W.M. Keck Science Department

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CHEMICAL HYGIENE PLAN

2019-2020

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INTRODUCTION

The purpose of the W. M. Keck Science Department's Chemical Hygiene Plan (CHP) is to establish a written program that provides for and supports the procedures, equipment, personal protective equipment, and work practices for protecting laboratory personnel from potential health hazards of using hazardous chemicals in the laboratory.

The CHP is also designed to comply with the regulations of California's Occupational Safety and Health Administration (Cal/OSHA) *Occupational Exposure to Hazardous Chemicals in Laboratories*, Title 8-California Code of Regulations, Section 5191 http://www.dir.ca.gov/title8/5191.html.

Components of the Chemical Hygiene Plan include:

I. Roles and Responsibilities
II. Standard Operating Procedures
III. Hazard Recognition
IV. Control Methods for Chemical Hazards
V. Incident and Emergency Response
VI. Training

Objectives of the Chemical Hygiene Plan include:

- Protect the health and safety of the W. M. Keck Science Department's faculty, staff, students and visitors.
- Provide safe work practices – academic, research, and administrative – for faculty, staff students, and visitors.
- Provide information to faculty, staff, students and visitors about health and safety hazards.
- Identify and reduce risk from health and safety hazards and encourage faculty, staff, and students to report hazards.
- Provide information and safeguards for the W. M. Keck Science Department and in the surrounding community regarding environmental hazards arising from operations at the W. M. Keck Science Department.

I. ROLES AND RESPONSIBILITIES

Keck Science Dean

Provide or obtain administrative and financial support, as needed, for implementing and maintaining the requirements of the CHP.

Faculty/Laboratory Supervisor

The Faculty/Laboratory Supervisor is responsible for the health and safety of laboratory personnel doing work in the laboratory. The Faculty/Laboratory Supervisor must make sure that all safety duties are carried out**.**

The Faculty/Laboratory Supervisor's responsibilities include:

- Implement and apply the CHP.
- Ensure that Standard Operating Procedures (SOP) are in place for using hazardous chemicals, emergency procedures, decontamination procedures, and waste handling are developed, available and followed.
- Ensure training and access to Safety Data Sheets (SDSs) and/or SDSs of hazardous materials used in the laboratory.
- Ensure workplace control are in functional working order (e.g., fume hoods) and safety equipment (e.g., emergency showers/eyewashes, fire extinguishers), with emphasis on controls for particularly hazardous substances.
- Ensure that appropriate personal protective equipment (PPE) and apparel are available, functioning properly, and used as required and/or needed.
- Investigate and report to the CHO any problems pertaining to the operation and implementation of laboratory practices and engineering controls.
- Identify laboratory operations, procedures and activities that require prior approval.

Laboratory Personnel

Laboratory Personnel who work with chemicals are responsible for:

- Attend necessary or required annual Laboratory Safety Training, and other training as required.

- Comply with oral and written safety rules, regulations, and procedures required for the task assigned.
- Review and understand the hazards of materials and processes in their laboratory research prior to conducting work.
- Utilize appropriate measures to control identified hazards, including consistent and proper use of engineering controls, PPE, and administrative controls.
- Understand the capabilities and limitations of PPE issued to them.
- Evaluating and maintaining PPE.
- Reporting unsafe conditions to the Faculty/Laboratory Supervisor or CHO.
- Immediately report all incident, accident or near-misses to the Keck Science Dean, CHO or supervisor and file all necessary accident forms with Human Resources (HR).
- Informing the Faculty/Laboratory Supervisor of any work environmental modifications as recommended by HR.

Chemical Hygiene Officer

The CHO is responsible for administering and overseeing institutional implementation of the CHP. The CHO provides technical guidance and resources (i.e., consulting and training materials) to personnel at all levels of responsibility on matters pertaining to laboratory use of hazardous chemicals.

- Performs hazard assessment of the overall operation to determine the appropriate safety control requirements, which include laboratory practices, PPE, engineering controls, and training.
- Assists the Faculty/Laboratory Supervisor in the selection of laboratory control methods.
- Performs industrial hygiene monitoring for evidence of personnel exposure and/or equipment contamination.
- Conducts periodic laboratory inspections.
- Reviews and evaluates the effectiveness of the CHP at least annually and updating it as necessary.

- Maintains hazardous materials inventory databases and generates necessary regulatory reporting.
- Provides technical assistance on storage, classification, compatibility, SDS's.
- Notifies the Keck Science Dean of concerns or gaps in compliance.

II. STANDARD OPERATING PROCEDURES (SOPs)

Laboratory-Specific SOPs

The Faculty/Laboratory Supervisor is responsible for providing written SOPs for specific laboratory practices involving hazardous chemicals (See Appendix A: Standard Operating Procedures Template). As needed, the CHO will review these SOPs. The Faculty/Laboratory Supervisor must ensure that laboratory personnel are trained on the use of SOPs applicable to their activities.

General Health and Safety Procedures

The Faculty/Laboratory Supervisor is responsible to ensure that all employees are trained in the use of these procedures.

- Do not work alone without prior approval.
- Develop safe work practices and avoid careless actions or horseplay.
- Be alert to unsafe conditions and immediately notify the Faculty/Laboratory Supervisor or CHO of unsafe conditions.
- Become familiar with the laboratory's emergency equipment (e.g., eyewash/shower station, and fire extinguisher).
- Adhere to the intent and procedures of the CHP. Immediately report all incident, accident or near-misses to the Keck Science Dean, CHO or supervisor and file all necessary accident forms with Human Resources (HR).

Chemical Handling

General:

- Before handling chemicals, become familiar with hazards, signs and symptoms of exposure, and precautions for preventing exposure.
- Do not underestimate hazard risks associated with chemicals or mixtures.
- If the chemical mixture toxicity is unknown, assume any chemical mixture is as toxic as its most toxic component. Assume substances of unknown toxicity are toxic.

Exposure Limits:

- When handling chemicals, do not exceed the Cal/OSHA Permissible Exposure Limits (PELs) or American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs).

Oral Pipetting:

- Prohibited. Mechanical pipetting aids must be used for all pipetting procedures.

Glassware:

- Inspect glassware for cracks and defects before using. Do not use broken or damaged glassware. Dispose of broken glass properly and label the waste containers as “Broken Glass.”
- For heating and pressurized operations, ensure that the appropriate glassware is used.
- Handle and store glassware with care to avoid damage.
- Pick up broken glassware with a broom and dustpan. Do not use your hands even if wearing gloves.

Distillations & Extractions

- Do not distill or evaporate organic solvents to dryness.
- Do not attempt any extraction until the solution is cooler than the boiling point of the extractant.
- Do not vent the separatory funnel near a flame or other ignition source.

Chemical Transport:

- Place chemical containers in secondary containment for transport.
- If several items are being transported, use a cart with side rails and/or use the original shipping containers to reduce the chance of an accidental spill.
- If multiple glass bottles are transported in a secondary container, make sure they are secured to minimize rattling to avoid breakage.
- Do no transport top-heavy items on carts. Always balance the load.

- Make sure incompatibles are transported separately.
- Do not ride the elevator with particularly hazardous chemicals or gas cylinders. Send the elevator alone with the chemicals or gas cylinders and meet it on the appropriate floor. Two people may be necessary.

Decontamination of Work Surfaces and Equipment:

Preventive Measures:

- Protect work surfaces (e.g., bench tops, hood surfaces, and floors) from contamination (i.e., cover with stainless steel or plastic trays, dry absorbent plastic backed paper or other impervious material). Immediately decontaminate or dispose of contaminated items used to protect work surfaces from contamination.

Methods of Decontamination:

The decontamination method selected depends on the type of material that has been spilled. SDS and chemical reference books can provide information on the selection of an appropriate method. The method of decontamination selected must be compatible with the spilled material and the conditions in the laboratory. The method chosen should be based on specific spill conditions (See Appendix B: Common Methods of Decontamination).

Chemical Storage

- Store stock quantities of hazardous chemicals in a secured area.
- Keep working quantities of chemicals to a minimum.
- Store flammable liquids in excess of 10 gallons in approved flammable liquid storage cabinets.
- Storage of flammable liquids outside of a flammable liquid storage cabinet must be placed in secondary containment and must be in an approved flammable liquid container, such as the original DOT approved container, in which it was shipped.
- Segregate reactive chemicals from incompatible chemicals (see Appendix C).
- Affix appropriate labels to storage containers.

Chemical Inventory

An inventory will be maintained listing all chemicals in the laboratory and storerooms. Chemicals will be listed alphabetically by location according to the most commonly used name. The inventory records will include the chemical name, average quantity on hand, the Chemical Abstract Sequencing Number (CAS #), and the manufacturer's name. As new chemicals are purchased, the CHO will be notified to make additions in the chemical inventory.

Laboratory Fume Hood Usage

The laboratory fume hood encloses an operation by providing a physical barrier between the user and other room occupants from hazardous gases and vapors. It provides protection from a possible chemical spill, release, or explosion as well.

- Prior to using a fume hood, become familiar with the location of the nearest exit, emergency shower/eyewash station, and fire extinguisher. Make sure the access to these areas is unobstructed.
- The hood is not a substitute for PPE. Always consult with the Faculty/Laboratory Supervisor to determine what types of PPE are required, such as safety glasses/goggles, lab coat, gloves, and etc.
- Know the toxic properties of the chemical with which you work. Be able to identify signs and symptoms of an exposure.
- Check the certification date on the hood. Only use the hood if its certification is current (certified within the last year). Do not use an out of certification hood. Immediately report out of certification hoods to the CHO or Faculty/Laboratory Supervisor. CHO will post an "out of service" notification on the hood.
- The sash is designated for use as a safety shield in case of a spill. Adjust the sash at or below the point that will not trigger the alarm. Keep the sash clean and clear. Use an appropriate shield if there is a chance of an explosion or eruption. Keep the sash completely lowered when there is no experiment in progress or whenever the hood is on and unattended.

- Avoid rapid movements in the hood when sash is open because movements may create sufficient turbulence to disrupt the air flow and cause contaminants to escape the hood and enter the room.
- Keep laboratory doors closed when a fume hood is in use.
- Do not place hazardous waste into the hood for evaporation. Hazardous waste must be accumulated for proper disposal.
- Keep all apparatus at least 6 inches behind the sash and from the rear of the hood.
- Avoid over storage of laboratory equipment in fume hoods.
- Clean all chemical residues in the hood after each use.
- Do not use a fume hood for any function which it is not intended. Certain chemicals or reactions require special constructed hoods. Examples are perchloric acid or high pressure reactions.
- Do not use a fume hood for storage or equipment or chemicals.

Hot Plate Usage

- Use a temperature control unit or a thermometer to monitor the temperature. Do not use mercury thermometers – instead use an alcohol thermometer.
- Replace unreliable or malfunctioning equipment.
- Use water baths for temperatures up to 70 – 80 °C. Use silicon oil baths at temperatures of 80 – 200 °C. For temperatures above 200 °C, use a sand bath.
- Use only heat resistant, borosilicate glassware, and check for cracks before heating on a hot plate. Do not place thick-walled glassware, such as filter flasks, or soft-glass bottles and jars on a hot plate.
- Do not heat a mixture to dryness – the glass may crack unexpectedly.
- Be careful when removing hot glassware or pouring hot liquids from a hot plate. Use gripping devices such as tongs or silicone rubber heat protectors.
- Use a medium high setting of the hot plate to heat most liquids, including water. Do not use a high setting to heat low boiling point liquids.
- Place magnetic or mechanical stir bars in liquids being heated to facilitate even heating and boiling.
- Do not leave a standard hot plate unattended.

- If a reaction must be left unattended, use a hot plate with overshoot protection.
- Periodically check the bath temperature.
- Maintain a three inch clearance of any materials from a hot plate.
- Remove any flammable or combustible materials from the fume hood when using the hot plate and keep the fume hood and work area clutter free.

Compressed Gas Cylinders

- Wear eye protection when handling compressed gases.
- Make sure that the correct regulator and Compressed Gas Association (CGA) connector is being used.
- Secure cylinders at the top and bottom. Keep the cylinder capped when not in use.
- Adjust the racks so that cylinders can be tightly secured.
- Do not expose cylinders to temperatures greater than 50° C (122° F).
- Do not lubricate, modify, force, or tamper with cylinder valves.
- Use only the correct fittings and connections to ensure compatibility.
- Avoid rapid release of compressed gases that can cause the hose to whip dangerously and/or build up a static charge that could ignite a combustible gas.
- Segregate gas cylinder storage from chemical storage.
- Keep incompatible glasses of gases stored separately. Keep flammables from reactive which include oxidizers and corrosives.
- Always label cylinders so you know their contents; do not depend on the manufacturers color code.
- When cylinders are no longer in use, shut the valves, relieve the pressure in the gas regulators, remove the regulators and cap the cylinders.
- Segregate empty cylinders from full cylinders.
- Gas cylinders, including lecture bottles should be stored in an upright manner.
- Toxic gases must be stored and used in a vented cabinet
- Corrosive gases should be disposed of as hazardous waste when not in use. Manufacturers recommend removal no later than one year after use.

New Procedures

- Evaluate all new experimental/operational procedures with Faculty/Laboratory Supervisor (See Appendix D: Guidelines for developing new procedures).

Housekeeping

Each laboratory worker is directly responsible for the cleanliness of their work space, and jointly responsible for common areas of the laboratory. The Faculty/Laboratory Supervisor is responsible for the maintenance of housekeeping standards.

The following procedures apply to the housekeeping standards of the laboratory:

- All spills on lab benches or floors must be immediately cleaned and decontaminated.
- The lab benches and fume hoods shall be kept clear of equipment and chemicals except those necessary for the work currently being performed.
  - Keep work areas clean and free from obstruction. Designate work areas away from paper work/computer areas.
  - Clean the work area at the end of each operation and on a regular basis.
  - Remove clutter from fume hoods when running chemical reactions.
  - Clean and return lab equipment to storage after each use.
- All floors, aisles, egress, fire extinguishers, eyewash/shower stations, electrical disconnects, and other emergency equipment will be accessible without obstructions.
  - Do not leave chemical containers on the floor
  - Remove excess cardboard boxes, styrofoam, or other combustibles from the lab.
  - Doors and eyewash/shower stations should not be blocked by any items.
- Chemical containers should be clean, properly labeled, and stored properly after each use.
  - Use secondary containment.
  - Flammables must be stored in flammable storage cabinets.

Hygiene Practices

Personal Hygiene:

- Keep hands away from mouth, nose, eyes and face.
- Confine long hair and loose clothing.
- Wear only non-absorbent, closed-toe shoes.
- When working with chemicals head to toe coverage is required.

Work Practices:

- Laboratories can have designated Clean Areas. These areas must be free of chemical, biological, and radioactive hazards and must be posted as such. All laboratory personnel must agree to the Clean Areas, or cross contamination can easily occur.
- Eating and drinking is not permitted in anywhere in the laboratory not designated as a Clean Area.
- Smoking, chewing gum or tobacco, or cosmetics is not permitted anywhere in the laboratory, including Clean Area.
- Do not smell or taste chemicals.

Decontamination:

- Wash areas of exposed skin before leaving the laboratory.
- Hand washing facilities are available within the work area, but not necessarily used exclusively for hand washing.
- Use liquid soap, whenever possible.

Eyewash and Safety Shower

- Ensure properly functioning eyewash and safety shower are accessible within 10 seconds to all laboratory personnel who handle hazardous chemicals.
- Keep the area around the eyewash and safety shower clear at all times.
- Eyewash and safety showers will be inspected monthly.

Hazardous Waste Management

Hazardous chemical wastes are properly stored, collected, and disposed.

Hazardous Waste Guidelines

- Do not pour hazardous waste down the drain.
- Do not evaporate hazardous waste in the fume hood.
- Do not purchase more of a chemical than you expect to use in the foreseeable future. The cost of disposal often exceeds the purchase price of the chemical.
- Hazardous waste containers must be completely labeled and dated when the first drop of hazardous waste goes in.
- Waste containers must be kept closed except when adding hazardous waste.
- Waste containers must be kept in secondary containment.
- For disposal of unknown chemicals, contact the CHO.

III. HAZARD RECOGNITION

The Faculty/Laboratory Supervisor with assistance from the CHO is responsible for understanding the hazards related to the use, storage, and disposal of laboratory chemicals.

Safety Data Sheets (SDSs)

The most important aspect to the recognition process is ensuring that laboratory personnel have access to Safety Data Sheets (SDSs). SDSs are documents prepared by the manufacturer and are available for most laboratory chemicals. For chemicals which SDSs are not available on the website, SDSs must be obtained from the manufacturer via postal mail or fax and maintained at the laboratory where the chemicals are used. The Faculty/Laboratory Supervisor with the assistance of the CHO is responsible for providing training regarding SDSs retrieval online.

Classes of Hazardous Chemicals

Hazardous chemicals have intrinsic physical, chemical, and toxic properties that require proper handling and storage procedures. If a chemical exhibits any of the following characteristics, it is classified as a hazardous chemical: (1) Flammable (2) Reactive (3) Corrosive (4) Toxic.

<u>Flammable Chemicals</u>

- Chemicals that have a flashpoint below 100 °F.
- Must be stored in a flammable cabinet with secondary containment or approved flammable refrigerator.
- Always store and use away from oxidizers.
- Always use in chemical fume hoods. If the experiment or procedure requires usage outside of a fume hood, the experiment or procedure must be reviewed and approved by the Faculty/Laboratory Supervisor.

Reactive Chemicals

- Chemicals that polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature.
- Can be water reactive, air reactive, oxidizer, acid sensitive, or peroxide forming (see Appendix E for description of each; see Appendix F for Air Reactive Standard Operating Procedures Template).
- Handle reactive chemicals with the proper safety precautions as described in the chemical's Safety Data Sheet.

Corrosive Chemicals

- Chemical that cause visible destruction of, or irreversible alterations in living tissue by chemical action at the site of contact
- If chemical pH at 2 or less, it is a corrosive acid (e.g., sulfuric acid, nitric acid).
- If a chemical pH at 12.5 or greater, it is a corrosive base (e.g., ammonia, sodium hydroxide).
- Always store acids away from bases. When using acids, avoid bases, and vice versa.

Toxic Chemicals

- Toxicity levels of chemicals are determined by its lethal dose 50 (LD_{50}) or lethal concentration 50 (LC_{50}). LD_{50} and LC_{50} can be found in the chemical's MSDS and/or SDS.
- Can be an asphyxiant, anesthetic, irritant, allergic sensitizer, systemic toxins, or CAL/OSHA's "particularly hazardous substances" (see Appendix E for description of each type of toxic chemical).

Laboratory Developed Chemicals

Chemicals produced in the laboratory require special consideration.

- If the composition of the chemical is known and is produced exclusively for a laboratory's own use, the Faculty/Laboratory Supervisor will determine if it is hazardous.

- If the chemical is produced as a byproduct whose composition is not known, it will be handled and stored as a hazardous chemical.

Hazardous Waste Stream

Processes that create waste streams that are potentially hazardous must be evaluated by Faculty/Laboratory Supervisor and/or CHO. In general, chemicals may not be disposed of via the sanitary sewer systems or ordinary solid waste streams unless the material being discharged is verified (pursuant to regulatory requirements) not to be a hazardous waste. Evaluation parameters are:

- Flammable
- Reactive
- Corrosive
- Toxic

Health Effects of Chemicals

Working with chemicals always involves the risk of chemical exposure. The health risk is dependent upon the toxicity of the chemical, the level of exposure, the types of effects, and the various routes of entry into the body.

<u>Toxicity vs. Hazard</u>

- Toxicity is the ability of a chemical to act as a poison or cause injury to tissues.
- Hazard is the likelihood that a chemical will cause an injury in a given environment or situation. The degree of hazard depends on how toxic the substance is, how it is absorbed, etc.

<u>Acute vs. Chronic Exposures</u>

- Acute exposure is exposure of short duration, usually to relatively high concentration or amount of material. Anhydrous ammonia gas is highly toxic and a severe irritant to the respiratory tract. Inhalation of anhydrous ammonia gas is an acute exposure that can cause chest pain and cessation of respiration, resulting in fatality.

- Chronic exposure is continuous or intermittent exposure extending over a long period, usually to relatively low material amounts or concentrations. Benzene is a known carcinogen in humans. Daily occupation exposure to benzene is a chronic exposure that can reduce the production of both red and white blood cells from bone marrow in humans, resulting in aplastic anemia.

Local vs. Systemic Effects

- Local effect is when a chemical is targeted toward a specific area of the body such as nose or throat.
- Systemic effect is when the entire body system and organs are all affected by exposure to the chemical.

Routes of Entry

There are various routes of entry whereby chemicals can gain entrance into the body.

Routes of Entry	Exposed Area	Examples
Absorption	Skin	Open wounds and abrasions, splashing of liquids
Inhalation	Nose & Mouth	Exposures to vapors, procedures that generate aerosols (pouring & pipetting)
Ingestion	Mouth	Eating or drinking contaminated food
Injection	Skin	Needle stick or pipette punctures, cuts from broken glass

Threshold Limit Value

Most health effects are dependent on the level of concentration of the exposures. The threshold limit value (TLV) is the allowable time-weight average (TWA) airborne concentration of a material to which most workers can be exposed during a normal 8-hour workday or 40-hour work week, without adverse effects.

IV. CONTROL METHODS FOR CHEMICAL HAZARDS

The most effective way to prevent adverse health effects from chemical exposure is to substitute less hazardous chemicals (e.g., substitute toluene for benzene or use aqueous soap instead of an organic solvent for cleaning). For experiments where there are no substitutions for hazardous chemicals, proper use of safety equipment is an effective method for preventing exposures and reducing hazards from chemicals. In particular, personal protective equipment (PPE) may be necessary to ensure an adequate margin of safety in case of incidental/accidental chemical release or contact.

Designated Area

To minimize contamination, designated areas are assigned for the usage of either a particularly hazardous substance or for a highly hazardous operation. For example, if carcinogens are being used in the lab, a Designated Area should be assigned and a warning label should be posted.

Engineering Controls

Faculty/Laboratory Supervisors and the CHO should be alert to the failure of engineering controls. Engineering controls must be properly maintained, inspected regularly, and never overloaded beyond their design limits. Engineering controls considered very reliable for protecting employees and the environment, include:

- Chemical fume hoods, glove boxes, closed systems, and other isolated devices. Note that fume hoods shall comply with 8 CCR 5154.1, Ventilation Requirements for Laboratory Type Hood Operations. Fume hoods are to be used, where feasible, to minimize exposure to employees of emissions from chemical processes. Each fume hood is to be inspected annually for proper face velocity and the hood's doorframe marked for maximum opening at the required face velocity. In-process use is to be verified by an in-place gauge, calibrated in linear feet per minute that can be easily read by the operator/laboratory personnel during the use of the fume hood. Toxic chemicals are always handled in a fume hood.
- Negative air pressure of the work place relative to common areas.
- Non-permeable work surfaces.

- Secondary containment spill trays.

Administrative Controls

Administrative controls to prevent exposures and reduce hazards include:

- Follow Standard Operating Procedures (SOPs) outlined in this CHP for laboratory work involving hazardous chemicals.
- Plan-review for new and renovated laboratory equipment and work areas prior to installation or construction.
- Substitution of less hazardous equipment (e.g., using safety cans instead of glass bottles).
- Scaling down the size of the experiment.
- Isolating the operator or process.
- Prior approval for laboratory activities involving particularly hazardous substances or procedures.

Personal Protective Equipment

All personal protective equipment (PPE) must be approved for use by the National Institute for Occupational Safety and Health (NIOSH) and meet applicable American National Standards Institute (ANSI) requirements regarding exposure protection limits. The need for PPE must be reviewed and specified prior to beginning any chemical handling procedure and must be used when required.

Compatibility of PPE materials with the chemical hazards must be evaluated prior to selecting any equipment. Refer to the PPE manufacturer's specifications and the chemical SDS to verify proper use application.

- Employees are required to wear gloves when there is the potential for direct skin contact with hazardous chemicals.
- Lab coats are to be worn only in laboratory areas and should be buttoned to protect the laboratory personnel's skin and clothing from contamination. Lab coats are provided and maintained by the department.

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

Consult with Faculty/Laboratory Supervisor to determine what PPE below are required for the laboratory:

- Laboratory Coat
- Gloves
- Eye Protection
- Long Pants
- Closed-toe Shoes
- For additional PPE guidelines, see Appendix H.

V. INCIDENT AND EMERGENCY RESPONSE

Chemical Exposure

- Eye contact: Go to the nearest eyewash station and flush the eyes for a minimum of 15 minutes for acids, 30 minutes for alkalis. Seek immediate medical attention by calling Campus Safety at 909-607-2000.
- Ingestion: Call Campus Safety at 909-607-2000 and request emergency medical assistance.
- Body/Skin Contact: Flush the affected area with water for a minimum of 15 minutes and remove any contaminated clothing; if large area of skin is contaminated, go to your nearest shower station and flush your body with water. Seek immediate medical attention by calling Campus Safety at 909-607-2000.
- After receiving treatment, report exposures to Faculty/Laboratory Supervisor and/or CHO.
- If someone has been exposed through inhalation route, check that the site is safe before entering. Assist the victim to fresh air. Keep the victim warm. Call Campus Safety at 909-607-2000 for assistance.

Medical Surveillance & Overexposure

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

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

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

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

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

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

Basic First Aid

- For non-serious injuries (cannot be a life threatening injury or exposure to the eyes) first-aid kits are available and accessible in laboratories.
- After using first-aid kit, report injuries to Faculty/Laboratory Supervisor and/or Chemical Hygiene Officer.

Chemical Spills

Consider the following factors when determining how to handle a chemical spill:

- Size of the spill.
- Toxicity or other hazardous properties of the spilled chemical.

- Availability of clean-up materials.
- Level of knowledge and training of the person doing the clean up.
- Availability of assistance.

If the following parameters are met, laboratory personnel can clean up the spill (See Appendix I: Guidelines for Cleaning a Chemical Spill)

- Spill is small (less than a liter) and the material that is spilled does not require the laboratory personnel to wear a respirator.
- Laboratory personnel are trained and competent to clean up the spill.
- Laboratory personnel have access to resources to clean up the spill.

If one or more of the following parameters is met, do not clean up the spill (See Appendix J: What to do if you are unable to clean unable to clean up a spill)

- Laboratory personnel feel it is unsafe to proceed with clean up.
- The chemical that is spill is unknown to the laboratory personnel.
- Laboratory personnel have not been trained to clean up a spill.
- There are insufficient resources available to clean up the spill.
- The spill is large (more than one liter of spilled chemical).
- The spilled chemical is highly hazardous (e.g., laboratory personnel will require a respirator to prevent inhalation hazards).
- Laboratory personnel start to experience physical symptoms of exposure (e.g., eye irritation, difficulty breathing, coughing, dizziness, nausea, or skin irritation).

Fires

Fume Hood Fires

- For fume hood fires, if laboratory personnel are competent (completed fire extinguisher training), a fire extinguisher can be used to extinguish the fire. Once the fire has been extinguished, report the fire to Faculty/Laboratory Supervisor and Chemical Hygiene Officer.
- If the fume hood fire cannot be put out with one fire extinguisher and is continuing to spread, pull the fire alarm, evacuate the laboratory, and alert others during

evacuation. Do not use an elevator during an evacuation. Call Campus Safety at 909-607-2000 for help.

- If the laboratory personnel are not competent using a fire extinguisher or not comfortable with the size of the fume hood fire, then pull the fire alarm, evacuate the laboratory, and alert others during evacuation. Do not use an elevator during evacuation. Call Campus Safety at 909-607-2000 for help.

Person on Fire

- Use a fire extinguisher or some other object to push the person under a shower station and activate the shower station.
- Do not use your hands to push the person under a shower station.
- Call Campus Safety at 909-607-2000 to obtain medical assistance for the person. Report incident to Faculty/Laboratory Supervisor and Chemical Hygiene Officer.

General Fires

- For general fires, if laboratory personnel are competent (completed fire extinguisher training), a fire extinguisher can be used to extinguish the fire. Once the fire has been extinguished, report the fire to Faculty/Laboratory Supervisor and Chemical Hygiene Officer.
- If the fire cannot be put out with one fire extinguisher and is continuing to spread, pull the fire alarm, evacuate the laboratory (when necessary evacuate the building), and alert others during evacuation. Once at a safe location away from the fire, call Campus Safety at 909-607-2000 for help.
- If the laboratory personnel are not competent using a fire extinguisher or not comfortable with the size of the fire, then pull the fire alarm, evacuate the laboratory, and alert others during evacuation. Call Campus Safety at 909-607-2000 for help.

Earthquakes

- Immediately duck, cover, and hold.
- If there is no place in the laboratory to duck under, find a safe area that is away from items that have the potential to fall on you during an earthquake. Be aware

of containers with chemicals that can potentially fall off and break to create a splash. Faculty/Laboratory Supervisors can work with the Chemical Hygiene Officer to designate a safe area in each laboratory.

- Once shaking and aftershocks have stopped, evacuate to the assembly area. Do not use an elevator after an earthquake. Ask your Faculty/Laboratory Supervisor or Chemical Hygiene Officer where the assembly area is located.
- At the assembly area, wait for further instructions.

VI. TRAINING

Laboratory Safety Training

- All laboratory personnel must complete Laboratory Safety Training with the Chemical Hygiene Officer.
- It is the responsibility of the Faculty/Laboratory Supervisor to inform new personnel that Laboratory Safety Training must be completed.

Fire Extinguisher Training

- If laboratory personnel work in a laboratory with flammable materials, the chemical hygiene office will schedule Fire Extinguisher Training with the personnel.

Laboratory-Specific Training

- If laboratory personnel work in a laboratory that requires specific training, it is the responsibility of the Faculty/Laboratory Supervisor to provide training based on his or her knowledge and expertise.

Record Keeping

- The Chemical Hygiene Officer will manage a database that tracks Laboratory Safety Training and Fire Extinguisher Training.
- The Faculty/Laboratory Supervisor will manage any documentation for Laboratory-Specific Training (see Appendix K: Laboratory-Specific Training Record Template).

APPENDIX A: STANDARD OPERATING PROCEDURES (SOPS) TEMPLATE

HAZARDS

(List all hazards associate with the procedures, such as chemical hazards and physical hazards.)

PERSONAL PROTECTIVE EQUIPMENT

Protective Clothing: *(List all protective clothing required for the procedures, such as lab coat, long pants, and closed-toe shoes.)*

Eye Protection: *(List all protective eyewear required for the procedures, such as safety goggles.)*

Gloves: *(List the type of gloves required for the procedures, such as disposable nitrile gloves.)*

WORK PRACTICES

(List all procedures that required the research/experiment to be completed safely.)

STORAGE

(List storage procedures for chemicals used in the research/experiment.)

EMERGENCY PROCEDURES

Eye Contact: Immediately go to an eye wash station. Hold eyes open and irrigate for 15 minutes. Call Campus Safety at 909-607-2000 for medical assistance.

Skin Contact: Remove contaminated clothing. Immediately wash affected areas with soap and water. Call Campus Safety at 909-607-2000 for medical assistance.

Ingestion: Call Campus Safety at 909-607-2000 for medical assistance.

Inhalation: Call Campus Safety at 909-607-2000 for medical assistance. *(List the symptoms a person will experience if a chemical has been inhaled, such as burning in mouth or shortness of breath)*

HAZARDOUS WASTE DISPOSAL

(Determine the chemicals that will produce hazardous waste from the research/experiment.) Chemical waste in concentrated or solid form is collected as hazardous waste and should not be flushed down the drain or disposed of in the trash. Write the date received and the date opened on all containers.

Liquids: *(Determine the procedures for collecting and handling chemical waste in liquid form.)* Once the container is full, move the container in secondary containment to room 24 (in the basement) and store it in the flammable cabinet.

Solids (contaminated gloves, centrifuge tubes, paper towels, etc.): *(Determine the procedures for collecting and handling chemical waste in solid form.)* Once the polyethylene bag is full, move the bag to room 24 (in the basement) and store it in the flammable cabinet.

Gels: *(Determine if research/experiment will generate gels contaminated with chemicals. If so, determine procedures for collecting and handling contaminated gels.)*

SPILL PROCEDURES

(Determine if small spills of hazardous chemicals can be cleaned by laboratory personnel.) For large spills outside the fume hood, evacuate the laboratory and restrict access to the laboratory. Immediately notify your Faculty/Laboratory Supervisor and Chemical Hygiene Officer for assistance.

Individuals cleaning spills must wear appropriate protective equipment as described in the Personal Protective Equipment section of this document.

(Determine decontamination methods.) All spill cleanup materials and absorbents should be disposed as contaminated solids as described in the Hazardous Waste Disposal section of this document.

ADDITIONAL INFORMATION

Training: Laboratory Safety Training must be completed for users of *(Insert hazardous chemicals.)*, with the exception of an instructional lab where the *(Insert hazardous chemicals.)* is/are being used under the supervision of a faculty at all times. Laboratory Safety Training is provided by the Chemical Hygiene Officer. Email the Chemical Hygiene Officer (htang@kecksci.claremont.edu) to schedule training.

Risk Assessment: The Chemical Hygiene Officer is available to review laboratory work practices and procedures and make recommendations to promote the continuous safe use of ethidium bromide in the laboratory.

Standard Operating Procedures (SOPs) Signature Page

My Faculty/Laboratory Supervisor has reviewed the SOPs with me. I have read all the materials in the SOPs. I understand this material and how it applies to the laboratory in which I will be working with *(Insert hazardous chemicals.)*. I realize I must follow these SOPs closely to ensure my own safety, and that of my fellow laboratory mates and Faculty/Laboratory Supervisor. I have familiarized myself with the location of safety equipment contained in the laboratory, and I have asked for clarification of those points I did not understand.

Date: _____

Student Name (Please Print): _____

Signature of Student:_____

Faculty/Laboratory Supervisor (Please Print):_____

Signature of Faculty/Laboratory Supervisor:_____

APPENDIX B: COMMON METHODS OF DECONTAMINATION

Dilution – The use of water to flush hazardous materials from the contaminated surface. Most common form of decontamination.	
Advantages	▪ Readily available at most laboratory locations ▪ Will not generate toxic fumes. ▪ Safe for personnel, protective gear, work surfaces and equipment
Disadvantages	▪ Reduces contamination, but does not change chemical makeup. ▪ Creates large amounts of potentially hazardous waste. ▪ Reactions with incompatible or water reactive materials such as heavy metals.
Chemical Degradation – The altering of the chemical structure of a contaminant to make it less hazardous.	
Advantages	▪ Can permanently reduce the effects of a hazardous material. ▪ Can limit clean up costs ▪ Remaining material may be non-hazardous.
Disadvantages	▪ Should not be used on personnel. ▪ Requires chemical expertise. ▪ May produce other types of hazardous materials.
Neutralization – The introduction of another chemical to cause a chemical reaction, resulting in a less hazardous product.	
Advantages	▪ Can eliminate the original hazardous properties of a material. ▪ Common neutralization materials are often readily available.
Disadvantages	▪ Will often result in some heat generation, sometimes posing an additional risk. ▪ Decontamination reagents may be hazardous. ▪ May give off toxic gases.

APPENDIX C: INCOMPATIBLE CHEMICALS

When transporting, storing, using, or disposing of any substance, exercise utmost care to ensure that the substance cannot accidentally come in contact with another with which it is incompatible. Such contact can result in an explosion or the formation of substances that are highly toxic, flammable, or both. The following table is a guide to avoiding accidents involving incompatible substances.

Examples of Incompatible Chemicals:

Chemical	Incompatible with
Acetic Acid	Chromic acid, nitric acid, perchloric acid, peroxides, permanganates, oxidizers
Acetone	Concentrated nitric and sulfuric acid mixtures, strong bases
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Alkali and alkaline earth metals	Water, carbon tetrachloride or other chlorinated hydrocarbons, powdered aluminum or magnesium, carbon dioxide, halogens, calcium, lithium, sodium, potassium.
Ammonia (anhydrous)	Mercury, chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid
Ammonium nitrate	Acids, powdered metals, flammable liquids, chlorates, nitrites, sulfur, finely divided organics or combustibles
Aniline	Nitric acid, hydrogen peroxide
Arsenical materials	Any reducing agent
Azides	Acids
Bromine	See Chlorine
Calcium Oxide	Water
Carbon (activated)	Calcium hypochlorite, all oxidizing agents
Carbon tetrachloride	Sodium
Chlorates	Ammonium salts, acids, powdered metals, sulfur, finely divided organic or combustible materials
Chromic acid and chromium trioxide	Acetic acid, naphthalene, camphor, glycerol, alcohol, flammable liquids in general
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, benzene, finely divided metals, turpentine
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulfide
Copper	Acetylene, hydrogen peroxide
Cumene hydroperoxide	Acids (organic or inorganic)
Cyanides	Acids
Decaborane	Carbon tetrachloride and other halogenated hydrocarbons
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Fluorine	Everything
Hydrocarbons (such as butane, propane)	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
Hydrocyanic acid	Nitric acid, alkali
Hydrofluoric acid (anhydrous)	Ammonia (aqueous or anhydrous)
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane
Hydrogen sulfide	Fuming nitric acid, oxidizing gases
Hypochlorite	Acids, activated carbon

Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Mercury	Acetylene, fulminic acid, ammonia
Nitrates	Sulfuric acid
Nitric acid (concentrated)	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, brass, any heavy metals
Nitrates	Acids
Nitroparaffin	Inorganic bases, amines
Oxalic acid	Silver, mercury
Oxygen	Oils, grease, hydrogen, flammable liquids, solids, or gases
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease, oils
Peroxides, organic	Acids (organic or mineral). Avoid friction, store cold.
Phosphorous (white)	Air, oxygen, alkalis, reducing agents
Potassium	Carbon tetrachloride, carbon dioxide, water
Potassium chlorate	Sulfuric and other acids
Potassium perchlorate	Sulfuric and other acids
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, sulfuric acid
Selenide	Reducing agents
Silver	Acetylene, oxalic acid, tartaric acid, ammonium compounds, fulminic acid
Sodium	Carbon tetrachloride, carbon dioxide, water
Sodium nitrite	Ammonium nitrate and other ammonium salts
Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerine, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulfides	Acids
Sulfuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate (similar compounds of light metals, such as sodium, lithium)
Telluride	Reducing agents
Chromic acid and chromium trioxide	Acetic acid, naphthalene, camphor, glycerol, alcohol, flammable liquids in general

APPENDIX D: GUIDELINES FOR DEVELOPING NEW PROCEDURES

Important factors in planning and evaluating an experiment include:

- The properties of the chemicals to be used
- Physical properties
- Reactivity
- Flammability
- Radiation
- Toxicity
- Biological and health effects
- Chemical products of the experiment

Select the appropriate engineering controls:

- Fume hoods
- Shielding
- Glove boxes
- Vacuum lines
- Any special equipment unique to the experiment

Select the appropriate personal protective equipment based on the chemical properties evaluation:

- Eye protection
- Lab coats
- Aprons
- Face protection
- Shielding
- Gloves

Implement administrative controls:

- Review the experiment with the laboratory supervisor
- Inform the group of any special hazards

APPENDIX E: REACTIVE CHEMICALS

Water Reactive

Chemical can react with water or moisture in air to produce toxic gas or heat, become flammable, or explode (e.g., sulfuric acid). Store and use away from water sources.

Air Reactive

Chemical can ignite spontaneously in air at room temperature (e.g., ammonium nitrate, pyrophorics). Laboratory personnel must receive proper training from the Faculty/Laboratory Supervisor prior to working with air reactive chemicals. Laboratory personnel must work direct supervision as well. Store properly in a flammable cabinet and use only in a chemical fume hood. See Appendix F: Air Reactive (Pyrophorics) Standard Operating Procedures Template.

Oxidizing

Chemical can detonate or explode under conditions of strong heat, confinement, or shock (e.g., nitric acid). Store and use away from flammable chemicals.

Acid Sensitive

Chemical can react with acids to produce toxic gas or heat, become flammable, or explode (e.g., hydroxides). Store and use away from acids.

Peroxide Forming Chemicals (PFCs)

- Peroxide Forming Chemicals (PFCs) are extremely sensitive to shock, heat, and friction (e.g., styrene). PFCs can react with oxygen in ambient air to form shock-sensitive peroxide crystals.
- They should be stored in airtight containers in a dark, cool, and dry place and must be segregated from other classes of chemicals that could create a serious hazard to life or property should an accident occur (e.g., acids, bases, oxidizers).
- The containers should be labeled with the date received and the date opened. This information, along with the chemical identity should face forward to minimize container handling during inspection.

- Minimize the quantity of peroxide forming chemicals stored in the laboratory and dispose of peroxide forming chemicals before peroxide formation.
- Carefully review all cautionary material supplied by the manufacturer prior to use.
- Avoid evaporation or distillation, as distillation can remove the stabilizer added to the solvents. Ensure that containers are tightly sealed to avoid evaporation and that they are free of exterior contamination or crystallization.
- Never return unused quantities back to the original container and clean all spills immediately.
- If old containers of peroxide forming chemicals are discovered in the laboratory, (past the expiration date or if the date of the container is unknown), do not handle the container. If crystallization is present in or on the exterior of a container, do not handle the container. Immediately alert other laboratory personnel about the container and notify the Faculty/Laboratory Supervisor and Chemical Hygiene Officer.

APPENDIX F: AIR REACTIVE (PYROPHORICS) CHEMICALS STANDARD OPERATING PROCEDURES (SOPS)

PURPOSE

Standard operating procedures (SOPs) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (e.g., both the SOPs for flammable liquids and carcinogens would apply to benzene). This SOP is intended to inform on safe working practices to follow whenever pyrophoric chemicals are utilized in the research laboratory. It is not a substitute for hands-on training by the Faculty/Laboratory Supervisor. This SOP should be read and understood prior to the commencement of relevant work and used to complement supervised practical familiarization with the various techniques described. If you have questions concerning the applicability of any item listed in this procedure consult with your Faculty/Laboratory Supervisor. Specific written procedures are the responsibility of the Faculty/Laboratory Supervisor.

If compliance with all the requirements of this standard operating procedure is not possible, the Faculty/Laboratory Supervisor must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOPs it replaces. The Chemical Hygiene Officer is available to provide guidance during the development of alternate procedures.

HAZARD

Pyrophoric chemicals are liquids, solids, and gases that will ignite spontaneously in air at or below 130 °F. Pyrophoric chemicals have the potential to explode or produce fire.

TRAINING PRE-REQUISITES

Hands-On Training: All users of pyrophoric chemicals in the laboratory must receive hands-on training and instruction from the Faculty/Laboratory Supervisor and must be closely supervised until safe work practices are consistently demonstrated. This training must be documented so that proof of training is available upon request.

Laboratory Safety Training: Laboratory Safety Training must be completed for users of pyrophoric chemicals. Laboratory Safety Training is provided by the Chemical Hygiene Officer. Email the Chemical Hygiene Officer (htang@kecksci.claremont.edu) to schedule training.

Fire Extinguisher Training: Fire Extinguisher Training must be completed for users of pyrophoric chemicals. Email the Chemical Hygiene Officer (htang@kecksci.claremont.edu) for upcoming trainings.

ENGINEERING CONTROLS

Fume hood: Many pyrophoric chemicals release noxious or flammable gases and must be handled in a hood. In addition, some solid pyrophoric materials are stored under kerosene therefore the use of a fume hood is required to prevent the release of flammable vapors in the laboratory. Before commencing any experiment involving a pyrophoric chemical, ensure that the fume hood to be used is clear of clutter and that any unnecessary potentially combustible or flammable materials have been removed. Fume hood space must never be used for solvent storage).

Glove box: Glove boxes must be used to handle pyrophoric chemicals if inert or dry atmospheres are required.

Safety shielding: Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of pyrophoric chemicals which pose this risk must occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants are acceptable.

PERSONAL PROTECTIVE EQUIPMENT

Protective Clothing: A flame resistant lab coat must be worn at all times when working with pyrophoric chemicals. In addition, wear standard laboratory apparel including a long pants and closed-toe shoes. Leave lab coats in the lab when your work is complete to prevent the spread of this or other chemicals outside of the lab.

Eye Protection: Chemical safety goggles the meet the ANSI Z.87.1 1989 standard must be worn at all times when handling pyrophoric chemicals.

Gloves: Gloves must be worn when handling pyrophoric chemicals. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. Wash hands thoroughly after removing gloves.

STORAGE

All pyrophoric chemicals must be clearly labeled with the correct chemical name and hazard information. Pyrophoric chemicals should always be stored in their original commercial container.

Pyrophoric chemicals should be stored under an atmosphere of inert gas or under an appropriate liquid. Do not store pyrophoric chemicals with flammable materials or in a flammable storage cabinet. Pyrophoric chemicals must be stored away from sources of ignition. Store bottles of pyrophoric chemicals inside the original metal shipping can, if available, to provide additional protection and secondary containment.

Never return excess chemicals to the original container. Introducing small amounts of impurities into the container can cause a potential fire or explosion.

Date containers upon initial receipt and upon opening. Take note of any printed expiration dates on the container label and dispose of them as required. Many pyrophoric chemicals become unstable or more dangerous with age.

Pyrophoric chemicals are typically shipped in bottles provided with gas impermeable septa such that transfers can be made via needles under a chemically inert atmosphere. Never remove the protective septum from such a bottle in an air atmosphere.

Purchase pyrophoric chemicals in the minimum quantity required for the work to be performed. Initial cost per volume/weight may be lower when chemicals are purchased in bulk, but repeated opening of containers and puncturing of septa leads to product degradation and loss. Wasted material and disposal cost will often offset any initial savings.

EMERGENCY PROCEDURES

A safety shower and eye wash station must be available in a nearby location where the pyrophoric chemicals are used. Laboratory personnel should familiarize themselves with the location of the nearest safety shower and eyewash station inside the lab prior to beginning work with pyrophoric materials. Also before starting work, know the location of the nearest fire extinguisher and fire alarm pull station

Eye Contact: Immediately go to an eye wash station. Hold eyes open and irrigate for 15 minutes. Call Campus Safety at 909-607-2000 for medical assistance.

Skin Contact: Remove contaminated clothing. Immediately wash affected areas with soap and water. If the contamination is on a large section of the body, immediately go to the nearest shower station for decontamination. Call Campus Safety at 909-607-2000 for medical assistance.

Ingestion: Call Campus Safety at 909-607-2000 for medical assistance.

Inhalation: Call Campus Safety at 909-607-2000 for medical assistance. Symptoms of inhalation include: wheezing, coughing, shortness of breath, burning in mouth, throat or chest, dizziness, and drowsiness.

HAZARDOUS WASTE DISPOSAL

All materials contaminated with pyrophoric chemicals should be disposed of as a hazardous waste. A container with any residue of pyrophoric materials should never be left open to the atmosphere. Any unused or unwanted pyrophoric materials must be destroyed by transferring the materials to an appropriate reaction flask for hydrolysis and/or neutralization with adequate cooling. The essentially empty container should be rinsed three times with an inert dry solvent; this rinse solvent must also be neutralized or hydrolyzed. The rinse solvent must be added to and removed from the container under an inert atmosphere. After the container is triple-rinsed, it should be left open in back of a hood or ambient atmosphere at a safe location for at least a week. After the week, the

container should then be triple rinsed again. The empty container, solvent rinses, and water rinse must be disposed as hazardous waste.

Immediately notify the Chemical Hygiene Officer if the lab has expired pyrophoric chemicals. Do not empty, quench, or rinse these containers with expired chemicals.

SPILL PROCEDURES

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the material safety data sheet. This should occur prior to the use of any pyrophoric chemicals. Spill control materials for pyrophoric chemicals are designed to be inert and will not react with the chemical.

In the event of a spill, alert personnel in the area that a spill has occurred. Do not attempt to handle a large spill of pyrophoric chemicals. Immediately turn off all ignition sources, vacate the laboratory, and notify your Faculty/Laboratory Supervisor. If you are unable to locate your Faculty/Laboratory Supervisor or the Chemical Hygiene Officer, immediately contact Campus Safety at 909-607-2000 for assistance.

Air Reactive (Pyrophorics) SOPs Signature Page

My Faculty/Laboratory Supervisor has reviewed the Air Reactive (Pyrophorics) SOPs with me. I have read all the materials in the Air Reactive (Pyrophorics) SOPs. I understand this material and how it applies to the laboratory in which I will be working with pyrophoric chemicals. I realize I must follow these SOPs closely to ensure my own safety, and that of my fellow laboratory mates and Faculty/Laboratory Supervisor. I have familiarized myself with the location of safety equipment contained in the laboratory, and I have asked for clarification of those points I did not understand.

Date: _____

Student Name (Please Print): _____

Signature of Student:_____

Faculty/Laboratory Supervisor (Please Print):_____

Signature of Faculty/Laboratory Supervisor:_____

APPENDIX G: TOXIC CHEMICALS

Asphyxiant

Chemical that has the ability to deprive oxygen from the body. Asphyxiants work by displacing so much oxygen from the ambient atmosphere that the hemoglobin in the blood cannot pick up enough oxygen from the lungs to fully oxygenate the tissues. As a result, the victim slowly suffocates. Common asphyxiants in a laboratory setting include nitrogen, argon, and carbon dioxide. Other than carbon dioxide, most asphysicants are colorless and odorless, so inhalation of asphyxiants is possible without realizing they are present.

Anesthetic

Chemical that depresses the central nervous system, causing drowsiness, disorientation, or stupor. A common anesthetic found in a laboratory setting is ethanol.

Irritant

Irritants are defined as non-corrosive chemicals that cause reversible inflammatory effects on living tissue by chemical action at the site of contact. A wide variety of organic and inorganic compounds, including many chemicals that are in a powder or crystalline form, are irritants. The most common example of an irritant may be ordinary smoke which can irritate the nasal passages and respiratory system. Consequently, eye and skin contact with all laboratory chemicals should always be avoided. Symptoms of exposure can include reddening or discomfort of the skin and irritation to respiratory systems. Common irritants present in a laboratory include any strong corrosives.

Allergic Sensitizer

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

Systemic Toxins

- Reproductive toxins can cause chromosomal damage (mutagens) and have effects on fetuses (teratogens). Many reproductive toxins are chronic toxins that cause damage after repeated or long-duration exposures with effects that become evident only after long latency periods (e.g., ethidium bromide).
- Hepatoxins can cause liver damage (e.g., carbon tetrachloride).
- Nephrotoxins can cause kidney damage (e.g., hydrocarbons).
- Neurotoxins can cause damage to nervous system (e.g., carbon disulfide).

CAL/OSHA "Particularly Hazardous Substances"

OSHA recognizes that some classes of chemical substances pose a greater health and safety risk than others. Substances that pose such significant threats to human health are classified as "particularly hazardous substances" (PHSs). The OSHA Laboratory Standard and Cal/OSHA regulation require that special provisions be established to prevent the harmful exposure of researchers to PHSs, including the establishment of designated areas for their use. There are three types of chemicals classified as PHSs: (1) Reproductive Toxins, (2) Acute Toxins (Highly Toxic Chemicals), and (3) Carcinogens

Reproductive Toxins

- A systemic toxin that include any chemical that may affect the reproductive capabilities, including chromosomal damage (mutations) and effects on fetuses (teratogenesis). Reproductive toxins can affect the reproductive health of both men and women if proper procedures and controls are not used. For women, exposure to reproductive toxins during pregnancy can cause adverse effects on the fetus; these effects include embryolethality (death of the fertilized egg, embryo or fetus), malformations (teratogenic effects), and postnatal functional defects. For men, exposure can lead to sterility.

Acute Toxins (Highly Toxic Chemicals)

- Highly Toxic Chemicals have a high level of acute toxicity and have the ability to cause harmful local and systemic effects after a single exposure (e.g., anhydrous ammonia). These chemicals, associated chemical waste, and storage containers must be handled with care to prevent contamination of work areas and unexpected contact. These chemicals must be labeled as “Toxic.” Empty containers of these substances must be packaged and disposed of as hazardous waste without rinsing trace amounts into the sanitary sewer system.

Carcinogens

- Carcinogens can cause cancer or tumor development, typically after repeated or chronic exposure. Their effects may only become evident after a long latency period and may cause no immediate harmful effects. Cal/OSHA has classified two types of carcinogens: (1) Select Carcinogen and (2) Regulated Carcinogen.
- Select Carcinogens are materials which have met certain criteria established by the National Toxicology Program or the International Agency for Research on Cancer regarding the risk of cancer via certain exposure routes. It is important to recognize that some substances involved in research laboratories are new compounds and have not been subjected to testing for carcinogenicity. Consult with the Faculty/Laboratory Supervisor and Chemical Hygiene Officer to determine if a chemical is considered a select carcinogen.
- Regulated Carcinogens fall into a higher hazard class and have extensive additional requirements associated with them. The use of these agents may require personal exposure sampling based on usage. When working with Regulated Carcinogens, it is particularly important to review and effectively apply engineering and administrative safety controls as the regulatory requirements for laboratories that may exceed long term (8 hour) or short term (15 minutes) threshold values for these chemicals are very extensive. The table on the following page is the list of Cal/OSHA Regulated Carcinogens.

Regulated Carcinogen based on 8 CCR	
2-Acetylaminofluorene	4-Dimethylaminoazobenzene
Acrylonitrile	Ethylene Dibromide (EDB)
4-Aminodiphenyl	Ethylene Oxide
Arsenic, Inorganic	Ethyleneimine
Asbestos	Formaldehyde
Benzene	4,4’-Methylenebis(2-Chloroanile) (MBOCA)
Benzidine and its salts	Methylene Chloride
1,3 Butadiene	Methylenedianiline (MDA)
Cadmium	Alpha-Naphthylamine
Bis-Chloromethyl ether	Beta-Naphthylamine
Methyl chloromethyl ether	4-Nitrobiphenyl
Coke Oven Emissions	N-Nitrosodimethylamine
1,2-Dibromo-3-Chloropropane (DBCP)	Beta-propiolacetone
3,3’-Dichlorobenzidine and its salts	Vinyl Chloride

APPENDIX H: GUIDELINES FOR PERSONAL PROTECTIVE EQUIPMENT (PPE)

- Always consult with the Faculty/Laboratory Supervisor prior to working with chemicals to determine what types of PPE are required for the experiment and procedure.
- PPE does not provide protection against all hazards. Choose appropriate PPE depending on the hazard and task you are performing.
- PPE does not eliminate the hazard, so know the limitations of PPE and follow safety precautions while working.
- Use and maintain PPE properly to ensure its performance. Having safety goggles does no good if they are resting on the top of your head.
- PPE should be properly sized and fitted to ensure its adequacy.
- Always wear safety goggles when there is a possibility of physical damage to the eyes or when the potential of a splash from hazardous materials exists. Goggles may be worn over prescription glasses.
- When the possibility of chemical contamination exists, wear protective clothing (a lab coat) that resists physical and chemical hazards of minor chemical splashes and spills.
- Loose clothing (such as ties or overlarge lab coats), clothing that expose abdomens, back, or hips (such as shorts or tank tops), torn clothing, or unrestrained hair poses a hazard in the laboratory.
- When working with corrosive, allergenic, sensitizing, or toxic chemicals, wear gloves made of material known to be resistant to permeation by the chemical.
- Do not wear sandals, open-toed shoes, or perforated shoes in the laboratory.
- Use a fume hood whenever exposure by inhalation is likely to exceed the threshold limits described in the MSDS and/or SDS.
- Inspect all protective equipment before using. Do not use defective personal protective equipment.
- Consult with the Faculty/Laboratory Supervisor when there are any changes or new procedures.

APPENDIX I: GUIDELINES FOR CLEANING A CHEMICAL SPILL

- Inform other laboratory personnel regarding the spill, the chemical name, the location of the spill, the estimated quantity of the spill.
- Evacuate laboratory personnel who are not handling the chemical spill.
- Wear appropriate personal protective equipment (PPE) before starting clean up. Wear a minimum of safety goggles, lab coat, and gloves. If the chemical requires a respirator to clean up the spill, laboratory personnel is prohibited from cleaning the spill and the Chemical Hygiene Officer must be informed of the spill.
- Consult the MSDS and/or SDS for spill cleanup information.
- Use best available clean-up materials (spill sheets, pillows, vermiculite, paper towels, or other absorbent materials).
- Bag all clean-up materials in a polyethylene bag (available in the stockroom, aisle 5, row C). Put a waste label on the bag or write the chemical directly on the bag. Never put contaminated material into normal trash.
- Inform the Faculty/Laboratory Supervisor and Chemical Hygiene Officer there was a chemical spill and that it was cleaned up.

APPENDIX J: WHAT TO DO IF YOU ARE UNABLE TO CLEAN UP A SPILL

- Alert other laboratory personnel within the facility and evacuate the laboratory.
- Keep people away and prevent others from entering the laboratory.
- When safely away from the spill, immediately notify the Faculty/Laboratory Supervisor and/or Chemical Hygiene Officer.
- The Faculty/Laboratory Supervisor and/or Chemical Hygiene Officer will determine the scope of the evacuation or if there is a need to activate the chemical spill clean-up team.
- If is it after hours or during the weekend and the Faculty/Laboratory Supervisor and the Chemical Hygiene Office are unavailable, call Campus Safety at 909-607-2000 for help. Explain to Campus Safety that there has been a spill (let them know what the chemical is if possible and the estimated quantity that has been spilled) and you need a chemical spill team.

APPENDIX K: LABORATORY-SPECIFIC TRAINING RECORD TEMPLATE

Laboratory-Specific Training Record

Laboratory-Specific Training is required before the start of experiments. The training must be conducted by the Faculty/Laboratory Supervisor who is proficient in laboratory-specific procedures and techniques.

Faculty/Laboratory Supervisor: _____

The laboratory personnel listed below have received training in the following topics:
Example: Using chloroform in the fume hood.

1. _____
2. _____
3. _____
4. _____

Print Name	Signature	Date