified as acute or chronic. Acute hazards are those capable of producing prompt or immediate effects (such as burns, inflammation, or damage to eyes, lungs, or nervous system). Some chemicals are extremely dangerous in this respect and a small amount can quickly cause death or severe injury. Other toxicological effects of chemicals may be delayed or develop only after exposure over long periods of time and are referred to as chronic hazards.

Corrosive Agents
Corrosive agents shall always be handled using personal protective equipment appropriate for the type of material, the quantity being used and the potential exposure route. This may include gloves, lab coat or protective chemical apron, goggles or face shields. Volatile corrosives shall be used in a fume hood when there is any potential for inhalation exposure. Be aware that many corrosive materials (i.e., hydrofluoric acid, phenol) exhibit additional hazards that must be addressed when they are used in the laboratory.

Handling Flammable and Combustible Materials
Do not use an open flame to heat flammable liquid or to carry out a distillation under reduced pressure. Use an open flame only when necessary, and extinguish it when it is no longer needed. Before lighting a flame, remove all flammable materials from the immediate area. Check all containers of flammable materials in the area to ensure that they are tightly closed. Store flammable materials properly. When volatile flammable materials may be present use only non-sparking electrical equipment. See the Attachment 7 on Fire Prevention within this plan for more details.

Explosive Controls

Safety shielding shall be used for any operation having the potential for explosion.

- When a reaction is attempted for the first time (in addition, small quantities of reactants should be used to minimize hazards).
- When a familiar reaction is carried out on a larger than usual scale (i.e., 5-10 times more material).
- When operations are carried out under non-ambient conditions.

Shields must be placed so that all personnel in the area are protected from hazards.

Chemical Management

Procurement of Chemicals

To minimize the presence of hazardous materials at SCU, chemicals should be ordered in the smallest quantity needed to conduct the work, considering overall cost and expected needs. Prior to ordering new chemicals, existing chemical stock on campus should be evaluated for use. For new chemicals that have not been previously used on campus, review the Restricted Substances information (Attachment 8) before acquiring in case prior CHO approval is needed. Consult the **SCU Chemical Donation Policy** and follow the policy requirements before accepting any chemicals for transfer to Santa Clara University from another University or organization.

Adhere to the **SCU Chemical Inventory Program** for the identification and management of chemicals onsite.

Stockrooms / Storerooms
Hazardous substances must be segregated by hazard categories, following manufacturer recommendations. Containers of Potentially Hazardous Substance materials should be placed in unbreakable secondary containers. Stored chemicals shall be examined periodically (at least annually) for replacement, deterioration, and container integrity.

If stockrooms and storerooms are to be used as preparation or repackaging areas, that information needs to be considered as part of the Risk and Hazard Assessment process to determine if appropriate engineering controls are present and what types of PPE would be appropriate in such operations.

Laboratory Storage

Storage in laboratories will follow these requirements:

- Incompatible chemicals are stored separately. Acids and bases are stored separately. Acetic acid is treated as a flammable rather than a corrosive. Compatibility information is available on the chemical's Material Safety Data Sheet.
- A FM or UL Listed flammable liquid storage cabinet must be used to store flammables.
- A corrosive storage cabinet is required for storage of acids and bases.
- Refrigerators used for storage of flammable liquids must be either listed as appropriate for flammable materials or rated as "explosion proof."
- Refrigerators must be labeled as No Food if storing chemicals or hazardous materials.
- Chemical storage in fume hoods and on bench tops is generally not permitted beyond enough to complete the current experiment.[3] Storage of hazardous waste is allowed in the fume hood if waste is deposited in the container at least once every week.
- To meet overall limits on storage under the fire code, no more than 1 gallon of flammable materials may be stored outside of a flammable cabinet or hood for more than a week without special permission.
- Hazardous chemicals (acids, bases, solvents, wastes) should be stored below eye level and in compatible secondary containment. To meet fire code requirements, all liquid and solid hazardous materials above NFPA 704 health, fire, or reactivity hazard class 3 & 4[4] must be stored in secondary containment of size sufficient to hold the contents of the largest single container.

Hazard Communication Labels

All Santa Clara University employees who work with chemicals must be familiar with conventions used for Hazard Communication through signs and labels. This information is provided in Attachment 9. Labels on incoming containers of hazardous chemicals are not to be removed or defaced until product is emptied from the container. All chemical containers shipped from the manufacturer, importer, or distributor will have the chemical name and hazard warning on the label of the container.

If chemicals are transferred from the original container, properly label the new container with the substance name, type of hazard, name of employee who prepared the container, and date of preparation.

If a chemical substance is synthesized in the laboratory, produced exclusively for the laboratory's use, the Laboratory Supervisor is responsible for determining if it is hazardous and labeling it appropriately. Santa Clara University's EHS department will, on request, work with the laboratory personnel to determine if it is a hazardous chemical and what labeling is appropriate

[3] The acceptability of small amounts of storage will be evaluated during the Risk and Hazard Assessment.

[4] The NFPA hazard classification system ("diamond") includes a rating (from 0 to 4) of the hazard of a chemical for health, fire, and reactivity. The higher the number, the more dangerous the chemical is in that category.

Specific Warning Signs and Labels

The CHO will define the requirements for posting of ensure that laboratories prominently post the following and ensure that Facilities provides signs that meet required posting:

- Emergency telephone numbers;
- Emergency Response Guidelines, as defined in the **Emergency Procedure Handbook**;
- Location signs for safety showers, eyewashes, fire extinguishers, and first aid equipment;
- Warning signs at areas or equipment where special or unusual hazards exist;
- Laboratory door safety signs that must be posted outside each laboratory, as per the local fire code, during the Risk and Hazard Assessment process.

The laboratory supervisor will ensure that such signs are maintained, are visible, and are kept current. The laboratory supervisor must contact the CHO if the sign needs to be updated due to changes in the type of chemicals that are used.

Globally Harmonized System / GHS

The GHS is a system for standardizing and harmonizing the classification and labeling of chemicals through the use of a standardized set of symbols. The symbols and their meaning are provided in Attachment 9.

Chemical Label Abbreviation

Chemical names should be fully spelled out on the container label unless your lab creates and manages its own list of agreed-upon chemical abbreviations for use on container labels. Use SCU chemical container labels and hazardous waste labels supplied by your Lab Manager or Technician or EHS. Abbreviations must appear on this list to be used in your lab. This list must be on display near the lab entrance and kept current.

Transport and Shipment of Chemicals

The following safety precautions should be taken for chemical transport.

- Liquid chemicals should be transported in secondary containment (such as a hand carrier). It is a regulatory requirement that all liquids over a pint in size and all liquids and solids rated at NFPA hazard class 4 must be transported in secondary containment [safety containers, or on a wheeled cart with a design capable of containing leakage or spillage and negotiating uneven surfaces (e.g., expansion joints or floor drains)] without tipping the chemical container or cart.
- Chemicals should be transported on elevators without riders where possible.
- Chemical containers should be sealed during transport.
- Cylinders should be strapped to a cylinder hand truck specifically designed for that purpose and cylinder valve protective caps shall be in place to protect the valve.
- Transportation of hazardous materials on any public road should NEVER be performed except under the oversight of EHS. This transportation is highly regulated and the University MUST ensure that all regulations are followed for such moves.

Environmental Monitoring and Surveillance

All environmental monitoring and surveillance will be performed by or overseen by EHS. All concerns of overexposure should be addressed to the supervisor and CHO and is handled through **Accident and Incident Investigation** process described in the **IIPP**. The permissible exposure limits (PEL) of OSHA and the threshold limit values (TLV) of the American Conference of Governmental Industrial Hygienists (ACGIH) should not be exceeded. This may be achieved by a combination of experimental design and engineering controls. In general, use of a fume hood is recommended when working with a volatile substance. These exposure limits may be found on a chemical's Material Safety Data Sheet (MSDS).

Air sampling specifications, including frequency and test method will be determined by the Chemical Hygiene Officer, in consultation with lab and other EHS personnel.

Restricted Substances

The California Occupational Safety and Health Administration's (OSHA) Laboratory Standard (8 CCR 5191(e)(3)(H), requires that provisions be made for employee protection for work with hazardous substances. Due to health and safety concerns, SCU has expanded this list of hazardous substances to create the SCU Restricted Substance list which includes:

- Select carcinogens,
- Reproductive toxins,
- Acutely toxic substances and gases,
- Chemicals with a NFPA health hazard class rating of 4,
- DEA Controlled Substances,
- Cryogenic liquids,
- Explosives,
- Peroxidizers,
- Reactive and Water Reactive materials,
- Pyrophorics,
- Toxic gases as regulated by Santa Clara County,
- CalOSHA Reportable Chemicals, and
- EPA Extremely Hazardous Substances and Wastes.

Specific consideration should be given to the establishment of a designated area, the use of containment devices, procedures for safe removal of contaminated waste, and decontamination procedures. Refer to Attachment 8 for the review and approval process for these hazardous substances.

Waste Disposal Program

Hazardous Waste

Information on the identification, handling, storage and collection of laboratory wastes, and personnel safety of waste generators, is detailed in **SCU's Hazardous and Universal Waste Program**. The program includes procedures for hazard identification, hazardous

waste accumulation, requesting removal of hazardous waste, and the disposal process. Also included is information on waste minimization activities. Hazardous waste generator training is provided by EHS annually.

Non-Hazardous Waste

Certain non-hazardous waste must be handled in specified manners:

- All “sharps” or needles must be disposed of in “sharps containers” available from EHS. Sharps are defined broadly as any laboratory waste item that can puncture human skin. This includes needles, syringes with needles, lancets, scalpels, razor blades, precision knives, pipettes and pipette tips. Broken glass is specifically excluded as it is addressed below.
- All broken glass must be disposed of in “broken glass” containers or in completely sealed cardboard boxes. Filled containers should be completely sealed with sturdy tape (to prevent puncture to the handlers), marked “FOR DISPOSAL”.
- Finely divided powders, such as silica gel or toners, must be placed in tightly sealed containers or bags before disposal.
- Biological and/or radioactive wastes are addressed separately from other laboratory wastes. Contact CHO for information on these wastes and waste disposal.

Sink Disposal

- DO NOT DISCHARGE ANY WASTE TO THE SEWER unless the EHS department has given explicit permission to do so. A list of permissible sewer discharges is given in SCU **Wastewater Program**.

Emergencies and Exposures

Accident Notification

Accidents involving fire or explosion will activate installed automatic alarm sensors and fire extinguishing systems. Where automatic systems do not exist, manual alarms are installed in egress routes and must be activated during evacuation.

Accidents involving major chemical spills, fire, or explosion shall be immediately reported to Campus Safety at extension 4444. Campus Safety will contact emergency services.

Reporting of accidents to Campus Safety should be clear and concise, including the following information:

- Nature of the accident.
- Hazardous material(s) involved.
- Nature of any injuries.
- Location.
- Name of the caller.
- Phone number where caller can be reached.

Personnel at the immediate scene of the accident should take actions that will mitigate the extent of the accident without jeopardizing their health and safety. As guidance, here are guides on when such cleanup could be undertaken without calling for outside aid:

If you can clean up the spill with standard PPE (gloves, safety glasses, lab coat) without exposing yourself;

You know the identity of the chemical;

You understand the hazards;

You have the supplies to clean it up.

When in doubt, warn others in the area, evacuate the area, travel to a safe location, and call Campus Safety x4444.

Incident Investigation and Reporting

Incidents involving injury, illness, exposure, or a hazardous material spill must be reported on the Employee Incident Report Form (see SCU **Injury and Illness Prevention Program** or contact the Department of Human Resources).

Medical Consultations

SCU must provide all employees who work with hazardous chemicals an opportunity to receive medical attention, including any follow-up examinations which the examining physician determines to be necessary, under the following circumstances:

- Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory, the employee shall be provided an opportunity to receive an appropriate medical examination.
- Where exposure monitoring reveals an exposure level above the action level (or in the absence of an action level, the exposure limit) for a Cal/OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements, medical surveillance shall be established for the affected employee as prescribed by the particular standard.
- Whenever an event takes place in the work area such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure, the affected employee shall be provided an opportunity for a medical consultation. Such consultation shall be for the purpose of determining the need for a medical examination.

The employee should contact EHS and HR to obtain a medical consultation. All medical consultations will be performed by or under the direct supervision of a licensed physician and shall be provided without cost to the employee, without loss of pay and at a reasonable time and place. (Note: In case of emergency, the employee should call 911 or Campus Safety (x4444) for immediate assistance) EHS must provide the following information to the physician;

- 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 quantitative exposure data, if available; and
- A description of the signs and symptoms of exposure that the employee is experiencing, if any.

For examination or consultation required under this standard, HR must obtain a written opinion from the examining physician which shall include the following;

1. Any recommendation for further medical follow-up;
2. The results of the medical examination and any associated tests, if requested by the employee;
3. Any medical condition which may be revealed in the course of the examination which may place the employee at increased risk as a result of exposure to a hazardous chemical found in the workplace; and
4. A statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.
5. The written opinion shall not reveal specific findings of diagnoses unrelated to occupational exposure.

First Aid

First Aid Kits are available for minor cuts and scrapes. Personnel trained in first aid are available during all hours and are accessed through Campus Safety Services at 408-554-4444. Campus Safety may arrange for external emergency response for support as needed.

6. Training

General Chemical Safety Training

Employees working in laboratories receive training by EHS. Each Supervisor for a laboratory will assure that each worker in their laboratory obtains the appropriate training prior to starting work. For faculty hired to work or teach in a laboratory, the Department Chair is responsible for assuring that EHS is contacted sufficiently in advance to ensure that the person is trained prior to starting work. This training includes the following topics:

- This Chemical Hygiene Plan, its content, and availability;
- The contents of the OSHA standard 8 CCR 5191 and its appendices (Occupational Exposure to Hazardous Chemicals in Laboratories).[5]
- Location of reference material on the hazards (including Material Safety Data Sheets), safe handling, storage and disposal of the specific hazardous chemicals found in the laboratory;
- The physical and health hazards of the specific chemicals in the work area (as described on the Material Safety Data Sheet);
- Methods and observations that may be used to detect the presence or release of a hazardous chemical (ex: monitoring conducted by the EHS Department, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released);
- Measures employees can take to protect themselves from hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used.

[5] Available at http://www.dir.ca.gov/Title8/5191.html

Laboratory Specific Training

Supervisors will ensure that laboratory-specific training is provided to employees for specific procedures and experiments. This training should be provided before laboratory work begins for the employee. It should include specifics of the hazardous materials to be used and specific safe work practices including PPE requirements for the laboratory.

Refresher Training

All employees covered by the Chemical Hygiene Plan will receive annual refresher training by the CHO. Low hazard laboratories may petition the EHS Department to have the refresher training occur every two years. Such petitions will be granted only if (a) risk is considered low; (b) the amount of PPE required is minimal beyond normal general laboratory practices described in Attachment 1; and (c) within the last year, all quarterly inspections have been completed on time, corrective actions were completed on time, and EHS inspections of the subject laboratory found no significant issues had been missed.

7. Review and Update of Chemical Hygiene Plan

The Chemical Hygiene Plan will be reviewed regularly, evaluated for effectiveness by the EHS Department, and updated as necessary. The results of the review will be transmitted to the Department Chair of all departments that have laboratories controlled by the CHP and to the person supervising the EHS Director. Any changes in the Chemical Hygiene Plan will be transmitted to employees in the next scheduled training.

8. Document Retention

The following documents are retained at these locations for three years, unless otherwise indicated:

Document	**Location**	**Retention**	**Responsible Party**
Chemical Hygiene Plan	Web or other location available to all employees	Retain current	EHS Director
Laboratory-specific PPE & Hazard Evaluations (including corrective actions)	EHS files	5 years	EHS Director,
Laboratory-specific SOPs	Laboratory Supervisor files	Retain current	Laboratory Supervisor
Training Records	EHS	3 years	EHS Director
Laboratory-specific Training Records (records recommended)	Laboratory Supervisor files	3 years	Laboratory Supervisor
Inspection Records and Corrective Actions	Laboratory	1 year	Laboratory Supervisor
Exposure Assessment Records	EHS	30 years	EHS Director

MSDS Records	CISPro (online system for all SCU MSDSs)	30 years	EHS Director
Medical Consultation Records	Medical File	Length of employment + 30 years	Human Resources

9. Key References and Resources

The document(s) listed below may be obtained from EHS.

- 8 CCR 5191 Chemical Hygiene Plan Requirements
- SCU Injury and Illness Prevention Plan
- SCU Hazard Assessment Program
- SCU Chemical Inventory Management Program
- SCU BioSafety Program
- SCU Non-Ionizing Radiation Program
- SCU Hoods, Spray Booths and Ventilation Program
- SCU Emergency Eyewash and Shower Program
- SCU Hazardous and Universal Waste Program
- SCU Wastewater Program

Attachment 1 – General Laboratory Standards

The following general standards should be followed by employees for all laboratory work with chemicals and hazardous materials. These general guidelines can be modified based on a written laboratory-specific evaluation of hazards and risks which lead to a laboratory-specific operation and protective equipment program. Employees should:

- Know the safety rules and procedures that apply to the work that is being done.
- Determine the potential hazards and appropriate safety precautions before beginning any new operation.
- Know the location of and how to use the emergency equipment in the work area, as well as how to obtain additional help in an emergency, and be familiar with emergency procedures.
- Be alert to unsafe conditions and actions and call attention to them so that corrections can be made as soon as possible.
- Use equipment only for its designed purpose.
- Use only those chemicals for which appropriate safety controls and protective equipment are available.
- Eating, drinking, smoking, gum chewing, or application of cosmetics should not occur in areas where laboratory chemicals are present.
- Employees should wash their hands prior to leaving the laboratory after using chemicals, even if gloves or other similar PPE was employed.
- Do not store, handle, or consume food or beverages in storage areas, refrigerators, glassware, or areas that are also used for laboratory operations.
- Refrain from using personal electronics such as cell phones and iPods in the laboratory.
- Handle and store laboratory glassware with care to avoid damage; do not use damaged glassware.
- Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain chemicals and fragments should implosion occur.
- Wash areas of exposed skin well before leaving the laboratory. It is especially important to wash hands routinely before leaving.
- Leave all protective equipment in the lab when exiting including lab coats and protective gloves.
- Avoid practical jokes or other behavior that might confuse, startle, or distract other workers.
- Do not use mouth suction for pipetting or starting a siphon.
- Confine long hair and loose clothing.
- Wear closed-toed shoes at all times in the laboratory; NO SANDALS ARE PERMITTED TO BE WORN IN THE LABORATORY.
- Safety goggles or alternative eyewear that was designated through the hazard review process must be worn in the lab at all times when chemicals are present and in use.

- Appropriate protective clothing (e.g., gloves, lab coats, etc.) should be kept in the laboratory and worn routinely. Bare midriff, legs, or shoulders are not allowed in the laboratory as directed by the laboratory supervisor
- Dispose of chemicals properly at the end of the experiment. Never put hazardous chemicals down the drain unless specific authorization has been granted.
- Hazardous experiments should not be unattended
- Be alert to unsafe conditions and see that they are corrected when detected.
- All new procedures must be evaluated for potential hazards associated with the work by the laboratory supervisor.
- Report incidents following the **Injury and Illness Protection Program**.

The following resources are available from EHS for an employee who wishes to explore alternative controls:

- Material Safety Data Sheet (MSDS) for the materials in question.
- "Safety in Academic Chemistry Laboratories" American Chemical Society.
- "Working Safely With Chemicals in the Laboratory – A Student Guide" Genium Publishing.

Attachment 2 - Definitions

Action level: The airborne chemical concentration that triggers air monitoring and the implementation of additional control measures. The action level is always lower than the corresponding Cal/OSHA permissible exposure limit (PEL) and is designed to protect personnel from overexposure. Best Management Practice is to use the more conservative of either the Cal/OSHA defined action level (generally one-half the PEL) or one-half the ACGIH Threshold Limit Value is used as the action level.

Carcinogen: See “Select Carcinogen”

Compressed gas: (Per Cal/OSHA 8 CCR 5191):

1. A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70° F (21.1 C); or
2. A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130° F (54.4 C) regardless of the pressure at 70° F (21.1 C); or
3. A liquid having a vapor pressure exceeding 40 psi at 100° F (37.8 C) as determined by ASTM D-323-72.

Controlled substances: Drugs and certain other chemicals, both narcotic and non-narcotic, which come under the jurisdiction of federal DEA and state laws regulating their manufacture, sale, distribution, use and disposal.

Corrosive: Substance causing irreversible destruction of living tissue by chemical action at the site of contact (dermal or respiratory). Major classes of corrosive substances include strong acids, strong bases, and dehydrating agents.

Cryogenic liquids: Materials with extremely low boiling points (i.e. less than – 150 °F (65.6 C)).
Common examples of cryogenic liquids are liquid nitrogen, helium, and argon. Dry ice is the common term for frozen carbon dioxide. One special property of both cryogenic liquids and dry ice is that they undergo substantial volume expansion when converted to a gas phase, which can potentially lead to an oxygen deficient atmosphere where ventilation is limited.

Explosive: (Per Cal/OSHA 8 CCR 5191) a chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

Flammable: (Per Cal/OSHA 8 CCR 5191) a chemical that falls into one of the following categories:

1. "Aerosol, flammable" means an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame projection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;
2. "Gas, flammable" means:
   (A) A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent by volume or less; or
   (B) A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air greater than 12 percent by volume, regardless of the lower explosive limit.
3. "Liquid, flammable" means any liquid having a flashpoint below 100° F (37.8 C), except any mixture having components with flashpoints of 100° F (37.8 C) or

higher, the total of which make up 99 percent or more of the total volume of the mixture.

4. "Solid, flammable" means a solid, other than a blasting agent or explosive as defined in 29 CFR 1910.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

Hazardous chemical: (Per Cal/OSHA 8 CCR 5191) A chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed laboratory personnel (includes carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes).

Highly toxic: (Per Cal/OSHA 8 CCR 5194, also referred as highly acute toxin) A chemical falling within any of the following categories:

1. A chemical 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 gm each.
2. A chemical 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.
3. A chemical that has a median lethal concentration (LC50) in air of 200 ppm by volume or less of 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.

Incompatible: Materials that could cause dangerous reactions by direct contact with one another.

Irritant: (Per Cal/OSHA 8 CCR 5194) a substance, which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact. (dermal or respiratory).

Laboratory Supervisor: The individual in charge of the laboratory. It may be a Principal Investigator (PI), laboratory instructor, laboratory manager, or laboratory technician, or other designated personnel. The laboratory supervisor is appointed by the Department Chair.

Non-laboratory personnel: Workers such as administrative staff, plumbers, and Heating, Ventilation & Air Conditioning (HVAC) technicians entering research laboratories to perform maintenance, administrative, or other non-research laboratory tasks.

Organic peroxide: (Per Cal/OSHA 8 CCR 5191) An organic compound that contains the bivalent –o-o- structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an

organic radical.

Oxidizer: (Per Cal/OSHA 8 CCR 5191) A chemical other than a blasting agent or explosive defined by Cal/OSHA, that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

Permissible exposure limit (PEL): Per Cal/OSHA, the maximum permitted 8-hour time-weighted average concentration of an airborne contaminant.

Pyrophoric: (Per Cal/OSHA 8 CCR 5194) A chemical that ignites spontaneously in air at a temperature of 130 °F (54.4 C) or below**.**

Reproductive toxin: (Per Cal/OSHA 8 CCR 5191) A chemical that affects the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis). Under Proposition 65, the State of California maintains a list of known chemicals causing reproductive toxicity.

Restricted Substances: substances that require prior approval by CHO before purchase and use (Attachment 8 contains the list of substances).

Standard Operating Procedure (SOP): a written set of instructions that document how to safely perform work involving hazardous materials or hazardous operations**.**

Sensitizer: (Per Cal/OSHA 8 CCR 5194) A substance that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the substance. The reaction may be as mild as a rash (contact dermatitis) or as serious as anaphylactic shock**.**

Select agents: Bacteria, viruses, toxins, rickettsia, and fungi identified by the United States Department of Health and Human Services (HHS), Centers for Disease Control and Prevention (CDC), the United States Department of Agriculture (USDA), and the Animal and Plant Health Inspection Service (APHIS) that pose a potential threat to public health or welfare. NOTE: The safety practices and precautions provided by the Chemical Hygiene Plan is most applicable with the use of Select Agent toxins as opposed to infectious agents. List of these agents is available at: CDC Select Agents. Researchers who use infectious agents in their work are also potentially subject to SCU's **Biosafety Program** and should evaluate their obligations under that program.

Select carcinogen: (Per Cal/OSHA 8 CCR 5191) A substance or agent that meets one of the following criteria:

1. It is regulated by Cal/OSHA as a carcinogen.
2. It is listed under the category, "known to be carcinogens" in the Annual Report on Carcinogens published by the National Toxicology Program (NTP)(latest edition); or
3. It is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer (IARC)
4. 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 doses of 50mg/kg of body weight per day.

Substitution: When designing and planning a laboratory operation, using the least hazardous chemical possible to minimize risk to personnel and property.

Toxic gas: A material that is regulated under Santa Clara County's Toxic Gas Ordinance as:
Class I Material: Has a median Lethal Concentration (LC 50) in air of 200 parts per million or less by volume of gas or vapor, or 2 milligrams per liter or less of mist, fume or dust, when administered by continuous inhalation for an hour, or less if death occurs within one hour, to albino rats weighing between 200 and 300 grams each.
Class II Material: Has a LC 50 in air more than of 200 parts per million but not more than 3,000 parts per million by volume of gas or vapor, or more than 2 milligrams per liter but not more than 30 milligrams per liter of mist, fume or dust, when administered by continuous inhalation for an hour, or less if death occurs within one hour, to albino rats weighing between 200 and 300 grams each.
Class III Material: Has a LC 50 in air more than of 3,000 parts per million but not more than 5,000 parts per million by volume of gas or vapor, or more than 30 milligrams per liter but not more than 50 milligrams per liter of mist, fume or dust, when administered by continuous inhalation for an hour, or less if death occurs within one hour, to albino rats weighing between 200 and 300 grams each.

Toxic substance: (Per Cal/OSHA 8 CCR 5194) Substances that cause adverse effects to specific target organs (i.e., lungs, liver, skin), or the nervous or blood systems. These substances can result in acute and/or chronic effects at moderate levels. Per Cal/OSHA, a toxic substance must fall within one of the following categories:
(a) A substance that has a median lethal dose (LD50) of more than 50 milligrams per kilogram but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
(b) A substance that has a median lethal dose (LD50) of more than 200 milligrams per kilogram but not more than 1,000 milligrams per kilogram 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 two and three kilograms each.
(c) A substance that has a median lethal concentration (LC50) in air of more than 200 parts per million but not more than 2,000 parts per million by volume of gas or vapor, or more than two milligrams per liter but not more than 20 milligrams per liter of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

Unstable (reactive): (Per Cal/OSHA 8 CCR 5191) A chemical which is the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature.

Water-reactive: (Per Cal/OSHA 8 CCR 5191) A chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

Attachment 3 – Personal Protective Equipment Guidelines

Details of the Personal Protective Equipment (PPE) requirements for laboratories are contained in the Laboratory Risk and Hazard Assessment (SCU **Hazard Assessment Program**). Each laboratory will be assessed and the appropriate PPE will be identified. The discussion below is a general summary of the details of that program.

Eye Protection

Eye protection is required for all employees whose eyes may be exposed to chemical or physical hazards. Side shields on safety spectacles provide some protection against splashed chemicals or flying particles, but goggles or face shields (with safety glasses) are required when there is a greater than average danger of eye contact as when pouring, agitating, or heating materials.

A higher than average risk exists when working with highly reactive chemicals, concentrated corrosives, or with vacuum or pressurized glassware systems.

At a minimum, safety glasses with side shields shall be worn when handling, mixing, heating, stirring, or transferring chemicals unless a specific alternative eyewear has been approved.

Safety glasses do not need to be worn while using optical equipment such as microscopes, macroscopes, or similar equipment where there is no external hazard and the safety glasses interfere with vision while performing research. Safety glasses must be replaced to protect eyes as soon as this equipment use is completed.

Body and Hand Protection

Lab coats or other similar clothing protectors are required for all laboratory employees who work with chemicals unless alternate means of protection have been approved. This includes while working with select carcinogens (California Code of Regulations, Title 8, Article 110, “Regulated Carcinogens”), reproductive toxins, substances which have a high degree of acute toxicity, strong acids and bases, and any substance for which the MSDS lists a significant “skin” notation. Lab coats, aprons, faceshields, etc. will be removed and stored in the designated location when leaving the lab.

Gloves made of appropriate material (glove material(s) compatible with the chemical hazard or physical hazard potentially exposed to) are required to protect the hands and arms from thermal burns, cryogenic materials, cuts, or chemical exposure that may result in absorption through the skin or reaction on the surface of the skin. Gloves are also required when working with hazardous substances where possible transfer from hand to mouth must be avoided. Gloves are required for work involving pure or concentrated solutions of select carcinogens, reproductive toxins, substances which have a high degree of acute toxicity, strong acids and bases, and any substance carrying a “skin” notation. As with lab coats, gloves are generally to be removed and stored/disposed in the designated location prior to leaving the laboratory.

Use the following steps for safe glove removal:

1. Pull one glove near your wrist towards your finger tips until the glove folds over. Carefully grab the fold and pull towards your finger tips. As you pull you are turning the inside of the glove outwards.
2. Pull the fold until the glove is almost off.
3. To avoid contamination of your environment, continue to hold the removed glove. Completely remove your hand from the glove.
4. Slide your finger from you glove free hand under the remaining glove. Continue to slide your finger towards your finger tips until almost half of your finger is under the glove.
5. Turn you finger 180 degrees and pull the glove outwards and towards your finger tips. As you do this, the first glove will be encased in the second glove. The inside of the second glove will also be turned outwards.
6. Grab the gloves firmly, by the uncontaminated surface (the side that was originally touching your hand). Release your grasp of the first glove you removed. Pull your second hand free from its glove.
7. Dispose of the gloves properly.

Gloves should be carefully selected using guides from the manufacturers. General selection guides are available; however, glove-resistance to various chemical materials will vary with the manufacturer, model and thickness.

Information concerning gloves and compatibility can be obtained from various glove charts. An example of such a chart is at http://www.hazmat.msu.edu:591/glove_guide/. The CHO can provide further assistance in making the proper glove selection.

Respiratory Protection

Respiratory protection is generally not necessary in the laboratory and must not be used as a substitute for adequate engineering controls. Availability of respiratory protection for emergency situations may be required when working with chemicals that are highly toxic and highly volatile or gaseous. If an experimental protocol requires exposure above the action level (or PEL) that cannot be reduced, respiratory protection will be required. Personnel will not be allowed to wear respiratory protection until they have been properly trained, fit-tested, and certified by the EHS Department.

The EHS Department will designate areas, activities, and tasks that require specific types of personal protective equipment as described above. If there are questions concerning the type of Personal Protective Equipment (PPE) that should be used for the chemical(s) in use, contact the EHS Department.

Attachment 4 - Laboratory Inspection Checklist

Laboratory Supervisor:_____ Department:_____

Building: _____ Room: _____

Inspector(s): _____ Inspection Date: ____/____/____

*Provide an explanation or corrective action on reverse side of this page for responses. Be sure to retain all documentation regarding inspections, including findings **and** corrective actions taken for a minimum of 1 year. Contact Sean Collins, EHS Director, at ext 5078 for questions or additional information.*

General Safety

Yes	No	N/A	Inspected Item
			1) Have there been any changes in the set up of the laboratory or types of processes and procedures conducted in the laboratory? *If there has been a change, stop this inspection and request that a Laboratory Risk and Hazard Assessment and/or PPE Assessment be conducted per SCU Hazard Assessment Program.*
			2) Are the appropriate warning signs posted at the laboratory door (radioactive, flammable, corrosive, etc.)?
			3) Does the chemical fume hood have the annual inspection, flow rate test and flow rate indicator?
			4) Are the areas around fire extinguishers, pull alarms, emergency showers/eyewash, and electrical panels clear?
			5) Is there an eighteen-inch vertical clearance maintained from fire sprinkler heads (e.g., over shelves)?
			6) Are the cabinets, furniture, and equipment taller than 4 feet seismically anchored?
			7. Are the refrigerators/freezers/microwaves labeled either “Food & Drink Only” or “No Food & Drink” and “Flammable Storage” or “No Flammable Storage” as appropriate?
			8) Are food and drink consumed in laboratory?
			9) Are any extension cords and power strips daisy chained and are there permanent extension cords in use?
			10) Are there unapproved uses of portable heaters or halogen lamps?
			11) Is there exposed wiring or damaged electrical cords?
			12) Are soldering and heat guns unplugged when not in use?
			13) Are ceramic hot plates cracked or otherwise damaged?
			14) Are floors dry with aisles and doorways unobstructed with 36” minimum clearance (i.e. no material storage or other blockages)?
			15) Are bench tops (including hoods) reasonably organized and clean?
			16) If present, are exit signs visible?
			17. Exit doors can be opened from the inside without special knowledge, keys, slide bolts or locks?
			18) Is PPE, as specified by the Laboratory Hazard Assessment, available and in use?

Hazardous Materials and Waste

Yes	No	N/A	Inspected Item
			19) All containers, including non-hazardous chemicals and wastes, legibly labeled and for hazardous chemicals and waste, labeled according to the SCU Hazard Label requirements (Appendix H of the Chemical Hygiene Plan)?
			20) Incompatible materials and wastes are properly segregated?
			21) Chemical and waste containers are in good condition, free of spillage in the secondary containment and closed except during use (no funnels)?
			22) Flammable liquids (including flammable waste and acetic acid) are stored in flammable cabinets or refrigerators as appropriate when not in use?
			23) Are hazardous materials or wastes are stored near sinks or drains?
			24) Peroxide-forming chemicals are labeled according to the date of purchase, date opened, and disposed before the expiration date occurs (disposed of after 18 months from date of receipt or 3 months from date of opening)?
			25) Extremely Hazardous wastes are properly identified and kept in quantities of less than one quart?
			26) Do the hazardous waste labels indicate that the waste has not been stored more than nine months?
			27) Is the red bag hazardous waste treated/disposed of within 7 days?
			28) Laboratory practices minimize volatilization (i.e. traps used, open-container procedures minimized)?
			29) Is storage in fume hoods minimized and sashes are kept closed when not in use?
			30) Glass and sharps (needles, syringes, razor blades, etc.) are stored in sharps container and properly labeled?
			31) Have the eyewash, safety shower and/or fire extinguisher been inspected in the last 30 days?

Compressed Gas

Yes	No	N/A	Inspected Item
			32) Cylinders greater than 26" tall are secured to a rigid structure at 1/3 and 2/3 heights with metal chains?
			33) Cylinder valves are closed and valve caps in place when cylinders not in use?
			34) Are incompatible cylinders (i.e. oxygen and hydrogen) separated by distance or fire-resistant barriers, while in storage?

Training

Yes	No	N/A	Inspected Item
			35) Do student employees work in this area? (If Yes, answer the following question)
			36) Have students/employees received area-specific training within the last 12 months?

Comments:

List the number of the Inspection Checklist Item marked no and the explanation and/or corrective action:

Checklist Item #	Explanation and/or Corrective Action	Proposed Corrective Action Completion Date and who will complete it

The California OSHA Laboratory Standard (Title 8) defines a hazardous chemical as chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees.

The use of toxic gases, pyrophoric substances, and the 13 specific carcinogens that require OSHA notice[6] must be pre-approved by the CHO due to the likelihood of specific permitting requirements (see Attachment 8, Restricted Substances).

The special precautions described in the following sections are to be used in conjunction with the information detailed in the Attachment 1 - General Laboratory Standards. The special precautions sections and any other relevant instructions in this Chemical Hygiene Plan may be used as part of the written standard operating procedures required by the OSHA Laboratory Standard. **Project-specific and/or area-specific standard operating procedures must be written by departments, work units, Laboratory Supervisors or Supervisors for hazardous chemical and hazardous operations work not covered by the following special precautions sections.**

Physical & Chemical Hazards

"Physical hazard" refers to a chemical for which there is evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive), corrosive, or water-reactive. Materials which present a physical hazard can be safely used if the specific hazard(s) are understood, and measures are taken to address the hazards. If appropriate precautions are not taken, a fire, an explosion, unwanted corrosion, personal injury, or property damage could occur. Certain chemicals cannot be safely mixed or stored with other chemicals because a severe reaction can take place or an extremely toxic reaction product can result.

An eyewash and safety shower must be readily accessible to areas where injurious materials are used and stored. In the event of skin or eye contact with an injurious material, immediately flush the area of contact with cool water for 15 minutes. Remove all affected clothing. Get medical help. Additional information concerning eyewash and safety shower requirements is available in SCU's **Emergency Eyewash and Shower Program** located on the EHS website.

Laboratories present special challenges in the prevention of repetitive stress injuries. Laboratory employees are urged to contact EHS to request an ergonomic workstation evaluation if they have any concerns regarding the setup of their workstations.

Special Precautions for Working with Flammables and Combustibles:

Flammable/combustible materials are materials which under standard conditions can generate sufficient vapor to cause a fire in the presence of an ignition source. Flammable materials can generate sufficient vapors at temperatures below 100^{o}F (38^{o}C);

[6] As per 8 CCR 5203, the chemicals that require approval include Methylenedianiline, 1,3 Butadiene, Methylene Chloride, Chromium VI, Cadmium, Vinyl Chloride, DBCP, Acyrlonitrile, Inorganic Arsenic, 4,4'Mehtylenebis (2-Chloroaniline), Formaldehyde, Benzene, Ethylene Dibromide, Ethylene Oxide, 2-Acetylaminofluorene, 4-Aminodiphenyl, Benzidine (and its salts),3,3'-Dichlorobenzidine (and its salts),4-Dimethylaminoazobenzene, alpha-Napthylamine, beta-Naphthylamine, 4-Nitrobiphenyl, N-Nitrosodimethylamine,Propiolactone, bis-Chloromethyl ether, Methyl chloromethyl ether, Ethyleneimine

combustibles, at temperatures at or above 100^{o}F (38^{o}C) and below 140^{o}F (60^{o}C). The vapors of these materials are invisible, and a vapor trail to an ignition source away from the immediate area can result in a flashback. Flammables are more hazardous at elevated temperatures due to more rapid vaporization. In addition, flammable and combustible materials react with oxidizers which can result in a fire. Employees must observe the following special precautions:

1. Eliminate ignition sources such as open flames, smoking materials, hot surfaces, sparks from welding or cutting, operation of electrical equipment, and static electricity. Post conspicuous "No Smoking" signs in areas where flammable materials are used or stored.
2. Minimize the quantity kept in the work area.
3. Store in approved flammable liquid containers (original containers or safety cans) and storage cabinets, or in a special storage room designed for that purpose. Store away from oxidizers.
4. Flammable liquids stored in glass containers shall not exceed 1 quart. Exception: For conditions where chemical purity must be protected, flammable liquids stored in glass containers shall not exceed 1 gallon unless specific permission for such use has been granted.
5. Refrigerators and freezers used for the storage of flammable or combustible liquids must have no internal sources of ignition (“lab-safe” or “flammable rated”).
6. Ensure that there is proper bonding and grounding when it is required, such as when transferring or dispensing a flammable liquid from a large container or drum. Bonding and grounding must be checked regularly.
7. Ensure that appropriate fire control systems or extinguishers are available.

Special Precautions for Working with Corrosives:

Corrosives are materials that can react with the skin causing burns similar to thermal burns, and/or which can react with metal causing deterioration of the metal surface. Acids and bases are corrosives. Observe the following special precautions.

1. Containers and equipment used for storage and processing of corrosive materials should be corrosion resistant.
2. Eye protection (safety glasses or splash goggles, as appropriate) and rubber gloves should always be used when handling corrosive materials. A face shield, rubber apron, and rubber boots may also be appropriate, depending on the work performed.
3. When mixing concentrated acids (caustics) with water, add the acid (caustic) slowly to water. **Never add water to acid (caustic)**.
4. Acids and bases should be stored separately from each other. Organic acids should be stored with flammable materials, separate from oxidizers and oxidizing acids.

Special Precautions for Working with Oxidizers

Oxidizers are materials that readily yield oxygen or another oxidizing gas, or that readily react to promote or initiate combustion of flammable/combustible materials. **Oxidation reactions are a frequent cause of chemical accidents.** Observe these precautions to reduce risk when storing or handling oxidizers.

1. Know the reactivity of the materials involved in experiment or process. Make sure that there are no extraneous materials in the area which could become involved in a reaction.
2. If the reaction can be violent or explosive, use shields or other methods for isolating the materials or the process.

3. Use the minimum amounts necessary for the procedure. Do not keep excessive amounts of the material in the vicinity of the process.
4. Store properly, away from organic materials, flammable materials and other reducing agents.
5. Perchloric acid should be used only in specially-designed perchloric acid fume hoods equipped with wash-down systems to prevent deposition of shock-sensitive perchlorates in the ductwork and machinery. Before purchasing perchloric acid, the laboratory supervisor should arrange for use of an approved perchloric acid hood.

Special Precautions for Working with Water-Reactive Materials

Materials that react with water to produce a flammable or toxic gas, or other hazardous condition are said to be water-reactive. Fire and explosion are serious concerns when working with these materials. Special precautions for safe handling of water-reactive materials will depend on the specific material, and the conditions of use and storage.

Contact CHO for information on the safe use of a specific material**.** Examples of water-reactives include alkali and alkaline earth metals (e.g. Li, Na, K, Ca, Mg), metal hydrides, some metal and nonmetal chlorides (e.g. $SiCl_4$, PCl_3, $AlCl_3$), calcium carbide, and acid halides.

Special Precautions for Working with Pyrophoric Materials

Pyrophoric materials ignite spontaneously upon contact with air. The flame may or may not be visible. Examples include butyllithium, silane, and yellow phosphorous.

Store and use all pyrophorics in an inert atmosphere.

Special Precautions for Working with Peroxidizables

Peroxidizables are substances or mixtures that react with oxygen to form peroxides. Some peroxides can explode with impact, heat, or friction such as that caused by removing a lid. Peroxides form inside the containers of some materials even if they have not been opened. Examples include ethyl ether, tetrahydrofuran, liquid paraffins (alkanes), and olefins (alkenes).

1. Date all peroxidizables upon receipt and upon opening. Unless an inhibitor has been added by the manufacturer, materials should be properly disposed of after 18 months from date of receipt or 3 months from date of opening.
2. Do not open any container having obvious crystal formation around the lid.
3. Other special precautions are similar to those used for flammables.

Special Precautions for Working with Light-Sensitive Materials

Light-sensitive materials are unstable with respect to light energy. They tend to degrade in the presence of light, forming new compounds that can be hazardous, or resulting in conditions such as pressure build-up inside a container which may be hazardous. Observe the following precautions.

1. Store light-sensitive materials in a cool, dark place in amber colored bottles or other containers that reduce or eliminate penetration of light.
2. Date containers on receipt and upon opening, and dispose of surplus material after one year if unopened or 6 months if opened.

Special Precautions for Working with Shock-Sensitive or Explosive Materials

Shock-sensitive/explosive materials are substances or mixtures which can spontaneously release large amounts of energy under normal conditions, or when struck, vibrated, or

otherwise agitated. Some materials become increasingly shock-sensitive with age and/or loss of moisture. The inadvertent formation of shock-sensitive/explosive materials such as peroxides, perchlorates, picrates, and azides is of great concern in the laboratory.

1. Contact the Chemical Hygiene Officer when work with shock-sensitive or explosive materials is planned or when it is suspected that the inadvertent formation of shock-sensitive materials in ductwork, piping, or chemicals being stored has occurred.
2. Date all containers of explosive or shock-sensitive materials upon receipt and when opened. Unless an inhibitor has been added, unopened shock-sensitive materials should be discarded within 12 months after receipt. Open containers of shock-sensitive materials should be discarded within 6 months of the date opened.
3. Use the minimum amount of materials necessary for a procedure. Keep a minimum amount of material on hand.
4. If there is a chance of explosion, use barriers or other methods for isolating the materials or the process.

Special Precautions for Working with Compressed Gases

Special systems are needed for handling materials under pressure. Toxic and corrosive gases present special problems in designing engineering controls. The physical and health hazards of any material are typically compounded by the pressure hazard. Carefully observe special precautions.

1. Signs shall be provided by the CHO and posted by the Laboratory Supervisor identifying type of cylinders to be stored and identifying any potential hazard.
2. Compressed gas cylinders shall be stored and secured in an upright position. Gas cylinders in storage and in use shall be kept tightly secured with chains. City of Santa Clara Fire Department requirements for gas cylinder restraints are ¼ inch thick steel welded link chain secured around the cylinder at 1/3 the height of the cylinder and 2/3 the height of the cylinder. The restraints shall be secured to the wall or counter in such a manner to prevent demounting due to a moderate earthquake. Lecture bottles shall be supported in a lecture bottle tube support to provide upright support.
3. Always use the smallest size cylinder required to perform the work.
4. Cylinders of compressed gases must be handled as high energy sources.
5. Cylinders on wheeled carts must be capped and secured by an approved (either UL or FM listed) cylinder support strap or chain. The cart must be an approved cylinder cart. Do not attempt to take a loaded cylinder cart up or down a stairway.
6. Close the gas cylinder at the top of the tank when not in use and remove the regulator if the cylinder is not to be used for a period over a month. Lecture size gas cylinders are too small to have valve protective caps.
7. Cylinders shall be stored and transported with the protective valve cap in place to prevent damage to the cylinder valve in the event the cylinder falls or the valve sustains impact. No cylinder shall be stored or transported with the regulator still installed.
8. All uncapped cylinders must be secured independently (not ganged behind a single chain) to a solid element of the lab structure. Carts are not acceptable for supporting uncapped or in-use cylinders.
9. Never bleed a cylinder completely empty. Leave a slight pressure to keep contaminants out.
10. Oil or grease on the high pressure side of an oxygen cylinder can cause an explosion. Do not lubricate an oxygen regulator or use a fuel gas regulator on an oxygen cylinder.
11. Always wear goggles or safety glasses with side shields when handling compressed gases.

12. Always use appropriate gauges, fittings, and materials compatible with the particular gas being handled. Regulators must be compatible with gas cylinders (do not use adapters).
13. All compressed gas cylinders and chemical containers should be stored away from heat sources and direct sunlight.
14. Wherever carbon monoxide or hydrogen sulfide is present in quantities greater than one standard lecture bottle size, detection alarms must be present and properly tested and maintained.
15. Wherever hydrogen is present, all tubing must be of braided stainless steel hose. Alternative tubing materials shall be reviewed by CHO on a case-by-case basis, to ensure that the alternative materials meet fire protection requirements.
16. When work with other toxic, corrosive, or reactive gases is planned, the CHO should be contacted for information concerning specific handling requirements for the gas involved. (see Attachment 8, Restricted Substances) Generally, these gases will need to be used and stored with local exhaust ventilation such as a lab hood or a gas cabinet and a formal registration with the Santa Clara Fire Department may be required as per City Ordinance.

Special Precautions for Working with Cryogens

Some of the hazards associated with cryogens (fluids used to maintain extremely low temperatures such as liquid nitrogen and dry ice) are fire, pressure, embrittlement of materials, and skin or eye burns upon contact with the liquid. Cryogens can condense nearly pure liquid oxygen from the air, creating a severe fire risk. A pressure hazard exists because of the large expansion ratio from liquid to gas, causing pressure build up in containers. Many materials become brittle at extreme low temperatures. Brief contact with materials at extreme low temperatures can cause burns similar to thermal burns. Carefully observe all special precautions.

1. Equipment should be kept clean, especially when working with liquid or gaseous oxygen.
2. Mixtures of gases or fluids should be strictly controlled to prevent formation of flammable or explosive mixtures.
3. For flammable cryogens the precautions provided in the "Flammable/Combustible Materials" section of this booklet should be used.
4. Always wear goggles when handling cryogens. If there is a splash or spray hazard, a face shield over the goggles, an impervious apron or coat, cuff less trousers, and fully-covering, non-lacing shoes should be worn. Watches, rings, and other jewelry should not be worn. Gloves should be impervious and sufficiently large to be readily thrown off should a cryogen be spilled. Cryo-gloves or pot holders should also be used. Respirators or oxygen monitors may be required if the cryogen is toxic and sufficient local exhaust ventilation is not available. Contact EHS to determine if exposure monitoring is necessary.
5. Containers and systems containing cryogens should have pressure relief mechanisms.
6. Containers and systems should be capable of withstanding extreme cold without becoming brittle. Glass containers should be taped solidly around the outside or encased in plastic mesh.
7. Neither liquid nitrogen nor liquid air should be used to cool a flammable mixture in the presence of air because oxygen can condense from the air, which could lead to an explosion hazard.
8. Funnels should not be used for pouring liquid nitrogen or any other cryogen.
9. Large mobile dewars or LN2 refrigerators (or the trolleys carrying these) used for transporting cryogens within a building or between buildings should be equipped with

a braking mechanism.
10. Large mobile dewars at risk for tipping should be transported on appropriate carts. Wheeled trolleys may not be used if the vessel must pass over elevator thresholds or other slots/crevasses wider than 25% of the wheel width.
11. Dispensing stations designed to allow research staff to fill smaller vessels from a larger self-pressurizing Dewar must be located in non-public areas, and should be posted with standard operating procedures.
12. Smaller vessels of liquid nitrogen or other cryogens transported by hand within or between buildings must have a handle or bail, and must be covered.

Health Hazards

"Health hazard" refers to chemicals for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. This term includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system and agents which damage the lungs, skin, eyes, or mucous membranes.

For many toxic materials, hygienic standards have been established and action must be taken to prevent personnel from receiving exposures in excess of these standards. These standards may be referred to as threshold limit values (TLVs) or permissible exposure limits (PELs).

The MSDS will list the hygienic standard for the hazardous chemical or each component of a mixture. In addition, the CHO has a complete listing of published TLVs and PELs and other works concerning the subject of industrial toxicology. If you would like to conduct a more thorough review of a particular compound, or if you would like an evaluation of the exposure to a specific material used in your work area, contact the CHO.

Protection from health hazards is provided by ensuring that exposure to such hazards is minimized or eliminated. To minimize the exposure, it is necessary to determine the route by which the exposure may occur, i.e. inhalation, skin contact, puncture, ingestion, or a combination of exposure routes.

Special Precautions for Working with Allergens

The term allergens describe a wide variety of substances that can produce skin and lung hypersensitivity. Examples include diazomethane, chromium, nickel dichromates, formaldehyde, isocyanates, and certain phenols. Wear suitable gloves to prevent hand contact with allergens or substances of unknown allergenic activity. Conduct aerosol producing procedures in a fume hood.

Special Precautions for Working with Embryotoxins and Reproductive Toxins

Substances that act during pregnancy to cause adverse effects on the fetus are referred to as embryotoxins. These effects include embryolethality (death of the fertilized egg, the embryo, or the fetus), malformation (teratologic effects), retard growth, and postnatal functional deficits. Examples include organo-mercurials, lead compounds, and formamide. Because the period of greatest susceptibility to embryotoxins is the first 8-12 weeks of pregnancy, which includes a period when a woman may not know she is pregnant, women of child-bearing potential should take care to avoid skin contact with all chemicals. The term "reproductive toxins" is used to describe substances that cause harmful effects on the male or female reproductive system or the developing embryo and fetus. These effects include but are not limited to menstrual irregularity, lowered fertility, testicular atrophy, and

birth defects. Special precautions when working with these substances include:

1. A review must take place for each use of embryotoxins between the Laboratory Supervisor and Chemical Hygiene Officer. Review continuing uses annually or whenever a procedural change is made.
2. Label embryotoxins as follows: EMBRYOTOXIN: READ SPECIFIC PROCEDURES FOR USE.
3. Store embryotoxins and reproductive toxins in unbreakable containers or unbreakable secondary containers in a well ventilated area.
4. Guard against spills and splashes. Appropriate safety apparel, especially gloves, should be worn. All hoods, glove boxes, or other essential engineering controls should be known to be operating properly before work is started.
5. Report of all incidents of exposure or spills.

Special Precautions for Working with Chemicals of Moderate Chronic or High Acute Toxicity:

Examples of chemicals of moderate chronic toxicity or high acute toxicity include diisopropylfluorophosphate, hydrofluoric acid, and hydrogen cyanide. Observe the following precautions:

1. Consult one of the standard compilations that list toxic properties of known substances and learn what is known about the substance that will be used. Follow the specific precautions and procedures for the chemical.
2. Use and store these substances only in designated (restricted access) areas placarded with appropriate warning signs.
3. Use a hood or other containment device for procedures that may result in the generation of aerosols or vapors; trap released vapors to prevent their discharge with fume hood exhaust.
4. Avoid skin contact by use of gloves and long sleeves and other protective apparel as appropriate.
5. Maintain records of the amounts of materials on hand, amounts used, and the names of the workers involved.
6. Be prepared for accidents and spills. At least two people should be present at all times if compounds in use are highly toxic or of unknown toxicity.
7. Store breakable containers in chemically resistant trays; also work and mount apparatus above such trays or cover work and storage surfaces with removable, absorbent, plastic backed paper.
8. If a major spill occurs outside the hood, evacuate the area and call for assistance
9. Thoroughly decontaminate or dispose of contaminated clothing or shoes. If possible, chemically decontaminate by chemical conversion to a less toxic product.
10. Store contaminated waste in closed, suitably labeled, impervious containers.

Special Precautions for Working with Chemicals of High Chronic Toxicity

Examples of chemicals exhibiting high chronic toxicity include dimethylmercury, nickel carbonyl, benzo-a-pyrene, N-nitrosodiethylamine, and other human carcinogens or substances with high carcinogenic potency in animals

1. Conduct all transfers and work in designated (restricted access) areas: a restricted access hood, glove box, or portion of a lab, designated for use of highly toxic substances, for which all persons with access are aware of the substances being used and necessary precautions.
2. Protect vacuum pumps against contamination with scrubbers or HEPA filters and vent

effluent into the hood.

3. Decontaminate vacuum pumps or other contaminated equipment, including glassware, before removing them from the designated area. Decontaminate the designated area before normal work is resumed there.
4. On leaving the area, remove protective apparel (placing it in an appropriate, labeled container) and thoroughly wash hands, forearms, face, and neck.
5. Use a wet mop or a vacuum cleaner equipped with a HEPA filter to decontaminate surfaces. DO NOT DRY SWEEP SPILLED POWDERS.
6. If using toxicologically significant quantities of a substance on a regular basis (in quantities above a few milligrams to a few grams, depending on the substance, 3 or more times per week), contact the CHO.
7. Keep accurate records of the amounts of these substances stored and used, the dates of use, and names of users.
8. The designated area must be conspicuously marked with warning and restricted access signs and all containers should be appropriately labeled with identity and warning labels (e.g., CANCER-SUSPECT AGENT).
9. Ensure that contingency plans, equipment, and materials to minimize exposures of people and property in case of accident are available.
10. For a negative pressure glove box, ventilation rate must be at least 2 volume changes/hour and at a pressure of at least 0.5 inches of water gauge. For a positive pressure glove box, thoroughly test for leaks before each use. In either case, trap the exit gases or filter them through a HEPA filter and then release them into a fume hood.
11. Use chemical decontamination whenever possible; ensure that containers of contaminated wasted are transferred from the designated area under the supervision of the CHO.

Attachment 6 - SOP Template

STANDARD OPERATING PROCEDURE TEMPLATE EHS Website: Laboratory Safety

#1	CONTACT INFORMATION:

Procedure Title	
Procedure Author	
Date of Creation/Revision	
Name of Responsible Person	*(The, Lab Supervisor)*
Location of Procedure	*(Building and room number)*
RESTRICTED SUBSTANCE Approval	*(If required. See section #10 of this template)*

#2	THIS STANDARD OPERATING PROCEDURE (SOP) IS FOR A:

☐ **Specific laboratory procedure or experiment**
Examples: synthesis of chemiluminescent esters, folate functionalization of polymeric micelles, etc.

☐ **Generic laboratory procedure that covers several chemicals**
Examples: distillation, chromatography, etc.

☐ **Generic use of specific chemical or class of chemicals with similar hazards**
Examples: organic azides, mineral acids, etc.

#3	PROCESS OR EXPERIMENT DESCRIPTION

[FOLLOWING GUIDANCE TEXT MAY BE DELETED WHEN COMPLETING THE FORM]
Provide a brief description of your process or experiment, including its purpose. Do not provide a detailed sequential description as this will be covered by section #6 of this template. Indicate the frequency and duration below.

Frequency:	☐ one time ☐ daily ☐ weekly ☐ monthly ☐ other:_____
Duration per Expt:	_____minutes; or _____hours

#4	**SAFETY LITERATURE REVIEW & HAZARD SUMMARY**

[FOLLOWING GUIDANCE TEXT MAY BE DELETED WHEN COMPLETING THE FORM]

1. List all physical and health hazards associated with the materials and procedures used in this SOP. Examples of potential hazards include: toxicity, reactivity, flammability, corrosivity, pressure, etc.

2. List all references you are using for the safe and effective design of your process or experiment, including safety literature and peer-reviewed journal articles.

Suggested Safety References include:

- American Chemical Society. *Journal of Chemical Health and Safety.* Available online at http://www.sciencedirect.com/science/journal/18715532.
- Canadian Centre for Occupational Health and Safety. Web Information Service. Available online at http://ccinfoweb.ccohs.ca.
- Furr, A. Keith. *CRC Handbook of Laboratory Safety*. Available online at http://crcnetbase.com.
- Hall, Stephen K. *Chemical Safety in the Laboratory*. Available in Swain Library.
- Lewis, Richard J. *Sax's Dangerous Properties of Industrial Materials*. Available online at http://www.knovel.com.
- National Oceanic and Atmospheric Association. CAMEO Database of Hazardous Materials. Available online at http://cameochemicals.noaa.gov.
- National Research Council. *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals*. Available online at http://www.nap.edu.
- Pohanish, Richard P. *Sittig's Handbook of Toxic and Hazardous Chemicals and Carcinogens*. Available online at http://www.knovel.com.
- U.S. National Library of Medicine. TOXNET Chemical, Toxicological, and Environmental Health Data. Available online at http://toxnet.nlm.nih.gov.

#5	**STORAGE REQUIREMENTS**

[FOLLOWING GUIDANCE TEXT MAY BE DELETED WHEN COMPLETING THE FORM]

Describe special handling and storage requirements for hazardous chemicals in your laboratory, especially for highly reactive/unstable materials, highly flammable materials, and corrosives.

#6	**STEP-BY-STEP OPERATING PROCEDURE**

[FOLLOWING GUIDANCE TEXT MAY BE DELETED]

1. For each step's description, include any step-specific hazard, personal protective equipment, engineering controls, and designated work areas in the left hand column.

   a. **Guidance on Engineering and Ventilation Controls –** Review safety literature and peer-reviewed journal articles to determine appropriate engineering and ventilation controls for your process or experiment. Guidance is available from the EHS Director.
   b. **Guidance on Personal Protective Equipment -** Respiratory protection is generally not required for lab research, provided the appropriate engineering controls are employed. For additional guidance on respiratory protection, consult with the EHS Director.
   c. **Designated work area(s)** - Required whenever carcinogens, highly acutely toxic materials, or reproductive toxins are used. The intent of a designated work area is to limit and minimize possible sources of exposure to these materials. The entire laboratory, a portion of the laboratory, or a laboratory fume hood or bench may be considered a designated area.

2. Describe the possible risks involved with failure to follow a step in the SOP in the right hand column.

Step-by-Step Description of Your Process or Experiment	**Potential Risks if Step is Not Done or Done Incorrectly (if any)**
Step 1: Don personal protective equipment. ☐ appropriate street clothing (long pants, close-toed shoes) ☐ gloves; indicate type:_____ ☐ safety goggles ☐ safety glasses ☐ face shield ☐ lab coats ☐ other:_____	
Step 2: Check the location/accessibility/certification of the safety equipment that serves your lab including fume hoods, safety showers, spill kits, fire extinguisher, etc.	
Step 3: *Describe the next step in the procedure.*	
Step 4: *Describe the next step in the procedure (add additional steps as needed).*	
Step 5: Dispose of hazardous solvents, solutions, mixtures, and reaction residues as hazardous waste.	
Step 6: Cleanup work area and lab equipment. *[FOLLOWING GUIDANCE TEXT MAY BE DELETED]* Describe specific cleanup procedures for work areas and lab equipment that must be performed after completion of your process or experiment. For carcinogens and reproductive toxins, designated areas must be immediately wiped down following each use.	
Step 7: Remove PPE and wash hands.	

#7	**EMERGENCY PROCEDURES**

A. Health-Threatening Emergencies *(ex: fire, explosion, health-threatening hazardous material spill or release, compressed gas leak, or valve failure)*

1. **Call 911**
2. Alert people in the vicinity and activate the local alarm systems.
3. Evacuate the area and go to your Emergency Assembly Point (EAP): Indicate EAP here.
4. Remain nearby to advise emergency responders.
5. Once personal safety is established, call Campus Safety at extension 4444

[PRECEDING GUIDANCE TEXT MAY BE DELETED]

If personnel exposed or injured:

1. Remove the injured/exposed individual from the area, unless it is unsafe to do so because of the medical condition of the victim or the potential hazard to rescuers.
2. **Call 911** if immediate medical attention is required.
3. Administer first aid as appropriate.
4. Flush contamination from eyes/skin using the nearest emergency eyewash/shower for a minimum of 15 minutes. Remove any contaminated clothing.
5. Bring to the hospital copies of MSDSs for all chemicals the victim was exposed to.

B. Non-Health Threatening Emergencies

For non-health threatening injuries and exposures

Call Campus Safety at extension 4444. for

For hazardous material spills or releases which have impacted the environment (via the storm drain, soil, or air outside the building) or for a spill or release that cannot be cleaned up by local personnel:

1. call Campus Safety at extension 4444

C. Small Spills/Local Cleanup:

In the event of a minor spill or release that can be cleaned up by local personnel using readily available equipment:

1. Notify personnel in the area and restrict access. Eliminate all sources of ignition.
2. Review the MSDS for the spilled material, or use your knowledge of the hazards of the material to determine the appropriate level of protection.
3. Wearing appropriate personal protective equipment, clean up spill. Collect spill cleanup materials in a tightly closed container. Manage spill cleanup debris as hazardous waste.
4. If greater than 30 ml, or if it will take longer than 15 minutes for you to clean up, immediately call Campus Safety at extension 4444 to report the spill, and notify your supervisor.

D. Building Maintenance Emergencies (e.g., power outages, plumbing leaks):

Call Facilities Operations at 408-554-4742.

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#8	**WASTE DISPOSAL**

Describe the quantities of waste you anticipate generating and appropriate waste disposal procedures. Include any special handling or storage requirements for your waste. Contact the EHS Director for questions and additional guidance. *[PRECEDING GUIDANCE TEXT MAY BE DELETED]*

#9	**TRAINING REQUIREMENTS**

General Training *(check all that apply):*

☐Chemical Hygiene Plan

☐Other:_____

Location Where Records Maintained:

Laboratory-specific training *(check all that apply):*

☐ Review of MSDS for other chemicals involved in process/experiment

☐ Review of this SOP

☐Other:_____

Location Where Records Maintained:

#10	**PRIOR APPROVALS**

You must seek prior approval from the Chemical Hygiene Officer if you plan to use a Restricted Substance (See SCU Chemical Hygiene Plan).

Attachment 7 – Ignition and Fuel Source Guide for Laboratories

Each Laboratory Supervisor is responsible for ensuring that there is effective fire prevention in their laboratory. For laboratories, that mostly depends on (a) controlling potential sources of ignition and (b) keeping potential fuel away from potential sources of ignition.

Typical potential sources of ignition in a laboratory include the following:

- Bunsen burners
- Soldering irons
- Portable Floor Heaters
- Heat guns
- Incompatible chemicals that mix
- Hot plates, ovens, and similar types of heaters
- Electrical equipment , especially items in poor repair
- Electrical cords and power strips (especially improperly used cords or items in poor repair – see the SCU Electrical Standards for further information on proper use of such items)

Typical potential sources of fuel in a laboratory include the following:

- Paper or cardboard of various types
- Flammable gases such as propane or natural gas.
- Flammable or combustible liquids
- Plastics

The process of fire prevention involves (a) housekeeping and attention to ongoing operations to ensure that ignition and fuel sources are properly separated and (b) periodic inspections of electrical and other equipment to ensure that it is in good repair.

Attachment 8 – Restricted Substances

The California Occupational Safety and Health Administration's (OSHA) Laboratory Standard (8 CCR 5191(e)(3)(H), requires that provisions be made by the Laboratory Supervisor for employee protection for work with hazardous substances. SCU has developed the following Restricted Substance List
that contains these hazardous substances:

- Select carcinogens
    - Regulated by OSHA as a carcinogen; or
    - Listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens" published by the National Toxicology Program (NTP) (http://ntp.niehs.nih.gov/?objectid=72016262-BDB7-CEBA-FA60E922B18C2540); or
    - Listed under Group 1 ("Carcinogenic to Humans") by the International Agency for Research on Cancer (IARC) Monographs (http://monographs.iarc.fr/ENG/Classification/index.php); or
    - Listed in either Group 2A or 2B by IARC or under the category "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:
        - After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m3; or
        - After repeated skin application of less than 300 mg/kg of body weight, per week; or
        - After oral dosages of less than 50 mg/kg of body weight per day.
- Reproductive toxins
    - Substances that cause chromosomal damage and substances with lethal or teratogenic effects on fetuses.
- Acutely toxic substances and gases
    - The ability of a chemical to cause a harmful effect after a single exposure. Parameters for assessing the risk of acute toxicity of a chemical are its LD50 and LC50 values. Acutely toxic chemicals meet the following criteria:
        - Chemicals with an Oral LD50 in rats <50 mg/kg.
        - Chemicals with a skin contact LD50 in rabbits <200 mg/kg.
        - Chemicals with an inhalation LC50 in rats <200 ppm/hour.
- Chemicals with a NFPA health hazard class rating of 4,
- DEA Controlled Substances,
- Cryogenic liquids,
- Explosives,
- Peroxidizers,
- Reactive and Water Reactive materials,

- Pyrophorics,
- Toxic gases as regulated by Santa Clara County,
- CalOSHA Reportable Chemicals, and
- EPA Extremely Hazardous Substances and Wastes.

Designated Areas

Specific consideration should be given to the establishment of a designated area, the use of containment devices, procedures for safe removal of contaminated waste, and decontamination procedures. Designated areas are areas that are defined as being used for work with hazardous substances and within which, certain types of precautions must be employed. A designated area may be the entire laboratory, an area of a laboratory, or a device such as a laboratory fume hood or glove box.

Additional Protection

Additional employee protection will be considered for work with hazardous substances. Laboratory supervisors are responsible for assuring that laboratory procedures involving hazardous chemicals have been evaluated for the level of worker protection required. Specific consideration will be given to the following areas:

- Planning the experiment and protocol;
- Establishment of a designated area;
- Access control;
- Use of containment devices such as fume hoods or glove boxes;
- Use of Personal Protective Equipment;
- Isolation of contaminated equipment;
- Practicing good laboratory hygiene and housekeeping;
- Prudent transportation of hazardous substances;
- Planning for accidents and spills; and
- Special storage and waste disposal practices.

Responsibilities

It is the responsibility of the Laboratory Supervisor to ensure that Restricted Substance determination is conducted on existing chemical inventories and on all future chemical purchases for their laboratory. Prior to beginning work with a Restricted Substance or once a Restricted Substance determination is made, the Laboratory Supervisor shall complete a **SCU Restricted Substance Approval Form** which reproduced at the end of this section. All employees who work with a Restricted Substance must have a prior approved Restricted Substance Approval Form on file.

SCU Restricted Substance Approval Form

The purpose of the **SCU Restricted Substance Approval Form** is to ensure that employees are adequately trained and familiar with the physical and health hazards prior to the use of the substance. Procedures for containment, storage, and waste management shall be described in detail. Safety precautions shall be addressed including: assignment of

a designated area, personal protective equipment (PPE), ventilation requirements, methods of monitoring exposure, first aid procedures, and spill or leak clean-up procedures.

A written **SCU Restricted Substance Approval Form** must be approved and signed by the Laboratory Supervisor and the CHO before work with **Restricted Substance** begins. Consultation with the CHO while completing the form is recommended to ensure that procedures and safety

precautions are adequate. The approved form shall be kept on file in the laboratory (readily accessible for use in an emergency.

The Laboratory Supervisor shall review and resubmit the **SCU Restricted Substance Approval**
Form if procedures and processes change.

Recordkeeping

The original approved copy of the **SCU Restricted Substance Approval Form** must be kept on file by the Laboratory Supervisor.

Designated Area(s)

Restricted Substances must be used in designated areas ONLY. The designated area must be identified and the boundaries clearly marked (See: "Warning Signs," below). Unauthorized personnel (i.e., persons who are NOT approved for use on the **SCU Restricted Substance Approval Form**) are restricted from entry into a designated area while work with the **Restricted Substance** is being performed.

Warning Signs

When the **Restricted Substance** is being used, designated areas must be posted with signs that denote the nature of the hazard. Contact EHS for appropriate signage, which will be supplied to properly address the type of designated area identified by the laboratory, and will provide suitable hazard warnings.

Personal Protective Equipment (PPE)

Chemically compatible gloves shall be used with **Restricted Substances**. It is recommended that glove manufacturers and/or EHS be contacted for compatibility information and assistance in selecting the appropriate glove. Other protective equipment and apparel such as a fully closed laboratory coat and chemical splash goggles and/or a face shield may be required according to the approved **Restricted Substance Approval Form**.

Containment

Restricted Substances should generally be used in a fume hood or glove box. Spill protection in the form of plastic backed matting (hospital paper) or chemical resistant pans should be employed. All weighing operations involving **Restricted Substance** shall be performed in a certified laboratory
fume hood, glove box, approved vented enclosure or by specified written procedure to manage risk. Air exhausted from glove boxes where **Restricted Substances** are handled must be vented to a certified fume hood or exhaust system.

Storage

Restricted Substance containers must be labeled as such (EHS can provide labels for this activity). Refer to other sections of the Chemical Hygiene Plan for general information on proper chemical storage, transportation and compatibility.

Decontamination and Waste

Every effort should be made to minimize spills or loss of **Restricted Substances**. All **Restricted Substances** must be disposed of as hazardous waste. During decontamination, all equipment should be thoroughly rinsed with a suitable solvent (which may be organic or water-based, depending on the material). This solvent should be collected as hazardous waste. Care should be exercised to prevent contamination of the outside of the waste container. In the event that decontamination is not feasible, the equipment should be placed in an impervious container that is sealed and properly labeled and disposed of as hazardous waste (contact EHS for hazardous waste disposal).

All solid **Restricted Substance** waste must be sealed in double-lined plastic bags and disposed of as hazardous waste.

When composed of finely divided solid materials, wet wiping, or mopping should clean spills of **Restricted Substances** . Water reactive materials should not be wiped up with a damp cloth. Dry sweeping should NOT be done. Contaminated toweling used for the cleanup of hazardous materials shall be disposed of as a **Restricted Substance** hazardous waste.

Employees should leave protective apparel in designated areas and wash hands and arms before leaving designated areas if possible.

Safety Precautions

Ensure that all laboratory occupants are aware of the hazards involved with each **Restricted Substance**s. Keep first aid procedures and materials readily accessible for use during an emergency.

Exposures

Never exceed exposure limits (consult MSDS). Know how a particular chemical can enter the body and symptoms of exposure. Notify your supervisor and the CHO if you suspect exposure. Seek medical attention if you suspect exposure.

Santa Clara University provides all employees who have received a hazardous chemical exposure the opportunity to receive medical attention.

Items Not Covered

Any specific safety program approaches or other items not covered by this program should be submitted to the CHO for review and approval.

SCU Restricted Substance Approval Form

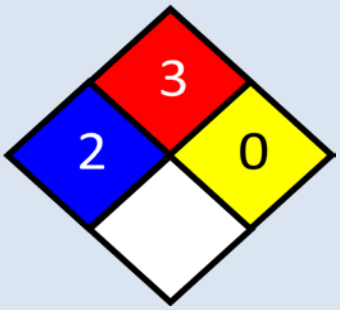
Before acquiring or using a Restricted Substance, please complete this form, sign it and obtain the CHO's approval.

Attachment 9 - SCU Hazard Label Requirements

Substance Name:
Acetone
Hazard Warning:
Flammable
Prepared by:
Date:

From Guide to California Hazard Communication Regulation published by CalOSHA:
If during the course of work, hazardous substances are transferred from the original container to a secondary portable container, the employer needs to ensure that the secondary container is labeled with the following information:
1. Identity of the hazardous substance
2. Hazard warning statements
http://www.dir.ca.gov/dosh/dosh_publications/hazcom. pdf

Alternative label with NFPA diamond hazard warning:



Substance Name:
Acetone
Prepared By:
Date:

Secondary container label with text hazard warning

Satellite Accumulation Start Date: June 15, 2010

HAZARDOUS WASTE Composition:
Isopropanol and Water Physical State: Liquid
Hazardous Properties: Flammable

Generator: Santa Clara University
500 El Camino Real
Santa Clara, CA 95053

Date Quantity Reached:

Satellite Accumulation Labels must have the following information:
- The accumulation start date for the waste (i.e., the date waste was first placed in the container);
- The words HAZARDOUS WASTE.
- The composition of the waste;
- The physical state of the waste (i.e., solid or liquid);
- The hazardous properties of the waste (i.e., flammable, corrosive, reactive, toxic);
- The name of the waste generator;
- The address of the waste generator.
- Within 3 days of reaching the 55 gallon or one quart point of generation satellite accumulation limit, the container must be marked with the date the quantity limit was reached.

From:
http://www.dtsc.ca.gov/HazardousWaste/upload/HWM_FS_Accumulating_Haz Waste_Generator.

Global Harmonization Hazard Symbols and Their Meanings