Safety Manual

Chemical Hygiene Plan

CHEMISTRY DEPARTMENT

CALIFORNIA STATE UNIVERSITY, FRESNO

July 2019

This Safety Manual is for use within the Chemistry Department at Fresno State, and is not applicable outside of our department.

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SAFETY MANUAL

INTRODUCTION TO LABORATORY HEALTH AND SAFETY

The Chemistry Department has a continuing commitment to promoting and maintaining safe laboratory conditions for students, faculty, and staff. This Safety Manual is designed to comply with local, state and federal regulations which deal with the health and safety of students and employees. The University has a legal commitment to develop and implement plans dealing with Chemical Hygiene, Hazardous Materials Management, Hazardous Materials Communication, Respiratory Protection, and Injury and Accident Prevention. This manual is a supplement to the University Health and Safety Program and addresses the conditions that exist in the Chemistry Department.

General principles for working with laboratory chemicals.

- Because few chemicals are without hazards it is prudent to minimize all chemical exposures. Skin contact with chemicals should be avoided as a cardinal rule. All chemicals can be handled with safety if the hazards associated with that chemical are known and the proper precautions taken.
- Avoid the underestimation of risk. Even chemicals with no known significant hazard should be handled with care. All substances of unknown toxicity should be considered toxic. One should assume that any mixture will be more toxic than its most toxic component. Do not underestimate the hazards of non-volatile residues from distillations which may contain impurities in concentrated amounts.
- The best way to avoid exposures to airborne substances is to prevent their escape into the laboratory atmosphere with the use of fume hoods or other ventilation devices. Treat the air in the laboratory as breathing air not as a vapor dispersion medium.
- Institute and maintain a working, viable safety program designed to minimize chemical exposures. Safety should be a visible, on-going part of the educational process.
- Ventilation levels in the laboratories should never allow the Permissible Exposure Limits or Threshold Limit Values to be exceeded. Use fume hoods to control the vapors or restrict the amount of chemical in use at any given time.

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CHEMICAL TOXICITY

All chemistry departments strive to expose their students to chemical theory as well as hands on laboratory experience. One of the strengths of the CSUF Chemistry Department is that all students have an opportunity to develop expertise in the chemical laboratory using chemicals, solutions, and different types of analytical equipment. As a consequence the student is exposed to materials which may be hazardous and have the ability to cause bodily harm if used in an inappropriate manner. Although many of the chemicals used in the chemistry department have a low potential to cause harm if used according to standard chemical procedures it is good practice to check for toxic effects before using any chemical for the first time. Because toxic effects vary with the chemical, manufacturers of chemicals are required

to provide information to all users of hazardous materials detailing the hazard properties of the material. The requirements for providing this kind of information are part of the Occupational Safety and Health Administration's Federal Hazard Communication Standard. There are several parts of this manual that have been developed in response to this legislation. To understand the information provided by the manufacturers a little background information on toxicology is helpful.

Toxicology

is a branch of science that studies the harmful effects of chemical substances on biological systems e.g. student bodies. There are three elements involved in a toxic reaction: 1) a chemical agent 2) a biological system that is acted upon and 3) the interaction between the biological system and the chemical agent which results in harm to the biological system. Poisons and drugs act only by modifying functions that already exist. Reactions by the body to an agent include the release of substances in the body (such as histamine), inhibition of nerve response (paralysis), or inhibition of the normal release of body substances. The extent to which a chemical can cause harm is dependent on several factors: chemical composition, amount, type of exposure, length of exposure, and individual characteristics such as age, sex, and state of health.

Before a person will exhibit a response to a toxin, the toxin must contact the body in some manner and cause a malfunction of some normal body process. The major routes of exposure are: dermal (skin), inhalation, ingestion, and intravenous. In the laboratory setting the first two are the most common types of contact. Once the toxic agent enters the body different organ systems may each be affected. The liver and kidney are often affected as is the central nervous system. Other potential mechanisms of action are carcinogenic, mutagenic (the ability to cause damage in DNA structure) and teratogenic (the ability to interfere with the development of a fetus in the womb).

Along with the route and site of exposure another important factor is the duration and frequency of exposure. An acute exposure is usually a single exposure, producing an immediate deleterious effect on the body. Chronic exposure to a chemical causes systemic damage to the body as a result of repeated exposures over a long period of time. The human reacts to contact with chemicals in many different ways. Allergic reactions may occur, the response may be immediate or it may be delayed as with a carcinogen, the effect may be reversible or irreversible, the response may have just a local effect or it may affect an organ far from the site of contact such as the kidney. One common factor associated with these different kinds of response is the dose; the greater the dose, the greater the effect.

Probably the most important concept in toxicology that brings together exposure and the body's response is the dose-response relationship. The body's response to exposure by a toxic agent is related to the amount of the agent that is able to cross body barriers (skin, lungs). This dose-response relationship is used in assessing the safety or toxicity of a chemical. This assessment is usually accomplished using mice or rats as test animals. One result of the testing protocol is the establishment of the median lethal dose, known as the LD50. This is the dose at which 50% of the test animals die after being exposed to the agent by the oral route. This is often an extrapolated number since achieving this precision can be very costly. The concept of LD50 has been established in toxicological literature as a

convenient method of estimating the hazard a chemical presents to the body. Since LD50's are established for animals, translating these figures to human LD50's is not an easy task. However the following table illustrates probable LD50's for humans. Since a child is much more susceptible to low levels of exposure (by a factor of ten) both child and adult figures are given. It should also be noted that adults of smaller stature would be at greater risk than persons who have greater body mass. LD50's are expressed in milligrams per kilogram of body weight.

Toxicity rating LD50 Probable Lethal Dose

	mg/Kg	Child (20 lb)	Adult (150 lb)
Almost Non-toxic	Over 5000	Over 4 tbs	Over 1 lb
Moderately toxic	500-5000	1 tsp- 4 tbs	3 tbs – 30 tbs
Very toxic	50-500	1/8 tsp – 1 tsp	3/4 tsp – 3 tbs
Extremely toxic	5-50	1 drop – 1/8 tsp	1/16 tsp – 3/4 tsp
Super toxic	Up to 5	Up to 1 drop	Up to 1/16 tsp

When trying to determine the degree of risk by the use of LD50's, remember the higher the number per kg of body weight the lower the risk, the lower the number, the higher the risk i.e. a chemical that takes 100g per kg of body weight to produce an LD50 is less toxic than a chemical that takes 1g per kg of body weight to produce an LD50.

When performing practical risk assessment (which we do every day) remember, gases can cause the most harm in the fastest amount of time due to the large amount of tissue in the lungs that is exposed to the gas. Fumes and mists are also dangerous for the same reason. Liquids can cause harm by two methods, dermal contact and any vapor given off can act as a gas. Solids may also give off a vapor but usually in such small amounts as to be of minimal harm. Dermal contact is the most common exposure situation found in the laboratory for solids and liquids. Even if there is no immediate sensation, when a chemical contacts the skin, it is important that the exposed area is flushed with running water as soon as possible. It is also wise to wash your hands several times during a laboratory session and before you leave the classroom

All of the factors discussed above are included on Safety Data Sheets (SDS) as part of the Federal and California Communication Standards also known as the Right-To-Know Law. SDS gives the user of the chemical the information needed to handle the chemical safely as well as hazardous ingredients, physical data, fire and explosion hazard data, physiological effects, emergency and first aid procedures, chemical reactivity and spill, leak, and disposal information. All of this information is provided so that you the user can recognize the hazards associated with the chemical and act in an appropriate manner. A file of SDS and a list of all the chemicals located in the Stockrooms and laboratories can be found in S339 and in McLane 144. The inventory list of chemicals contains a hazard warning for each chemical that is considered hazardous. The warnings are based on terms used in the Registry of Toxic Effects of Chemical Substances published by the National Institutes of Safety and Health.

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CHEMICAL HAZARD CHARACTERISTICS

The chemical inventory maintained by the Chemistry Department lists two different hazard codes to help students and staff handle chemicals in a safe manner. The STORAGE CODE indicates what chemicals can be stored in the same area and is based on color. The CHEMICAL HAZARD CODE specifies the chemical characteristics of that chemical in relation to other chemicals and health effects on the body. A given chemical may have more than one classification in the CHEMICAL HAZARD CODE and when working with that chemical, all warnings should be heeded.

CHEMICAL HAZARD CODES

1. IRRITANTS

   are chemicals that cause an irritation to the skin or lung lining. The effect is not always immediate and when expressed, may last for some time. Avoid getting these chemicals on the skin or breathing in any dust or vapor. Wash your hands often when working with these chemicals to minimize the length of exposure to incident contact.

2. CORROSIVES

   are either concentrated acids or bases. These substances can cause severe burns to the skin comparable to burns caused by heat. Flush exposed area with copious amounts of water immediately on contact with any part of the body.

3. TOXIC SUBSTANCES

   are chemicals that cause harm to the body in various ways. Chemicals can be absorbed through the lungs and skin, be distributed throughout the body and disrupt bodily functions far from the site of exposure. Effects can be dizziness, headaches, respiratory difficulty, kidney failure, liver involvement as well as cellular breakdown. Using proper safety equipment, when handling these chemicals, is absolutely necessary.

4. FLAMMABLE

   substances give off a vapor that is capable of forming a mixture with air (oxygen) that can be ignited by a flame or spark. The flammability rating of a substance is given by its flash point. The flash point is the lowest temperature at which the vapors given off will form a mixture with air that will ignite. The lower the flash point the more likely the vapor can be ignited by a heat source. The vapors given off by these chemicals are often toxic. Restrict ignition sources in a room if you are using flammable chemicals. Do not use open flames, use heating mantles or thermos-wells when heat is necessary. Keep all containers of flammable chemicals tightly closed.

5. REACTIVE SUBSTANCES

   cause an explosive reaction when exposed to water and/or air. Sodium, potassium and lithium metals are examples of chemicals that react violently with water. Pyrophoric chemicals react with air so rapidly that ignition occurs, producing a very dangerous situation. The use of an inert atmosphere in a glove is absolutely essential when working with these chemicals.

6. OXIDIZERS

   are chemicals that react with other chemicals (fuel, combustible materials) with the evolution of heat due to the transfer of electrons to the oxidizer. Oxidizing agents should be stored separately from reducing agents (those compounds giving up the electrons). Any experiment dealing with the Redox process should be monitored closely.

STORAGE CODES

The STORAGE CODES used to facilitate proper storage of chemicals have been developed by chemical manufacturers using colors as a classification scheme. The color codes listed below parallel the HAZARD CODES; however the HAZARD CODES give multiple ratings so that all possible hazards are listed.

RED = FLAMMABLE

WHITE = CONTACT HAZARD CORROSIVES

YELLOW = REACTIVE HAZARD

BLUE = HEALTH HAZARD, TOXIC

GREEN = MINIMAL OR LOW HAZARD

All chemicals are colored coded with a painted dot according to the above scheme when received in the department. Many of the manufacturers have labels that follow this color scheme, with other hazard warnings also given. Some manufacturers do not use colors on their labels but give hazard warnings as required by law. You should read all hazard warnings on the labels before using the chemical and follow the recommendations given. Before using a chemical that you are not familiar with, you should also read the Safety Data Sheet for that chemical. The SDS is located in each of the chemical stockrooms. Other reference sources available in the department use the chemical classifications listed above and should be referred to as often as needed to handle chemicals in a safe manner in the laboratories.

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GENERAL SAFETY RULES AND PROCEDURES

IMPORTANT: If you have any concerns about the safety of any experimental procedure ask your instructor **BEFORE** proceeding to the next step.

GENERAL SAFETY RULES

Do not eat or drink in the laboratories or chemical stockroom.

Avoid inhalation of chemicals. Do not smell any chemical.

Do not smoke in laboratories.

When working with chemicals wash your hands often to minimize incidental contact.

Do not leave water running, hot plates on, or pumps on without taking precautions against possible malfunction.

Review the safety hazards of all chemicals in use before beginning an experiment by referring to the SDS, safety literature located in S339 and McLane 144 or safety information listed on the Department web site.

Minimize repeated or prolonged exposure to all chemicals.

Review experimental set up of glassware and/or equipment to pinpoint any situation which may cause a run-away reaction or the development of high pressures or temperatures.

Never pipet a chemical by mouth; always use a pipetting aid (safety bulb).

Immediately report any hazardous condition observed (such as frayed electrical cords or water leaking on the floor) in any laboratory to the stockroom staff for corrective action.

Do not work alone, always have another person within calling distance.

HOUSEKEEPING

Clean your work area after each use.

Keep aisles clear.

Label all containers with proper chemical name and concentrations as well as Globally Harmonized System (GHS) labels.

Wash glassware after use. Do not allow liquid chemicals to evaporate and dry out in glassware unless that is part of the experimental procedure.

The stockroom has two types of glassware cleaning detergents available for use. One type is for general glassware on which there is no build-up of chemical residue and is available in each of the teaching laboratories in a gallon bottle with a pump dispenser. Take the bottle to the glassware stockroom for refills. The other type of detergent is called MICRO and is for use in the quantitative laboratories and where there is a heavy build-up of chemical residue. To obtain this detergent see the technicians in S338. Do not use chromic acid cleaning solutions without first checking with the technicians in S338.

Return chemicals to the stockroom as soon as you decide you have no further use for them. Do not let chemicals accumulate in your work area.

All syringes and needles regardless of type (GC, Disposable, Glass), use or size must be returned to the stockroom for disposal. There are no exceptions to this rule.

All spills shall be cleaned up immediately (this includes water). A bottle of sodium bicarbonate is kept in each laboratory to be used to absorb small acid or base spills. A counter brush and dust pan is also kept in each laboratory for use in solid spills.

Keep balances clean.

SAFETY EQUIPMENT

Most laboratories are equipped with: deluge shower, fire extinguisher, eye wash station, first aid kit and fume hood.

Do not put anything under the safety shower.

The fire extinguishers in the labs are located by the doors and are of the Ammonium Phosphate base.

Use safety equipment appropriate for the experiment being conducted i.e. fume hood, safety shield, gloves, eye protection.

Always wear safety glasses or goggles whenever experiments are in progress. Contacts may be used provided additional eye protection such as goggles are worn over the eyes: Any student who wears contacts under their goggles/safety glasses must mark their goggles/safety glasses with a orange sticker (available from the stockrooms) on the left side to indicate that contacts are present.

Know the location of emergency equipment in the department i.e. eye wash stations, emergency phones, showers.

Always use the fume hood when working with volatile chemicals.

Always wear closed toed shoes, not sandals.

Report any malfunctioning safety equipment to the stockroom staff as soon as possible.

WASTE DISPOSAL

Dispose of waste properly. Put paper in waste paper baskets, broken glass in metal buckets, and chemicals in appropriately labeled waste containers.

Put broken glass in the bucket labeled "Deposit Glass Here".

Please read the procedures for disposing of hazardous waste located in another section of this manual.

HANDLING VACUUM AND PRESSURE EQUIPMENT

When using a Dewar flask to hold cryogenic materials, be aware that the flask can implode. Make sure the flask has been wrapped with filament tape before using.

Vacuum systems can also implode or collapse due to weak spots in the system. Be sure the system is inspected before use and that all hoses are clamped on firmly.

When using compressed gases, the tank must be clamped to a cylinder stand or to the counter top. See further instructions on using compressed gases in another section of this manual.

Some lecture cylinders of gases are available from S338 or McLane 144. Before using these cylinders make sure you know what type of valve to use with that particular gas and the chemical properties of the gas. Cylinder stands are also available from the stockroom and should be checked out and returned with the cylinder.

GENERAL HANDLING AND STORAGE OF CHEMICALS

When using ethyl ether or any other flammable chemical, be sure no one in the room is using a heat source that might act as an ignition point.

All chemical reagent bottles shall be labeled with the proper name of the chemical (not in chemical notation) and the concentration if not pure as well as GHS labels.

Do not contaminate stock chemical bottles with dirty spoons or pipettes.

Transfer liquid hazardous chemicals in the fume hood with the face shield pulled down to protect the face and upper torso.

Store chemicals in your laboratory according to hazard characteristics, on shelves with earthquake strips, or in cabinets with doors.

Do not store chemicals or apparatus in the fume hoods unless the fume hood is not used as a work area.

Return chemicals to S338 when you no longer need them.

Be aware of flammable solvents and their location before using an open flame in a laboratory. Move any flammable solvents to a protected area before igniting the flame.

Nitric acid is a strong oxidizer as well as a corrosive. Do not use as a cleaning agent unless instructed to do so. Never add nitric acid to an organic chemical or a waste bottle containing an organic chemical.

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PROCEDURES FOR STUDENTS DOING INDEPENDENT/GRADUATE RESEARCH

The Chemistry Department Faculty and staff have a continuing commitment to promoting and maintaining a safe laboratory environment. As a student conducting independent research, it is important that you comply with all department safety policies and conduct yourself in a responsible and safe manner when working in the laboratory.

SAFETY TRAINING PROGRAM

As a student doing research, you are required to attend the safety training program conducted by the department before you commence doing experimental work. You must read the department safety manual.

KEYS

Keys to laboratory rooms are issued by the Campus Key Control at the request of the supervising faculty member. Before receiving a key you must review the department safety manual, take a safety test and state that you will follow all department safety rules. You will be required to present your university ID card when receiving the keys at the University Student Union Information Center.

Keys to laboratory lockers are obtained from the stockroom staff at the request of the faculty member. Ask your faculty research advisor to request lab locker keys. All keys must be returned at the end of the semester. If keys are not returned your grades will be attached. If you lose your locker keys a $10 charge per key will be collected for replacement before new keys are issued.

Not all students will be issued keys.

SECURITY

Please remember to make sure each laboratory or room you have used is locked at the end of each research session.

Do not unlock doors for other students.

You are not to work alone after 5 p.m. If you do work after 5 p.m. you must have another student with you for safety reasons.

All campus phones can be used to call "911" in life threatening situations.

GLASSWARE STOCKROOM

Glassware may be checked out of the stockroom, S230 including corks, stoppers, thermometers and other miscellaneous items. To obtain glassware and other reusable supplies you must present your university ID card and fill out the check-out form. You must return these items clean, dry and unbroken.

When returning items you will receive the white stockroom copy of the chit card, which YOU will destroy. If you cannot return the item because it is lost or broken you will be charged for the item. If you do not pay for or return the item by the end of the semester, your grades will be attached. You must clear all check-out form, clean your lab locker and return all keys at the end of the semester. If you want to work over the semester break or during the summer you must see the stockroom staff to receive keys and supplies i.e., start the process over again. There will be NO carryovers from one semester to another.

The glassware stockroom is not open during noon hours or on Fridays. To obtain supplies on Friday see the technician in S338.

CHEMICAL SUPPLIES

Chemicals are available from S338. When you need a chemical see the stockroom staff. If the chemical is not available tell your faculty advisor. He will request it to be ordered or suggest an alternative chemical that is available.

If a chemical is deemed extra hazardous the stockroom staff may ask you to read and certify that you have received a SDS before giving you the chemical.

If you need a bulk solvent you must give a container obtained from the glassware stockroom to the chemical stockroom staff for filling. The staff may request you to provide a container for other chemicals depending on supplies available for lab use.

The stockroom staff will not prepare reagents for your use. You must obtain the chemicals and prepare them yourself.

GC Syringes, IR Cells, UV Cuvettes and stop watches are available from the technicians in S338.

SAFETY LITERATURE

Safety literature is available in most laboratories, S339 and McLane 144. Safety Data Sheets are available in S339 and McLane 144. Please refer to these literature sources if you have questions about possible hazardous properties of the chemicals you are working with. Safety information is also available from the Chemistry Department Web Site.

HAZARDOUS WASTE

Each student involved in a research project that produces a possible hazardous waste must analyze their waste stream and collect any chemical which may be defined hazardous. If you have any questions as to what is hazardous, contact your instructor or the stockroom staff.

Collect your waste in accordance with the waste collection procedures found in the Hazardous Waste Disposal section of this document.

DO NOT leave any unlabeled containers containing chemicals in the laboratory. Unlabeled containers are a safety hazard as the contents must be considered hazardous and must be handled with extreme caution.

Waste oils, such as vacuum oil or mineral oil, are to be collected and consolidated in a non-halogenated organic waste bottle.

COMPRESSED GAS

If you need a compressed gas for your research, you must request the gas from the stockroom technician. He will order the gas as necessary. Cylinders are not to be moved from room to room by the student unless he/she was properly trained. All changes must be done by the technician. All cylinders must be attached to a bench or cylinder stand with approved tie-downs. When you are finished with a cylinder or a cylinder is empty, request the technician to remove the cylinder. Remember the department may be paying a rental fee for the cylinder, do not keep the cylinder in your lab longer than necessary.

Compressed gases are only delivered once a week, so plan ahead.

EQUIPMENT SERVICE

The Department has an equipment technician available for check out of equipment and equipment repair. To obtain a piece of equipment, see the equipment technician. He will tell you if it is available, where it is located, whether it can be moved to a different location and provide instruction manuals.

If you need a piece of equipment repaired please contact the equipment technician.

If you need assistance in learning how to use a piece of equipment, see your instructor and/or he equipment technician.

END OF SEMESTER PROCEDURES

1. Return all glassware clean, dry, and intact to the glassware stockroom.
2. Return all chemicals, GC syringes, NMR tubes, quartz cuvettes, stopwatches, and IR cells to the chemical stockroom. Return all building keys to the Campus Key Control and all locker keys and padlocks to the stockroom staff.
3. Return all equipment obtained from the equipment technician.
4. Turn in all hazardous waste properly labeled.
5. Clean your work area so it is ready for the next student.
6. Make sure any locker that you have used is completely clean.
7. Remember your grades will be attached if you do not make sure all of these items have been attended to.

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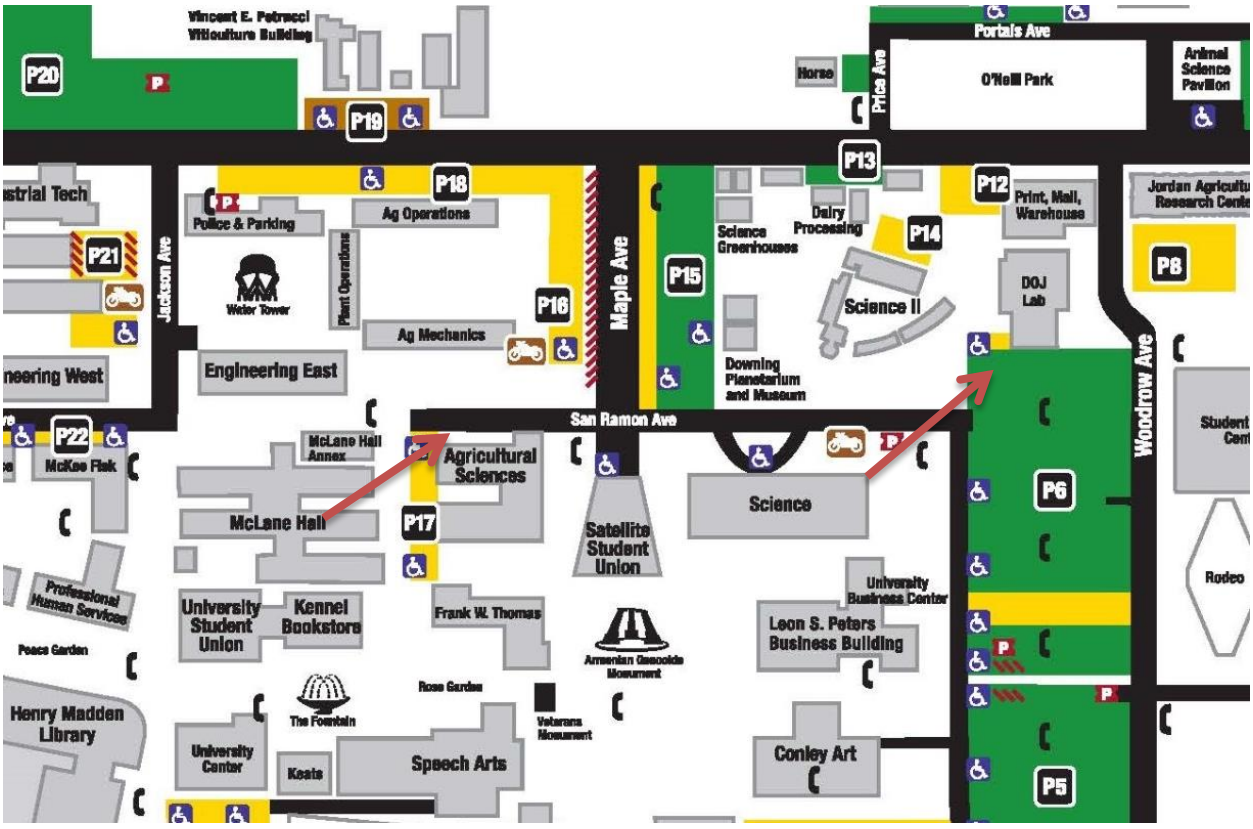
EVACUATION PROCEDURES IN CASE OF FIRE AND /OR TOXIC GAS LEAKS

In case of fire (fire drill) or toxic gas leak:

- Alert personnel working in the area where there is a fire.
- Confine the fire if you can by closing all doors.
- Evacuate the room.
- Pull the fire alarm.
- Proceed to the designated emergency evacuation area.

DO NOT USE ELEVATOR!!

The assembly area in the event of an evacuation of the Science Building is north side of P6 parking lot (shown below). The assembly area for McLane Hall is north of the Agriculture Building (shown below).



During a fire drill everyone must leave the building and proceed outside just as if there was a fire.

For a small bench top fire where a fire extinguisher might put out the fire, alert all persons in the area of a fire, have one person notify the support staff while another uses the fire extinguisher. If the fire is not

extinguished within 30 seconds to 1 minute, evacuate the room, pull the nearest for alarm and proceed out of the building.

KNOW THE LOCATION OF ALL FIRE EXTINGUISHERS.

KNOW THE LOCATION OF THE NEAREST FIRE ALARM.

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GENERAL EMERGENCY PROCEDURES

When an emergency occurs, determine the extent of the situation and whether it is safe to remain in the area. If the emergency is such that the area must be evacuated, notify everyone in the room to leave, then notify the stockroom staff or security the nature of the accident. If the accident is small and can be self-contained, the stockroom staff will evaluate the situation and initiate the proper procedures. If the emergency is of a catastrophic nature the fire alarm will be pulled and evacuation of the building will begin. The University emergency plan will then be put into action.

Procedures for dealing with an emergency

1. Determine the size and nature of emergency.
2. Start evacuation if necessary.
3. Call "911" in a life threatening situation.
4. Notify the stockroom staff.

In case of fire

1. Determine size of fire.
2. Evacuate if necessary.
3. If fire is small, use fire extinguisher that is located by the entrance door of each laboratory.
4. Pull the nearest fire alarm (in the hallway) if the fire can not be controlled with the fire extinguisher.
5. If you use a fire extinguisher be sure and tell the stockroom staff so that the extinguisher can be serviced.

In case of a chemical spill

1. If a spill is small and there is a bottle of sodium bicarbonate available, ring the spill with the sodium bicarbonate and call the stockroom staff to handle final disposal.
2. If the spill is too large to handle with sodium bicarbonate evacuate the room and call the stockroom staff, who will assess the extent of the spill and then notify the Environmental Health, Safety, and Risk Management Office for further assistance.

CHEMICAL SPILL CLEAN-UP PROCEDURES

1. Members of the stockroom staff shall constitute the clean-up team. Chain of command: supervisor/ instructor, technician(s).
2. Protective clothing shall be donned commensurate with the type of chemical spilled.
3. If the spill is a liquid, determine what it is, then neutralize it. If the spill is a solid, cover with wet paper towels then scoop into a suitable container (DO NOT DRY SWEEP A SOLID).
4. If sand or absorbent material are used and neutralization is indicated, pick up absorbent into container and neutralize in a fume hood as indicated by standard chemical procedures, i.e., SDS, OSHA Guidelines, etc.
5. Contaminated absorbents shall then be collected and put into containers suitable for final disposal. Label container with a hazardous waste label detailing the contents. See instructions below.

Classroom Spill Control Procedures

1. Alert any person(s) in the immediate area of the spill.
2. If the chemical has splashed on anyone immediately wet the area by appropriate means (eye wash station, shower, sink) and remove clothing if required.
3. Evacuate the area and prevent other people from entering.
4. Notify the stockroom staff immediately.
5. If a person is injured, stockroom personnel will call the Campus Police to transport person to the Health Center. Do not transport the person yourself.
6. If the spill is small (<100 ml) and is an acid or base, ring the spill with sodium bicarbonate found in each laboratory in the vicinity of the sink. Wait until the bubbling has stopped and no liquid remains, then scoop the solid into a plastic disposal bag obtained from the stockroom, label and give to the stockroom staff for final disposal. If the spill is a volatile compound or if the quantity can not be absorbed by a small amount of sodium bicarbonate use a spill control bucket located in the chemical and glassware stockrooms (S338, MCL144).
7. If a spill occurs when the stockroom staff is not available use the spill control buckets as needed or if the spill is endangering other students or equipment and/or is too big for you to handle call the campus police immediately at 911, evacuate the room and remain in the area until the Campus Police arrive.

REMEMBER:

Attend to injured persons

Evacuate area

Notify stockroom staff

For detailed procedures for specific chemicals, consult the Aldrich catalog, Hazardous Chemicals Information and Disposal Guide by Armour et al., SDS and the NIOSH Occupational Health Guidelines for Chemical Hazards.

DISPOSAL PROCEDURES

The contaminated absorbent will be put in proper containers with labels indicating chemical name, toxicity, corrosive characteristics, flammability, and reactivity if known.

The waste will then be given to the Campus Hazardous Waste Coordinator for proper packaging and removal to a disposal facility as specified in the Campus Hazardous Waste Management Plan.

MERCURY SPILLS

Mercury spills present a different problem than most spills because the mercury can not be picked up with the usual absorbents for liquids.

When mercury is spilled (usually from a broken thermometer) the mercury can be picked up with a vacuum flask connected to the house vacuum source. The flask is available from the chemical stockroom S338. Make sure the long piece of vacuum hose is connected to the vacuum outlet with the shorter piece of vinyl chloride tubing connected to a dropper pipet for picking up the mercury droplets. Return the flask to the stockroom with the mercury in the flask.

When a vacuum line is not in easy reach, use the following procedure.

Cover the bottom of a 20 ml beaker with 20 mesh granular zinc to a depth of about 2-3 mm. Add diluted HCl or acetic acid to cover the zinc. Allow the reaction to proceed about 1 minute. Rinse with water and decant off the liquid portion. The remaining slurry may be applied to the visible beads of Hg with a wood splint or index card. The amalgam forms quickly and can be picked up using another index card. Put amalgam in a suitable container for disposal.

All waste mercury is collected and sent off campus for recycling.

DO NOT ignore spilled mercury as mercury is extremely toxic in the vapor state. Never pour mercury down the sink since it will pool in the trap and emit vapors into the room.

SODIUM AND OTHER ALKALI METALS

If an alkali metal is spilled notify the stockroom staff so that they can handle the removal of the metal. DO NOT try to remove the metal yourself unless there is no stockroom staff member available.

Sodium, potassium and lithium should be covered with powdered graphite when spills occur. The metal can then be disposed of by reaction with a DRY SECONDARY ALCOHOL.

DO NOT PUT WATER ON THESE METALS AS AN EXPLOSION WILL RESULT.

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ACCIDENTS AND ACCIDENT REPORTING

If an accident should occur, immediately notify the Stockroom Staff, Campus Police, or the Office Staff. Accident is defined as a fire, chemical exposure to the body, an injury breaking the skin barrier, explosion, or chemical release such as a spill.

If no one is available in the department office call the Campus Police on one of the emergency phones located in the hallways or laboratories of the Science Building and McLane Hall. Emergency numbers are posted in each classroom and by each phone.

Dial 911 from any phone in life threatening situations.

Please report the accident to the stockroom staff or the office staff so that a report can be filed with the campus safety office as needed.

Any person who is injured shall be transported to the Health Center for treatment by the Campus Police. Do not transport an injured person yourself, that is what the Campus Police is for.

If the accident should happen after hours, on the weekend or at any other time that the Health Center is closed, the following procedure shall be followed:

After Hours Emergencies - In cases of emergency, illness or accident, the Campus Police Office should be called. An officer who is trained in first aid and CPR will evaluate the situation and call an ambulance when indicated. There may be minor injuries such as a cut finger where an ambulance is not needed, but transportation is required.

Therefore, in all cases of emergency or urgent transportation needs, call the Campus Police at Ext. 88400.

If an accident involves chemical exposure to the eye, immediately flush the eye using the eye wash station located in the laboratory then call Stockroom Staff or Campus Police.

If an accident involves chemical exposure to the skin, immediately flush the area with water, then notify the stockroom or the Campus Police. Remove clothes as needed and use fire blanket if present as a privacy screen.

If an accident involves toxic fumes move the person to fresh air then call the Stockroom or Campus Police. Once the Campus Police are on the scene, the University emergency response plan is implemented as needed.

After an accident was resolved, the person who was involved in the accident MUST notify the safety officers within 24 hours from when the accident occurred via either an e-mail or fill out a Chemistry Department Incident Report Form.

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PROCEDURES FOR MINIMIZING EXPOSURE TO BLOODBORNE PATHOGENS

In the event of an accident occurring in a chemistry department laboratory that results in blood contaminating any surface, the following procedures should be followed:

When a student is injured resulting in a cut from which blood flows have the student, press paper towels to the area to stem the flow until other help arrives.

If you must come in contact with the blood, minimize your exposure by putting on the disposable gloves found in the First Aid Kit before touching the bloody area.

Have another student call 911 if it is a life threatening situation. If it is not a life threatening situation, call the stockroom staff and arrangements can be made to have the student transported to the Health Center.

Do not put any blood contaminated item including paper towels in the waste paper basket. Contact the stockroom staff for proper disposal bags.

If blood has gotten on any laboratory surface such as the counters or the floor, flood the contaminated surface with a 10% solution of household bleach which can be found in each teaching laboratory. Before cleaning up the contaminated bleach solution, obtain a biohazard bag from the stockroom, put on disposable gloves, clean the area, put all contaminated towels and gloves in the biohazard bag, seal the bag and give to the stockroom staff for proper disposal.

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HAZARDOUS WASTE COLLECTION

The use of hazardous materials is a common element in all chemistry laboratories. Unfortunately the use of these materials often results in end products that are also hazardous. Hazardous end products that have no further use in the class room must be disposed of in the proper manner in compliance with federal and state regulations. These regulations determine how hazardous wastes are to be collected, stored and what the final disposal method will be. The Chemistry Department has developed procedures that bring the collection of these wastes into compliance with the regulations.

It is the general policy of the Chemistry Department that the producer of the waste (instructor or student) must obtain a waste container and a hazardous waste label from the Stockroom before starting an experiment. The label is to be filled out with the appropriate information and affixed to the container before any waste is put into the container. For most students enrolled in chemistry classes their only concern will be to deposit their waste in the container that has been properly labeled by their instructor. Chemistry majors as they take classes that require independent projects will need to determine what waste they are going to produce from these projects and collect that waste in the proper manner.

Guidelines have been developed for each of these situations in order that the hazardous waste produced by the Department laboratories is collected and containers are labeled in a consistent lawful manner. All students taking a laboratory class in the Science building will receive an instruction sheet at the beginning of each semester. Students involved in independent projects (undergraduate and graduate) will receive an instruction sheet as needed. Please pay particular attention to the instructions regarding incompatible chemicals and proper labeling. Failure to comply with these instructions may result in the disposal company refusing to pick up our waste.

The waste produced in the lower division classes will be collected in a slightly different manner due to the large size of the classes and the consistency of the waste stream. The liquid waste will be collected in 2 1/2 L bottles labeled “Hazardous Waste”. The bottles will be put into the laboratories as needed. When a bottle is full it is the responsibility of the students to return the bottle to the stockroom and obtain an empty bottle for the class to use. All of the bottles remaining in the laboratory will be picked up at the end of the week and emptied into the designated drum by the stockroom staff. A plastic large-mouth container will be put into the laboratory as needed for the collection of solid hazardous waste. It is the duty of the instructor to inform the student as to what waste is to be placed in these containers. Do not place non-hazardous waste in these containers. If the instructor has a question as to whether a waste is considered hazardous he shall contact the stockroom staff for clarification.

Disposing of hazardous waste is a very expensive process, therefore it is essential that no experiment end product be offered for waste disposal unless it has been deemed hazardous or until that end product is reduced to its lowest possible hazard state. No experiment shall be considered complete and therefore no waste is produced until the chemicals have been reduced to their lowest hazard state. This does not apply to the lower division classes due to the number of students and the amount of waste. All of the organic laboratories have instructions and the proper neutralization materials for corrosive materials as standard equipment in the classroom. All other classes should consider waste reduction at the time of disposal and contact the stockroom staff for assistance.

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PROCEDURES FOR THE DISPOSAL OF HAZARDOUS MATERIALS FROM CLASSROOM EXPERIMENTS

Put the waste from your experiment into the containers as instructed by your professor.

The container must have a WASTE label affixed on it and the chemical name must be listed on the label before any waste is put into the container.

DO NOT Mix incompatible chemicals.

When in doubt ask your instructor.

When a container is full please obtain another from the stockroom.

Do not mix organic chemicals with inorganic compounds.

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PROCEDURES FOR THE DISPOSAL OF HAZARDOUS MATERIAL FROM STUDENT PROJECTS

All projects must be analyzed for possible waste solvents and end products that are considered hazardous.

Project waste must be kept separate from classroom experiment waste.

Students must obtain a container and hazardous waste label from the stockroom. Fill in date and generator sections immediately.

As waste is collected a cumulative list must be kept on the label detailing the full chemical name (in English) to the container.

DO NOT MIX incompatible chemicals.

DO NOT MIX organic chemicals with inorganic compounds.

When the waste container is full, return the bottle to the stockroom.

When a project is complete, return all partially filled waste containers to the stockroom. Do Not Leave In Laboratory.

When in doubt, ask your instructor or the stockroom staff for help.

Do not allow ethyl ether cans to remain in the Lab more than 2-3 weeks after being opened. After 2-3 weeks check for peroxide formation (consult your instructor) or return the can to stockroom.

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PROCEDURES FOR OBTAINING AND USING COMPRESSED GASES

Contact a stockroom technician if you need compressed gases. He will provide training on how to handle compressed gases.

When moving a cylinder of gas, the four-wheeled gas cart must be used.

When moving a cylinder, always have the cap securely in place.

Never use lubricant on a gas regulator.

Always use the proper regulator for the gas in use.

All cylinders must be attached to counters or cylinder stand with straps or chains.

When a cylinder is almost empty, contact the stockroom technician for a replacement.

When returning cylinders to the central storage area, make sure the cylinder is put in the correct area (empty, full), is behind the restraining chain, and the gate is locked.

Contact the stockroom staff for compressed gases in lecture cylinders.

When removing lecture cylinders from the stockroom, make sure the proper valve is attached and a lecture cylinder stand is available for proper support.

Refer to the SDS for that gas for information in proper handling techniques and toxicity.

REMEMBER -- WHEN A CYLINDER FALLS OVER AND THE STEM IS DAMAGED, THE CYLINDER BECOMES A MISGUIDED MISSILE THAT CAN GO THROUGH A WALL.

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ELECTRICAL AND RADIATION HAZARDS

ELECTRICAL HAZARDS

Electrical currents of very low amperage and voltage under certain circumstances may result in fatal shock. Low voltage d.c. circuits do not normally present a hazard, although severe burns are possible. Recommendations for minimizing electrical hazards follow:

Do not try to repair electric or electronic equipment. The equipment technician should be notified whenever a piece of equipment does not function.

Electrical wires should never be used as supports or to tie other items to equipment.

Do not pull electrical cords out of a socket by the cord; pull on the plug at the wall.

All electrical cords should have a three prong plug that includes a ground wire.

Do not use a piece of equipment that has a frayed or damaged cord. Take the item to the equipment shop area if possible for repairs. Otherwise notify the technician of the problem.

When using a hot plate, make sure the cord is away from the hot surface as the cord may melt.

Do not touch any electrical equipment if there is water on the floor at your feet.

Use caution when operating electrical equipment near water containing apparatus such as a distillation set-up.

RADIATION SAFETY

X-RAY Generators

Proper protective equipment must be used when operating any equipment generating X-RAYS. Take special care not to defeat any of the safety interlocks designed to prevent X-RAY exposure. Do not exceed safe operating limits for these instruments. Operate them only after you have been made familiar with all operating procedures.

Warning signs must be displayed on or near the main power switch of the equipment. Warning signs should be posted on the entry doors to the rooms containing X-RAY equipment.

Ultraviolet Lamps

Do not look directly into a ultraviolet (UV) lamp.

Protect the skin from exposure to the radiation as the light can cause burns.

Do not touch the lamps as they can be very hot.

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LASER SAFETY PROGRAM

Lasers produce intense radiation that can cause harm to eyes and skin. It is important every student who uses a laser must be trained in laser safety.

The principle investigator is responsible for ensuring that all students who use lasers are trained in their use and that the students comply with all safety rules.

General Rules

Always wear goggles that offer protection against the specific wavelength of the laser in use.

Never look directly at the beam or pump source.

Do not adjust the beam by looking along the beam.

Keep a high general illumination level in areas where lasers are in operation.

Low light levels cause dilation of the pupils and thereby increase the hazard.

Warning signs must be posted on entry doors to any room containing a laser.

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GUIDELINES FOR THE USE OF RADIOACTIVE MATERIALS

All projects that use radioactive materials must be approved by the radiation safety committee prior to implementation.

All purchase orders for radioactive materials must be sent to the radiation safety officer and must list the university registration number.

All radioactive materials must be routed to the radiation safety officer from shipping-receiving for a radiation check before the package can be accepted by the department for use.

All personnel or students handling radioactive material must be trained by the project leader or instructor in proper handling techniques that stress minimal exposure and safety. Radiation safety is also available from the Radiation Safety Office located in the Environmental Health, Safety, and Risk Management Office.

Radioactive materials must be kept in a secure area and labeled with appropriate signs.

All storage areas shall be monitored and inspected at least monthly for broken or leaking containers and excessive radiation.

All sealed sources in the Chemistry Department shall be leak tested at least every six months.

The department shall maintain a list of all sealed radioactive material, and the location of each source.

All radioactive waste must be collected in accordance with university procedures.

Whenever a project is in progress the laboratory must have the University Radioactive Substance warning sign posted outside the room.

Anyone using radioactive substances must use them in accordance with University policy as instituted by the Environmental Health, Safety, and Risk Management Office.

EMERGENCY PROCEDURES INVOLVING RADIOACTIVE SUBSTANCES

For contamination of personnel or major contamination of a laboratory:

Take steps to limit further contamination to personnel and/or the laboratory.

Contact the university Police Department and the Radiation Safety Officer immediately at 88400 or 87422. Avoid contaminating nearby areas. Return to the laboratory at once.

If contamination is limited to the laboratory only, leave the laboratory but stay in the immediate vicinity until assistance arrives.

If personnel are contaminated, stay in the laboratory unless this would result in further contamination of the persons affected. If it is necessary to leave the laboratory, stay in the immediate vicinity until assistance arrives. Avoid contaminating nearby areas.

For minor contamination of the laboratory:

Clean the contaminated area and seal any waste material in a plastic bag.

Inform the Radiation Safety Officer as soon as possible to arrange for disposal of waste material and inspection of the decontaminated area.

Refer to the Radiation Safety Manual for additional information.

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VACUUM PUMPS

READ THIS WHOLE DOCUMENT BEFORE TURNING ON A VACUUM PUMP.

BASIC DIRECTIONS FOR USING A VACUUM PUMP

Attach pump to the system to be evacuated; be sure to include an appropriate trap. Make sure system is vented to the atmosphere.

Plug in pump or turn on switch.

Slowly close vent to atmosphere until completely closed and the vacuum is being applied to your system.

Make sure oil level in sight glass on pump is between the two lines while pump is in operation.

When you are ready to turn off the vacuum pump, slowly open the vent to the atmosphere, when vent is completely open unplug or turn off switch on pump.

PUMP/SYSTEM CONFIGURATION

The components of a vacuum system are:

- vacuum pump
- trap
- vacuum gauge
- vessel or system to which vacuum will be applied

VACUUM GAUGES

The type of vacuum gauge to be used is determined by the pressure range to be measured. Gauges are available from the equipment technician.

The vacuum gauge should be placed in the system close to the test vessel between the trap and vessel.

GENERAL INSTRUCTIONS

If you need a vacuum pump see the equipment technician.

All pumps must be equipped with an appropriate trap before the pump is turned on. Since all gases being evacuated will pass through the pump and its oil adequate traps must be employed. Do not allow any foreign material to enter the vacuum pump; this includes glass, metal filings and condensable gases. If gases are allowed to condense in the oil, proper vacuum will not be reached.

All pumps must have belt guards.

The oil level when the pump is running must register between the two lines on the sight-glass on the side of the pump.

Keep lines as short and as large in diameter and direct as possible. The use of small diameter vacuum tubing increases the time required to achieve full pumping speed.

If the inlet of the pump is larger than the vessel, make any reduction at the vessel end, not the pump end of the line.

Do not allow the pump to cycle on and off. If the desired vacuum has been attained block off the pump with a valve and allow the pump to run at a low pressure.

If at any time you realize you have contaminated the oil in a pump, please notify the equipment technician immediately. Do not attempt to change the oil yourself unless instructed to by the equipment technician.

The most common cause of pump failure and unsatisfactory performance is contaminated oil. If water or acid vapors have passed through the pump and the oil is allowed to stand for any length of time severe corrosion and damage to the pump will occur.

Common indications of oil contamination is an odor indicating a solvent has been pulled into the oil, a cloudy, milky look to the oil caused by water or a layering of another substance on top of the oil.

If the oil looks OK but you would like to check for contamination, connect a gauge directly to the pump and determine if the rated ultimate vacuum can be reached.

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CHEMICAL DEMONSTRATION GUIDELINES

Chemical demonstrations can be a very effective means of teaching. However, as with any chemical reaction, the potential for harm is always present. The following guidelines are provided by the American Chemical Society.

Chemical demonstrators must:

- Be familiar with the properties of the chemicals and with the chemical reactions involved in all demonstrations performed.
- Comply with all local rules and regulations.
- Wear some form of eye protection for all chemical demonstrations.
- Warn the members of the audience to cover their ears whenever a loud noise is anticipated. Plan the demonstration so that harmful quantities of noxious gases (e.g. nitrogen dioxide, sulfur dioxide, and hydrogen sulfide) do not enter the local air supply.
- Provide safety shield protection for any explosion whenever there is the slightest possibility that a container, its fragments, or its contents could be propelled with sufficient force to cause personal injury.
- Arrange to have a fire extinguisher at hand whenever the slightest possibility for fire exists.
- NOT taste or encourage spectators to taste any non-food substances.
- NOT use demonstrations in which parts of the human body are placed in danger (such as placing dry ice into the mouth or dipping hands into liquid nitrogen).
- NOT use open containers of volatile, toxic substance (e.g. benzene, carbon tetrachloride, carbon disulfide, formaldehyde) without adequate ventilation as provided by fume hoods.
- Provide written procedure, hazard and disposal information for each demonstration whenever the audience is encouraged to repeat the demonstration.
- Arrange for appropriate waste containers for and subsequent disposal of materials harmful to the environment.

Additional department guidelines:

- Never perform a demonstration without first rehearsing beforehand.
- Make sure all solutions are still good.
- Never perform a demonstration in a room without appropriate safety equipment on hand (e.g. fume hood, fire extinguisher, goggles).

Several volumes of demonstrations are located in McLane Hall 144 and are available to instructors who wish to perform a demonstration. See the stockroom staff for the books and materials.

REMEMBER: keep the demonstration simple, short, and if possible with a showy visual effect.

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SAFETY AND CHEMICAL INFORMATION RESOURCES

Chemical and Safety information can be found on the Chemistry Department Web Site on two pages, Safety Information and Chemical Information. These sites have pointers to databases, SDS sites, and safety information sites including EPA and OSHA.

The following publications relating to safety are found in S339, and/or McLane144. They are available for use when the stockrooms are open.

Safety Data Sheets

Safety in Academic Chemistry Laboratories - American Chemical Society

Safety in the Chemical Laboratory - Four Volumes - Journal of Chemical Education

Prudent Practices for Handling Hazardous Chemicals in Laboratories -National Research Council - 2011

Prudent Practices for Disposal of Chemicals from Laboratories - National Research Council - 1995

Hazardous Chemicals Information and Disposal Guide - Armour Et. Al. - 2003

First Aid Manual for Chemical Accidents - Lefevre - 1989

Occupational Health Guidelines for Chemical Hazards - Three Volumes - NIOSH

Registry of Toxic Substances - EPA - 2002

Merck Index - 12 Ed.

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