Chemical Hygiene Plan*

Department of Chemistry, Physics, and Geology at Winthrop University

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Section A: Responsibilities

1. Chair of Department

- Has ultimate responsibility for chemical hygiene in the Chemistry Department. The chair must ensure that an effective hygiene program is in place and supported by everyone in the department.

2. Department Chemical Hygiene Officer

- Coordinates and implements the Chemical Hygiene Plan.
- Maintains all records required by the Chemical Hygiene Plan (CHP).
- Conducts a formal CHP inspection of all laboratories and chemical storage areas each semester. Documents results of each semester's inspection; follows up to ensure appropriate corrections have been made by the responsible faculty or staff member.
- Advises course directors, researchers, instructors, and workers of how the CHP applies to them.
- Works to continually improve chemical hygiene practices, procedures and equipment.
- Maintains an up-to-date safety library that is available to all which includes a current copy of the CHP.
- Reports all accidents and other potential exposure conditions to the Chair. Keeps a central file of all incident and hazard reports

3. Laboratory Chemist

- Conducts weekly visits to all chemical areas for compliance with the CHP to identify and to correct CHP items, which require immediate attention.
- Conducts annual inventory of all chemicals in all storerooms and labs; updates the chemical data base with the inventory results
- Logs the receipt of each new chemical in the department by:
    - Entering them into data base
    - Adding inventory bar code to container
    - Adding label with receipt date and disposal date
    - Obtaining MSDS sheet, placing copy in central MSDS inventory and in appropriate MSDS notebook in lab where it will be stored and used.
- Monitors procurement, use, and disposal of all chemicals used in the department.
- Identifies and prepares chemical waste and excess chemicals for disposal.
- Works to ensure that chemicals are properly labeled and stored.
- Tests all eyewashes and safety showers throughout the department and keeps a written record of these.
- Monitors and ensures that protective equipment is available and maintained according to the chemical hygiene plan (i.e. lab aprons are clean and available, testing of eyewash stations and safety showers, ensures that spill kits are properly stocked, fire extinguishers are inspected, etc.)
- Coordinates with other campus organizations and faculty on chemical hygiene issues.
- Ensures that copies of MSDS's are available for chemicals in each lab and in a central location.

4. Faculty and Lab Instructors

- Faculty must attempt to ensure their own safety as well as the safety of all students under their supervision by:
  - Complying with the CHP in teaching and research laboratories.
  - Developing good personal chemical hygiene habits.
  - Ensuring that housekeeping and maintenance of all lab areas are up to standard.
  - Reporting all accident and unsafe conditions to the chair or chemical hygiene officer.
  - Participating in chemical hygiene training.
  - Informing all students of safety precautions and supervising students to ensure they work safely in the laboratory.
- The following is a short list of some of the issues that should be addressed before the start and during each lab period. The faculty member or instructor should ensure that:
  - Students are briefed on safety/emergency considerations and procedures for the laboratory work being conducted.
  - Students are advised of any MSDS considerations for the substances being used that day.
  - Students are properly informed of the proper waste disposal produces for each lab, ensuring that all waste containers are properly labeled and that students adhere to the proper waste disposal procedures.
  - Students are actively supervised during lab work to ensure safe procedures are being followed.
  - Chemicals are properly labeled.
  - Chemicals are properly stored during and at the end of each lab period.
  - The proper laboratory protective equipment is used by everyone in the lab, including visitors.
  - The laboratory area is maintained in a state of cleanliness, safety equipment and exit routes are free of obstructions
  - At the end of each lab, ensure that all waste containers are properly closed; equipment is turned off or unplugged if appropriate and all utility valves are turned off.

5. Student Employees

- Participating in chemical hygiene training
- Planning and conducting each operation in accordance with the Chemical Hygiene Plan.
- Developing good laboratory hygiene habits.
- Reporting unsafe acts or conditions to the instructor or the safety coordinator.
- Being familiar with procedures for dealing with accidents and emergencies

6. Students

- All students are required to ensure the safety of themselves and others by following all safety precautions as outlined in the Chemical Hygiene Plan.

7. Safety Committee

- Members:
  - Chemical Hygiene Officer
  - Laboratory Chemist
  - Chair of the Department
  - A chemistry faculty member
  - A physics faculty member
  - A geology faculty member

- Duties
  - Ensure that independent inspections of all laboratory areas are conducted and documented each academic year.
  - Conduct annual review of the Chemical Hygiene Plan and update as necessary.
  - Monitors the use of particularly hazardous chemicals, particularly in research areas.

8. The University Chemical Hygiene Officer

- Ensure that all hoods, safety showers and fire extinguishers are properly maintained and tested.
- Annually inspect laboratories and chemical storage areas for compliance with CHP plan; provide the chemical hygiene officer and department chair with documentation of all such inspections and testing.
- Ensure that all University employees, outside of the chemistry department, that have access to any laboratory in the chemistry building are properly trained as to the safety procedures that must be followed when entering a laboratory.
- Coordinate and schedule chemical waste disposal at least twice each year so that no waste is stored on site in excess of 270 days.

Section B: Laboratory Facilities and Information

1. Facility Description

- A list of all areas that are engaged in laboratory use of hazards chemical must be maintained and up to date. See **Appendix A**.
- Emergency phone numbers will be posted on the door of all laboratories and chemical storage areas.
- All safety equipment will be clearly labeled.
- Hazardous chemical Right-to-Know information must be posted in the department.
- Emergency procedures and evacuation routes must be posted for each lab.

2. Signs and Information

Signs

- NFP warning signs must be posted on all laboratory doors and chemical storage areas and must alert employees and visitors to the potentially hazardous materials located within.
- Signs must be posted to show the location of all safety equipment including safety showers, eyewash stations, fire extinguishers, telephones, etc.
- Signs must also be posted showing the location of MSDS's.
- Areas where large quantities of highly flammable chemicals are stored and used must be labeled with "No smoking and no open flames" signs.
- Storage areas for the following classes of chemicals must be appropriately labeled:
    - Carcinogens
    - Corrosives
    - Flammable liquids
    - Flammable solids

Information

- Material safety data sheets (MSDS)- a MSDS is a document containing chemical hazard and safety handling information.
    - Material safety data sheets (MSDS) must be maintained and readily available to all employees and students.
    - A MSDS will be obtained for each chemical the department receives.
        i. An electronic database of MSDS's will be maintained. This database can be accessed by faculty and staff from any computer on the WIN domain.
        ii. A copy of the MSDS will be placed in the laboratory in which the chemical is stored.

- A copy of the chemical hygiene plan (CHP) must be accessible in all areas where chemicals are used and stored.
- All employees must be currently trained in accordance with the CHP.
- Employees must have access to various reference materials including a copy of the chemical hygiene plan, a copy of OSHA's Laboratory Standard, and material safety data sheets. A list of reference material and locations can be found in **Appendix B**.

3. Facilities and Maintenance

- General ventilation system for each lab that ensures 4 to 12 air changes per hour to prevent the buildup of chemical vapors.
- Storage areas will have continuous ventilation, fire alarms, and spill control material. Storeroom ventilation will be checked every 6 months.
- All labs will have hoods for use with volatile chemicals that are toxic, flammable, or corrosive. Additionally, general chemistry labs and the organic lab will have individual local exhaust ventilation at each work position. Each hood will be inspected at the beginning of each semester for proper airflow.
- Eyewash stations and safety showers must be located in each lab. They must be clearly visible and accessible and never restricted or blocked in any way. Eyewash stations should be flushed once a month and safety showers should be tested and flushed every three months. A log of these inspections will be kept.
- Fire extinguishers must be clearly visible and accessible in each laboratory. The maintenance of fire extinguishers is the responsibility of the Office of Environmental Health and Safety. Inspection records of fire extinguishers can be obtained from the Environmental Health and Safety Office.
- Fire blankets are available in labs that routinely use heating devices. Fire blankets can be used to put out small fires, but should not be used to extinguish flames on a person.
- Spill control kits- All laboratories and storage areas where hazards chemicals are used should contain a chemical spill kit. Minimally, the kit should contain:
    - Splash resistant goggles
    - Chemical resistant gloves
    - Large, sealable plastic bags
    - Absorbent materials
    - A scraper and scoop
    - Spill control kits will be checked before the beginning of the Fall semester and replaced when depleted.
- Personal protective equipment such as safety goggles, aprons, gloves, face shield, and lab coats are available for anyone handling concentrated acids, bases, and other hazardous chemicals.
- Telephones should be are located in every laboratory and chemical storage area; phones must be clearly marked and labeled with the following telephone numbers:
    - Fire 9-911
    - Public Safety -3333
    - Environmental Health and Safety- 2328
- Emergency contact information should be posted on each laboratory door and should include the following:
    - Name, office number and office telephone number of the employee responsible for the lab
    - Public safety's phone number
    - Office of Environmental Health and Safety's telephone number
- All laboratories and storage areas, in which hazardous chemicals are used and/or stored, will be briefly inspected weekly by the laboratory chemist, each semester by the chemical hygiene officer and annually by the department chair and University Chemical Hygiene Officer. See **Appendix C** for a laboratory safety checklist.
- An inventory of all chemicals will be conducted yearly by the laboratory chemist; a database of all chemicals will be maintained and updated. All chemicals will be bar-coded.

4. Procurement and Inventory of Chemicals

- Requisitions for chemicals are initiated by faculty members or the laboratory chemist.
- Anyone ordering a chemical must use the ordering form for chemicals and supplies and give a copy to the laboratory chemist and to the department's administrative specialist. See **Appendix D** for the correct form.
- Chemicals are delivered to the supply room or to the chemical storage building.
- All chemicals must be delivered to the chemistry stockroom to ensure that the laboratory chemist is aware of all chemicals received by the chemistry department. This excludes hazardous materials that are delivered directly to the chemical storage building such as compressed gas cylinders, liquid nitrogen cylinders, etc. The laboratory chemist must be notified of all such deliveries.
- When a shipment arrives:
    - The laboratory chemist will inspect the shipment to ensure that it is in fact the material ordered, is in good working condition, and that a MSDS is provided.
    - The laboratory chemist will ensure that a copy of the MSDS is kept in the chemistry stockroom and that a copy is placed in the MSDS notebook in the lab where the chemical will be used.
    - A preprinted format label will be placed on each chemical, which will include the date of receipt and an open date to be recorded when the chemical is opened.
    - All chemicals will be bar-coded and logged into the chemical inventory by the laboratory chemist, which will include the amount of chemical ordered, the location as to where the chemical will be stored, and the date the chemical is received
    - Anyone removing a chemical from the stockroom before it is inventoried must provide the laboratory chemist with the name and storage location of the chemical along with the date the chemic al was received.
- **Empty chemical bottles that have a bar-code must be removed from the chemical inventory.**
- Compressed gas cylinders will be tagged accordingly. See **Compressed Gases (Section E, Part 2)**

5. Training

- All employees, including faculty, staff, student research and teaching assistants, and nonchemistry staff, exposed or potentially exposed to hazardous chemicals must be provided with information and training to ensure that they are appraised of the hazards of chemicals present in the department. The degree of training will depend on the person's work function in the laboratories.

Information Requirements

Employees that work with hazardous chemicals, including faculty, part-time laboratory instructors, staff, and students must be informed of the following:

- The contents of the OSHA Laboratory Standard and its appendices. This information must be available to employees
- The contents, location and availability of the chemical hygiene plan.
- The permissible exposure limits for OSHA regulated substances or recommended exposure limits for other hazardous chemicals where there is no applicable OSHA standard
- Signs and symptoms associated with exposures to hazardous chemicals in the laboratory
- The location and availability of known reference material on hazards, safe handling, storage, and disposal of hazardous chemicals found in the laboratory. A list of reference materials available in the department can be found in **Appendix B**.
- How to read and use MSDS's and labels.

Training Requirements

Training of the above-mentioned employees will include the following:

- Methods and observations that may be used to detect the presence or release of a hazardous chemical
- The physical and health hazards of chemicals in the work areas
- The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used.

Training Responsibilities

- All department employees, including faculty, staff, and students working with hazardous chemicals must participate in the training program.
- All employees working in the same building as the chemistry department who could potentially be exposed to hazardous chemicals should be trained by the University Chemical Hygiene Officer or their own department and informed of the existence of the OSHA Laboratory Standard and the department's chemical hygiene plan.
- Refresher information should be provided yearly.
- Training for chemistry department employees will be conducted by the department's chemical hygiene officer.
- Research students must be farther trained by their research advisor to ensure that they are properly trained in the specific hazards involved in their research.

Documentation of Training Programs

- Records as to the content of the training programs provided to whom must be maintained. See **Appendix E**.

Training of Nonchemistry Staff

- Any person who enters a laboratory to perform routine maintenance, including custodial, public safety and facilities management personal will be trained by the Office of Environmental Health and Safety or by their individual departments. Training must include the use of personal protective equipment.
- Supervision of such programs and documentation of training programs will be the responsibility of the Office of Environmental Health and Safety

Section C: Safe Work Practices in Laboratories

1. General Principles

- Know the hazards involved with all chemicals you will be working with before starting work in the laboratory.
- Know the types of protective equipment available and use the proper type for each job.
- Know the location of and how to use the emergency equipment in the lab in which you are working.
- All persons, including visitors should wear proper personal protection, wherever chemicals are stored or used.
- Avoid consuming food or beverages in areas where chemicals are being used or stored.
- No smoking in laboratories or in areas where chemicals are stored.
- Avoid hazards to the environment by following accepted waste disposal procedures.
- All chemicals must be correctly and clearly labeled.
- Avoid distracting or startling any other worker. Practical jokes or horseplay cannot be tolerated at any time.

2. Health and Hygiene

- The proper eye protection is required for everyone entering a chemical work area.
- Know the types of protective equipment available and use the proper type for each job.
    - Splash goggles are required whenever a splash hazard exist. Safety glasses are only suitable in situations where physical hazards exist. Proper eye protection is required whenever working with UV light. The use of lasers requires special eye protection.
    - Closed-toe shoes, preferably leather, that cover the entire foot are required for everyone entering a lab. Shoes with high heels or made with woven material do not provide adequate protection. Open toe shoes and sandals are not acceptable.
    - Gloves are chemical specific. Gloves suitable for one chemical may not be adequate in protecting against another. When working with a highly toxic substance be sure you are using the proper gloves.
    - Lab coats and aprons are available for employees. Heavy duty aprons are available when using concentrated acids and bases.
- Confine long hair and loose clothing when in the laboratory.

- Do not taste any chemical and always use the proper technique when smelling a chemical.
- Avoid unnecessary exposure to chemicals by any route (inhalation, absorption, or ingestion)
- Be sure to wash your hands thoroughly after working in the lab.

3. Food in the Laboratory

- Contamination of food and drinking materials is a potential route for exposure to toxic substances. Food should be stored, handled, and consumed in an area free of hazardous materials.
- No food should be stored or consumed in any laboratory.
- Glassware or utensils that have been used for laboratory operations should never be used to prepare or consume food or beverages.

4. Labeling Procedures

- All chemicals will have their manufacturer's original container warning label about hazards and should be labeled with the date of receipt and the date of initial opening.
- For smaller working amounts of chemicals that are transferred to secondary containers, those containers must be properly labeled including any health hazards. The container must be labeled with:
    - **The contents of the container i.e. the common name of the chemical. Chemical formulas and structural formulas are not acceptable except for small quantities of compounds synthesized in the laboratory.**
    - **Date of transfer**
    - **Physical and health hazards (labels available in SIMS 107 and 306)**
    - **Indicate the strength or concentration of the substance where applicable**
    - **Faculty member's name is needed if the chemical is being used for research and not class use.**
- These labeling requirements do not apply to portable containers intended for the **immediate** use by the employee or student performing the transfer and to students assigned unknown chemicals for analysis.

5. Waste Disposal Procedures

- Container Management:

    - Containers used to accumulate waste must be in good condition (no severe rusting or apparent structural defects)
    - Use a container of appropriate size with a screw caped lid. Containers with glass stoppers or corks are not acceptable.
    - The container used to store waste must be compatible with the waste.
    - A container that begins to leak must have its contents immediately transferred to another container or the leaking container can be packed into another suitable container.
    - The contents of the waste must be clearly marked on the container.
    - For hazardous waste, the words "hazardous waste" must be clearly marked on the container.
    - Waste containers must remain closed except when it is necessary to add waste to the container.
    - When disposing of chemicals, keep each different class of chemicals in a separate clearly labeled disposal container.
    - Do not completely fill a waste container.

? Accumulation Points:

- Waste will be stored in the chemical storage building until it is picked up and removed from campus.
- Disposal of waste from campus must occur every 180 days or 270 days if the waste is being transported to a facility more than 200 miles away.
- The Office of Environmental Health and Safety is responsible for the removal of waste from campus.
- Accumulation points must be inspected weekly. Areas where containers are stored must be inspected for leaks and deterioration caused by corrosion or other factors. Inspection records must be maintained on site for at least three years from the date of inspection.
- An inventory of all waste stored in the chemical storage building must be maintained.
- All hazardous waste containers must have a yellow hazardous waste label on the bottle before being transported to the chemical storage building.

? Satellite Accumulation point

- The satellite accumulation point must be under the control of the operator of the process that generates the waste.
- All containers of hazardous waste stored in a satellite accumulation point must be labeled with the words "Hazardous Waste" and the contents of the waste.
- All satellite accumulation points must be identified as such.
- Containers must be in good condition
- Waste cannot be transported from one satellite accumulation point to another.
- Container holding hazardous waste must always be kept closed during accumulation except when it is necessary to add or remove waste.
- No single satellite accumulation point may hold more than 55 gallons of hazardous waste or more than 1 quart of acute hazardous waste at any one time.

? Employee Responsibilities:

- The faculty member in charge of the lab generating the waste is responsible for properly labeling the waste with a University hazardous waste label and then notifying the laboratory chemist that they have waste that needs to be disposed. The laboratory chemist will then inventory the waste and transport it to the proper waste accumulation point in the chemical storage building.
- Faculty must ensure that research students properly label and dispose of waste.
- Faculty must ensure that all waste has been removed form their laboratories at the end of each semester.

? Training Requirements

- All employees must be thoroughly familiar with waste handling and emergency procedures relevant to their responsibilities.
- New employees that work with hazardous waste must be trained within 6 months.
- All employees must take part in an annual review of the training program.

? General Waste Information

- Broken thermometers may contain mercury in the fragment and should be disposed of in a glass container designated for broken thermometers.
- Never put chemicals down the drain unless they are neutralized and allowed by local regulations, i.e. neutralized chromic acid contains chromium, a health hazard, which must be disposed of as a hazardous waste.

? Labeling Requirements

All waste must have a preprinted University waste label on it before waste is transported to the accumulation point. The following information must be added to the label:

- Generator
- Department
- Phone number (office number for generator)
- Room number and building
- Contents: The name of the chemical/s (do not use formulas or abbreviations) and percentages
- The health or physical hazards
- The date the waste was moved to the accumulation area (i.e. the storage building outside)

6. Special Safety Considerations

Centrifuges

? For tabletop centrifuges, make sure that they are properly securely and anchored in a location where vibration will not cause bottles or equipment to fall.
? Never leave the centrifuge until full operating speed has been obtained and the machine appears to be running safely without vibration.
? If a vibration occurs, stop the centrifuge immediately and check the counter-balance load. Check swing-out buckets for clearance and support.
? Regularly clean rotors with noncorrosive cleaning solutions.
? For larger centrifuges, ensure regularly schedule maintenance has been performed and has been recorded in the logbook.

Cold Room

? General Cold Room Procedures
  - Keep the time working in the cold room to a minimum. If prolonged periods of time must be spent in the cold room, please wear appropriate PPE (gloves, hat, jacket, etc.)
  - Do not place any objects outside the cold room door. This could prevent the door from opening and trapping someone inside.
  - The cold room floors are metal and will conduct electricity. Use extreme caution when working with electrical equipment. Use rubber-insulating mats on the floor to avoid shocks.

- During normal working hours, students must either enter the cold room with someone else, or there must be other people in the biochemistry 303 suite. If there is no one in the biochemistry area, the student must find another faculty member on the floor and inform them that they are entering the room.
- Students are not allowed to enter the cold room after hours alone.
- Turn the light to the cold room off when you exit the room. The light is connected to a sign in the hallway informing others that the room is in use.

? Emergency Procedures
  - If an alarm sounds, leave the room immediately and call Facilities Management at 323-2261.
  - If you experience dizziness or lightheadedness while working in the room, push the panic button and leave the room immediately. In a life-threatening emergency, call 9-911 or -3333 immediately. For non-life threatening incidents, employees will need to notify the chair and call the Office of Environmental Health and Safety at -2328 or 242-9545 so that they can be medically evaluated. If a student experiences dizziness or lightheadedness, call public safety at -3333.
  - Pushing on the door from inside should open the door. If you cannot get the door opened from the inside, push the lever down to open the door. If that does not work, there is a black knob by the door. If you turn the knob 90? counterclockwise, it will remove the lock so that the door can be opened.
  - The cold room is wired to the back-up generator. Thus, if the electricity were to go out in the building, the cold room and its oxygen sensor would still have power.

? Safe Chemical Use
  - Do not use flammable or toxic chemicals, corrosive acids, asphyxiants or open flames in the cold room. The room does not have ventilation to exhaust such chemicals resulting in possible personal overexposure.
  - Volatile flammable chemicals can cause fires or explosions. The cold room has exposed motors for circulation fans and thus, it a potential ignition source.
  - Corrosive acids can corrode cooling coils in the refrigeration system leading to refrigerant leaks.
  - Asphyxiant gases can displace oxygen in the room. Do not use liquid nitrogen or dry ice in the cold room.
  - Compressed gases cannot be stored in the cold room. When using compressed gases, be sure connections are secure to minimize leakage. If the oxygen sensor alarm sounds when using a compressed gas, leave the cold room immediately. Be sure to turn the gas off when you are finished using it.
  - Dry ice cannot be stored in the cold room. The release of carbon dioxide can lower oxygen levels in the room.

? Preventing Mold Growth
  - Keep the door firmly shut to avoid condensation on interior surfaces.
  - Do not have open containers of water or aqueous solutions.
  - Clean up all liquid spills immediately.
  - Report any water leaks or dripping faucets to Facilities Management @ 323-2261 immediately
  - Store paper products in closed plastic containers. Do not store cardboard or other porous organic materials in the room.

? Maintenance
    - The oxygen sensor in the room must be inspected and tested to ensure it is working properly. The Chemistry department will test and calibrate the oxygen sensor every 3 months.
    - The oxygen sensor will be replaced every two years.
    - The cold room should be inspected yearly by facilities management for leaks, temperature control, and piping integrity.

Ultraviolet Lamps

? All radiation shorter than 250 nm should be considered dangerous.
? Protective safety glasses with UV-absorbing lenses should be worn when the eye may be accidentally exposed to light in this wavelength region.
? It is advisable to operate such UV systems in a completely closed radiation box.
? Skin areas exposed to UV can receive painful burns, so precautions to protect skin should be taken.
? Handling of mercury arc lamps will deposit oils from the skin onto the outside glass surface causing local overheating of the lamp. Over time deposits on the inside of the glass may absorb UV and cause overheating.
? Whenever possible, UV sources should be adequately cooled and operated within an enclosure designed to prevent damage by explosion of glass fragments and leakage of mercury vapor.

Lasers

? The American National Standards Institute has established safety rules and ratings for lasers.

    - ***Class 1 lasers*** denote lasers that cannot produce a hazard under normal operating conditions.
    - ***Class 2 lasers*** denote low-power visible lasers that do not normally present a hazard, but may if viewed directly for extended periods of time. Class 2 lasers present no danger to the skin, and the beam does not even feel warm on the skin.
    - ***Class 3 lasers*** are lasers that can produce a hazard if viewed directly.
    - ***Class 4 lasers*** can produce a hazard not only from direct viewing or a specular reflection but also from diffuse reflection.

? Lasers with a power of less than 1 mW are classified as ***class 2 lasers*** and are the most appropriate for use in the teaching laboratory.

    - Although 1 mW seems small compared to a 100 W light bulb, all the energy is concentrated to a roughly 1 mm^2 area, making the energy per unit area very large. Because the eye can focus the already intense laser beam onto a small area of the retina, permanent damage can result from extended viewing of the direct beam.
    - In addition, the eye becomes sore with prolonged viewing of diffuse of reflected light. All experiments should be set up to minimize the chances of such exposure.
    - The basic safety rule is to avoid looking directly into the laser beam

? Use of ***class 3*** and ***class 4 lasers*** require protective eye goggles and other safety precautions. These lasers are generally too powerful for use by beginning students, but are often necessary for advanced physical chemistry and analytical chemistry laboratories. In such cases, a separate set of safety guidelines will be published for work with these lasers.

Reduced Pressure Operations

? ***Vacuum desiccators*** should be protected by covering with cloth-backed friction or duct tape or enclosed in a box or approved shielding device for protection in case of implosion.

- Only chemicals being protected from moisture should be stored in a desiccator.
- Before opening, make sure the atmospheric pressure has been restored; frozen lids can be loosened by a single edge razor blade as a wedge that is then tapped with a block to raise the lid.

? All ***vacuum lines*** should be trapped, and shielding should be used whenever the apparatus is under reduced pressure.

? ***Water aspirators*** for reduced pressure are mainly used for filtration purposes; they are sometimes used for reduced pressure for rotary evaporation equipment.

- Only equipment approved for this purpose should be used.
- Never apply reduced pressure to a flat-bottomed flask unless it is a heavy-walled filter flask designed for the purpose.
- Place a trap and check valve between the aspirator and apparatus so that water cannot be sucked back into the system if the water pressure should fall unexpectedly while filtering.

? If ***vacuum pumps*** are used, a cold trap should be placed between the apparatus and the vacuum pump, so that volatiles from a reaction or distillation do not get into the pump oil or out into the atmosphere of the laboratory.

- When possible, vacuum pump exhausts should be vented to a hood.

Cooling Baths and Cold Traps

? When ice water is not cool enough for use, salt and ice may be used. For even lower temperatures, dry ice may be used with an organic liquid.

- An ideal cooling liquid to be used with dry ice should be nontoxic, low viscosity, nonflammable, and low volatility.
- Ether, acetone, and butanone are ***too flammable and volatile and should not be used***.
- The following meet the criteria for use with dry ice in cooling baths:
  - Ethylene glycol or propylene glycol in a 3:2 ratio with water and thinned with isopropyl alcohol
  - Isopropyl alcohol
  - Some glycol ethers

? ***Cryogenic coolants*** should always be used with caution; cryogenic liquids must be handled in properly vented containers.

- Be aware that very low temperature coolants, such as liquid nitrogen, may condense oxygen and cause an explosion with combustible materials.
- Avoid pouring cold liquid onto the edge of a glass Dewar flask when filling because the flask may break and implode.
- For the same reason do not pour a cryogenic liquid out of a glass Dewar flask; use mild air pressure or a siphon.
- Metal and plastic Dewar-type flasks are preferable and eliminate this problem.
- Never use a household thermos in place of a Dewar flask.

? ***Dry Ice*** should be handled with caution:

- Do not lower your head into a dry ice chest; no oxygen is present, suffocation can occur.
- Do not handle dry ice with bare hands; if the skin is even slightly moist, severe burns can result.
- Use leather or suitable cryo-gloves to handle dry ice; when chipping dry ice, wear goggles.

Oil and Sand Baths

? When ***hot oil or sand*** is used for heating, extreme care must be taken to avoid:

- Overturning the bath
- Hazardous splattering caused by water falling into hot oil or sand
- Smoking caused by decomposition of the oil or of organic materials in the oil
- Fire caused by overheated oil bursting into flames.

? Whenever possible, use ***sand baths*** for heating rather than ***oil baths***; when using oil baths, consider the following:

- Operating temperature and temperature control devices
- Type of oil used (silicone oil, Dow Corning 550, is suggested for most heating needs)
- Available ventilation
- Method of cooling the hot oil
- Storage of oil for reuse
- Location away from possible sources of spilled chemicals or water

7. Faculty and Student Research Chemical Hygiene and Safety

Research is an important part of undergraduate education and requires special safety considerations. Each research mentor is totally responsible for ensuring that all research they carry out or mentor is conducted in accordance with the policies, principles, and procedures outlined in the Department Chemical Hygiene Plan

Laboratory Supervision Requirements

? Working hours are 8 am – 6 pm and require that following conditions be met:
- The proper personal protective equipment must be used and all laboratory procedures must be carried out in accordance with the CHP.

- Research students are responsible for informing their research advisor that they are in lab working.
- A faculty member must be present on the floor in which a student is working and the student must notify the faculty member as to where they will be working. This rule also applies to students using computers in a laboratory.
- If a faculty mentor is going to be out of their office for the day, they must arrange with another faculty member to supervise their students for the day. Research students must be notified of your absence and are responsible for reporting to the designated faculty member.

? Laboratory work after hours
  - No laboratory work can be conducted by students outside normal working hours if the student's research mentor is not present.
  - Exceptions must be approved by the safety committee and will be limited to activities that are essential to the research, but do not involve hazardous chemicals or procedures.
  - Unsupervised after hours computer use in laboratories is discouraged due to the hazardous nature of the laboratory. Students can use laboratory computers for data analysis after hours if there is a faculty member on the floor, and the faculty member is aware of the student's presence.
  - When entering Sims after hours, you must bring someone with you not only for laboratory safety reasons, but also for your own personal safety.

Student Training and Information Requirements:

? Students must have access to MSDS's and be made aware of the hazards associated with the substances they will be working with.
? The department's safety officer will train research students in general laboratory procedures and individual research advisors will train their research students in the specific chemical and physical hazards that exist in their lab.
? Once students are adequately trained, they must demonstrate competence in the techniques they will be using before being allowed to carry out these independently.
? Some techniques must only be done under direct faculty supervision.
? Students must be trained on the chemical disposal procedures to be used; on labeling requirements for all chemicals or solutions they prepare; and on guidelines for laboratory storage, housekeeping, and cleanliness requirements that must be met before they can depart each day.
? Students are not allowed to work in lab alone.
? Students must know and must demonstrate competence in the specific prudent safety practices necessary for the work being done.

Project Summary

Each research advisor must submit to the Department Safety Committee a project summary. Project summaries are due as follows:

? An updated summary is due the week before the start of classes in the fall.
? If you are starting a new project, a project summary is due the week before the start of classes in the semester in which the research will take place.
? If you are starting a new project for the summer, a project summary is due May 1, so that the safety committee can review the information before May 15.

Each project summary should address the following:

- An overview of the research project including objectives.
- A list of all chemicals that are expected to be used. If any particularly hazardous chemicals will be used by the student, the research advisor must include the potential hazards associated with the use of such chemicals, the proposed procedures, justification for why the proposed procedure must be used, and any special safety and precautionary steps that will be taken.
    - Particularly hazardous chemicals include corrosive, flammable, highly reactive or explosive chemicals, or toxic chemicals such as carcinogens, reproductive toxins, embryo toxins, chemicals of high chronic toxicity, or materials exhibiting a high degree of acute toxicity
- Clearly indicate what activities students can and cannot perform alone
    - Any activity in which an accident could happen cannot be performed by a student unsupervised
- Will any unsupervised activities need to be performed outside working hours (8am to 6 pm)?
    - If so, clearly state what these activities will involve, and when and how often they will occur.
    - Unsupervised activities taking place outside normal working hours must be approved by the Department Safety Committee.
    - Approval will be limited to activities that are essential to the research, but do not involve hazardous chemicals or procedures.
- Upon the completion of a student research project, how will you ensure that the student has:
    - Returned all chemicals to their proper location
    - Returned all equipment
    - Labeled all waste properly and has taken it to stockroom personal for proper disposal
    - Disposed of any unused chemicals and/or solutions that will no longer be used for this project
    - Removed and properly disposed of all materials stored in refrigerators and freezers

Also, any student conducting research for academic credit will be required to submit to the research course instructor, as part of their grade, the following:

- A list of chemicals that will be used
- The hazards associated with the use of each substance
- The proper personal protective equipment that must be used
- A detailed description of any operations that will be performed outside normal working hours, including whether or not such operations require supervision

Completion of Student Research Project

- The research course director and faculty research mentors will not assign satisfactory final research grades to students until they have:

- Returned chemicals used to their proper location
- Returned all equip ment
- Properly labeled all waste and taken it to a location identified by the lab chemist Properly disposed of all calibration solutions
- Removed and properly disposed of all materials stored in refrigerators and freezers

Research Chemical Inventory Manageme nt

? At the end of each academic year, each faculty member will inventory their research chemicals, identify materials that are no longer necessary, and properly dispose of excesses. This includes any substances stored in refrigerators or freezers.

? Chemicals will be ordered in the smallest possible quantities that are prudent, even at the expense of higher long-term costs. The goal is to minimize on-hand chemical inventories.

Section D: Storage and Handling Requirements

1. General Storage Requirements

a. General Storage Facilities Requirements

- Shelves should be made of a chemically resistant material wherever flammable or corrosive chemicals are stored and should have a lip or side rails.
- Flammable, corrosive, or particularly hazardous chemicals should not be stored any higher than 5 feet off of the ground. Large bottles should be stored no more than two feet from ground level.
- No smoking or flames of any kind in chemical storerooms.
- All storage rooms shall have continuous ventilation and must be checked if any buildup of odors is noticed.
- Aisles in storage rooms must not be blocked.
- Storerooms cannot have floor drains in order to prevent contamination of the water supply.
- A storeroom shall be clearly posted for the type of hazards inside.
- Chemical storage rooms should not be used as preparation areas unless a separate area is set up as a preparation area. This will help limit the possible contamination of a large quantity of virgin chemicals.

b. Storage Location of Chemicals

- Large quantities of chemicals must be stored in the chemical storage building
- Working quantities of chemicals will be stored in one of the chemistry prep areas or in the laboratory if it is a chemical that is used on a routine basis.
- Chemicals used for research can be stored in research labs as long as the storage of such chemicals adheres to the requirements outlines in the chemical hygiene plan.
- Storage of chemicals in hoods and on lab benches should be kept to a minimum and all such containers should be returned to the appropriate storage area whenever the experiment is complete.

c. Chemical Storage

- Chemicals shall be segregated by hazard classification and compatibility. The following list can be used as a guide for segregating chemicals by hazard classification. A list of common incompatible chemicals can be found in **Appendix F**.
- Storage Compatibility:
  - Inorganic acids
  - Caustics
  - Inorganics
  - Oxidizers
  - Water Reactive
  - Toxic - carcinogens, reproductive hazards
  - Flammable
  - Organic Peroxides
- Keep chemicals away from heaters and sunlight.
- Annual inspections of all containers for seal, label integrity, warning labels, quantity on hand, and any signs of decomposition.
- Labels on stored chemicals should be able to be read easily.

- Large quantities of chemicals should be stored outside in the chemical storage building in the appropriate room.

d. Storage of Chemicals in Laboratory Areas

- Chemical inventories should be kept to a minimum in working laboratories.
- These minimal inventories should be stored in a safe manner as outlined in the chemical hygiene plan.
- All flammable chemicals in laboratories must be stored in a flammable cabinet.
- Acids should be stored in acid cabinets.
- Other corrosives should be stored on containment trays.
- Carcinogenic chemicals can only be stored in a laboratory if a designated area is set up for the storage of such chemicals.
- Chemicals should be segregated by chemical characteristics to avoid incompatibilities.

e. Storage of Chemicals in Refrigerators

- All refrigerators used for the storage of potentially explosive materials must be explosion proof.
- Nonflammable materials can be stored in a nonexplosion proof refrigerator, but cannot also be used for consumable food storage.
- Clearly label all materials placed in refrigerators.
- All refrigerators must be labeled to indicate its general use, such as “Chemical Storage Only. Do Not Store Food In This Refrigerator” or as “Food storage: No Chemicals”.

f. Inventory Control

- An inventory of all chemicals must be maintained in an electronic data base.
- An inventory of all chemicals will be conducted once a year, which will include all chemicals in prep areas, laboratories, and refrigerators.
- All chemicals must be delivered to the chemistry stockroom so that proper inventory records can be maintained.
- Keep the reserve supply of chemicals to a minimum.
- Many chemicals are assigned an expiration date. The expiration date should be strictly observed. Expired chemicals should be marked for disposal.
- A date received/date opened label should be placed on all chemicals when received. Whoever opens the chemical is responsible for recording the date opened.
- Stored chemicals must be visually inspected annually. Indications that a chemical should be disposed of include:
    - Chemical is kept passed its expiration date
    - Slightly cloudy liquids
    - Chemicals that are changing colors
    - Spotting on solids
    - Caking of anhydrous materials
    - Existence of solids in liquids or liquids in solids
    - Pressure buildup in bottles
    - Evidence of reaction with water
    - Damage to the container
    - Questionable labels
    - Leaks
    - Corroded lids

2. General Handling Procedures

- Know the hazards involved with all chemicals you will be working with before starting work in the laboratory.
- Know the types of protective equipment available and use the proper type for each job.
    1. Splash goggles are required whenever a splash hazard exist. Safety glasses are only suitable in situations where physical hazards exist.
    2. Closed-toe shoes, preferably leather, that cover the entire foot are required for everyone entering a lab.
    3. Gloves are chemical specific. Gloves suitable for one chemical may not be adequate in protecting against another. When working with a highly toxic substance, be sure you are using the proper gloves.
    4. Lab coats and aprons are available for employees. Heavy duty aprons are available when using concentrated acids and bases.
- Know the location of and how to use the emergency equipment in the lab in which you are working.
- Use caution when transporting chemicals:
    1. Transport chemicals on a cart that can contain a spill.
    2. Use a nonbreakable, secured secondary container for transporting a hazardous chemical that exceeds 1 liter or 1 kg.
    3. Do not ride the elevator when transporting compressed gas cylinders or cryogens. Place a prominent sign on the cylinder warning others not to board the elevator.
- Avoid unnecessary exposure to chemicals by any route (inhalation, absorption, ingestion or injection)
- Do not taste any chemical and always use the proper technique when smelling a chemical.
- All persons, including visitors should wear proper personal protection, wherever chemicals are stored or used.
- Avoid consuming food or beverages in areas where chemicals are being used or stored.
- Sims is a non-smoking building.
- Avoid hazards to the environment by following accepted waste disposal procedures.
- All chemicals must be correctly and clearly labeled.
- Avoid distracting or startling any other worker. Practical jokes or horseplay cannot be tolerated at any time.

Section E: Provisions for Particularly Hazardous Materials

1. Chemicals of Chronic or High Acute Toxicity

Definitions:

- **Carcinogen:** Substances that are suspected or known to cause cancer. Some have threshold limits of exposure. (A list of carcinogenic chemicals can be found in **Appendix G**.)
- **Mutagen:** Chemical or physical agent that causes genetic alterations
- **Teratogen:** Substances that cause the production of physical defects in a developing fetus or embryo.
- **Substances with a High Acute Toxicity:** Any chemical falling within any of the following OSHA defined categories:
    1. A chemical that has a LD_{50} of 50 mg/kg or less when administered orally to a test population.
    2. A chemical that has a LD_{50} of 200 mg/kg or less when administered by continuous contact for 24 hours to a test population.
    3. A chemical that has a LC_{50} in air of 200 ppm or less of a gas or vapor, or 2 mg/L or less of mist, fume, or dust when administered by continuous inhalation for one hour to a test population.

General Guidelines

- As a general rule, all chemicals of known or potential carcinogenic properties will not be used unless no suitable alternative is available.
- Prepare a plan for the use and disposal of these materials before beginning any laboratory work.
- Be prepared for accidents and spills. Know the location of all safety equipment. Have the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the material safety data sheet.
- The proper personal protective equipment including gloves, ensure gloves are impervious to the chemical being used, and a long sleeved lab coat must be worn.

Storage Guidelines

- Chemicals of chronic or high acute toxicity shall be stored in a cool dry location with warning signs and adequate ventilation.
- Chemicals of chronic or high acute toxicity can be stored in a laboratory if a designated area is set up and properly labeled as such.
- Store all containers of prepared solutions that contain a chemical of chronic or high acute toxicity on a tray to contain spills.
- All containers must be clearly labeled and must include the appropriate health hazards.

Handling Guidelines

- All work should be performed in a fume hood. The area in which the research is being carried out must be clearly marked with warning signs if left unattended, such as "Warning: Highly Toxic Substance in Use".
- If a chemical of chronic or high acute toxicity is transferred to a secondary container, the container must be properly labeled with the name of the chemical (chemical formulas and structural formulas are not acceptable), date, your supervisors name, and the health hazard.
- Never leave a container of chemical of chronic or high acute toxicity opened or unlabeled.
- Clean up small spills thoroughly.
- If a spill occurs outside the fume hood, evacuate the area and notify your instructor or the chemical hygiene officer.
- When you are finished working, clean all areas where the chemical was used.
- All empty containers that contained a chemical of chronic or high acute toxicity, including the original manufacturer bottle, must be washed with water twice with the washings being treated as waste.
- Remove all protective equipment before leaving the lab. Wash your hands and any other exposed body surface thoroughly.

2. **Compressed Gases**

Definition:

A compressed gas is any material or mixture having in the container an absolute pressure exceeding 40 psia at 21 ? C (70 ? F), or a pressure exceeding 104 psia at 54 ? C (130 ? F), or any flammable liquid material having a vapor pressure exceeding 40 psia at 38 ? C (100 ? F).

General Guidelines

- ? Compressed gas cylinders should be handled as high-energy sources and therefore as potential explosives.
- ? All cylinders, full and empty, must be restrained.
- ? Before using a compressed gas, be familiar with the properties of the gas.
- ? Always wear your safety glasses when handling compressed gases.
- ? **Do not extinguish a flame involving a highly combustible gas until the source of gas has been shut off.**
- ? If you are using a compressed gas that is not listed below, you must consult the chemical hygiene officer so that the proper procedures for that gas can added to the chemical hygiene plan.
- ? **Gas cylinders can only be ordered from companies that will accept the return of empties.**
- ? Whenever possible, lecture bottles must be ordered from companies that accept the return of partially filled or empty cylinders.
- ? The contents of any compressed gas cylinder must be clearly identified by the manufacturer. Any cylinder that is not clearly identified will not be accepted and will be returned to the manufacturer. Color-coding is not a reliable means of identification.
- ? Contents of the cylinder must be visibly labeled including hazard class, as indicated below. The label facing the wall is not acceptable.
- ? Paper tags will be used on all cylinders to indicate the state of the tank as: Full, In Use, or Empty.
- ? All compressed gas cylinders must be clearly marked and identified with the proper labels or tags as indicated in the table below:

Compressed Gas	***Must be labeled as***
Acetylene	Flammable Gas
Argon	Non-Flammable Gas

Helium	Non-Flammable Gas
Hydrogen	Flammable Gas
Nitrogen	Non-Flammable Gas
Nitrous Oxide	Non-Flammable Gas
Oxygen	Oxygen Containing Gas

Storage Guidelines

? When a new cylinder is received:

- It must be immediately inspected to insure it is not leaking, that the proper cap is securely in place, and that it is properly labeled.
- The proper hazard identification tag must be secularly fastened to the tank. Do not fasten any tags to the cap of the cylinder. All tags must be securely attached to the cylinder.
- A status tag indicating that the cylinder is full must be secularly attached to the cylinder. The date the cylinder was received should be added to the top of the status tag.
- All extra gas cylinders will be located in the chemical storage building. They must be secured at all times. Valves are to remain closed and caps are securely in place when not in use.
- Oxygen cylinders cannot be stored in the same vicinity as flammable gases. Therefore, DO NOT store flammable gases in the compressed gas storage room in chemical storage building.
- Empty cylinders must be identified as emptied and returned to the chemical storage building and separated from full cylinders.

Handling Guidelines

? In use cylinders must be secured at all times to prevent tipping, falling, or rolling. They must be securely attached to walls, benches, or other fixed surface with chains or straps.
? Regulators are gas specific and not necessarily interchangeable. Always make sure you are using the proper regulator.
? Check for leaks with soapy water.
? Cylinder valves should be opened slowly and only after the proper regulator has been attached.
? Never use any kind of lubricant on valve regulators.

- There shall be no smoking or open flames in areas were flammable compressed gases are being stored or used.
- Be aware that rapid release of a compressed gas will cause an unsecured gas hose to dangerously whip around.
- Do not extinguish a flame involving a highly combustible gas until the source of the gas has been shut off.
- Rapid release of a compressed gas builds up a static charge that could ignite the gas if it is flammable or combustible.
- Never bleed cylinders completely. Leave a slight pressure to keep out contaminants.
- Acetylene cylinders:

    - Always store acetylene cylinders upright.
    - Do not use an acetylene cylinder that has been stored or handled in a non-upright position until it has sat for in an upright position for at least 30 minutes.
    - Ensure that the outlet line of an acetylene cylinder is protected with a flash arrester.
    - Never exceed the pressure limit indicated by the warning red band of an acetylene pressure gauge.
    - Ensure that the tubing being used for transporting acetylene gas is appropriate. Some tubing materials such as copper form explosive acetylides.

Transportation of Compressed Gas Cylinders

- Use only the gas cylinder cart, properly designed for moving gas cylinders, when moving a cylinder.
- Do not drag, roll or slide cylinders.
- Secularly strap the cylinder to the cart.
- The valve should be closed and the cover cap secured in place before moving the cylinder. Do not move a cylinder with a regulator.
- Handle only one cylinder at a time.
- Do not ride the elevator with a compressed gas cylinder.
- Students are not allowed to transport compressed gas cylinders by themselves. They must be properly trained and must be accompanied by a faculty/staff employee.

Lecture Bottles

- Whenever possible, lecture bottles must be ordered from companies that accept the return of partially filled or empty cylinders.
- Regulators are gas specific and are not necessarily interchangeable. Always make sure you are using the proper regulator. Name all associated equipment with the gas name to prevent unintentional mixing.
- Lecture bottles must be inspected twice a year for signs of leakage and/or corrosion. If the bottle shows signs of leakage and/or corrosion, the bottle must be returned to the supplier or special arrangements must be made for disposal.

3. Corrosive Chemicals

Definition- The definition of corrosive chemicals is very broad. In general terms a corrosive chemical can be defined as a chemical where living tissue as well as equipment is destroyed on contact. Strong acids and bases, dehydrating agents, and oxidizing agents are commonly considered corrosive chemicals. A list of common corrosive chemicals is found in **Appendix H.**

General Guidelines

- The following is a list of the major classes of corrosive chemicals.

Strong Acids	Concentrated acids can easily attack skin and eyes causing severe and painful burns. Hydrofluoric acid is an extremely dangerous material and all forms, including vapors and solutions, can cause severe, slow-healing and painful burns.
Strong Bases	Alkali metal hydroxides are very destructive to the skin and particularly to the eyes.
Dehydrating Agents	Dehydrating agents have a strong affinity for water. When they are added to water too rapidly, a violent reaction accompanied by spattering can occur. These substances can cause sever burns on contact with the skin or eyes.
Oxidizing Agents	Powerful oxidizing agents are considered corrosive chemicals. The halogens are strong oxidizing agents and because they are gases they pose danger to sensitive tissues through inhalation.

Storage Guidelines

- Large quantities of inorganic corrosives will be stored in acid room of the chemical storage building in a clearly labeled area.
- Large quantities of organic corrosives will be stored in a separate area of the organic storeroom and clearly labeled as such.
- Smaller working quantities of concentrated acids should be stored in corrosive cabinets.
- Storage areas must be kept dry, well ventilated and cool, but not cold as acetic acid freezes at 60? F (16? C)
- Isolate corrosives from all other nearby chemicals.
- Whenever possible, store corrosives in their original shipping containers.
- Acid spill control material must be readily available.
- Store corrosives four feet or less above the floor.
- Recognize that some acids, such as perchloric and fuming nitric, must be treated as strong oxidizers rather than acids.
- Separate corrosives that will react with other corrosives.
- Perchloric acid cannot be used in Sims. Perchloric acid requires a special perchloric acid hood which is not available in Sims.

Handling Guidelines

- Eye protection, indirect or nonvented splash goggles, must always be used when handling corrosive materials.
- Chemical resistant rubber gloves, a face shield and a heavy-duty rubber apron may also be appropriate, such as when working with concentrated corrosives. Such personal equipment is not necessary when working with dilute acids and bases since washing with water is sufficient in decontaminating the skin.
- Never add water to acid. When diluting a concentrated acid, **always add acid slowly and cautiously to water**.
- Corrosive chemicals can only be used in areas that are equipped with an eyewash station and safety shower.
- In the event of skin or eye contact with a corrosive chemical, remove all affected clothing and immediately flush the area with cool water for 15 minutes. Seek medical help.
- Procedures involving concentrated corrosive chemicals or chemicals that may result in the generation of corrosive fumes, gases, vapors, aerosols and/or dusts must be conducted in a fume hood.
- Be prepared for spills. For large spills of corrosive chemicals, evacuation of the building maybe required.
- When strong corrosives are used in student experiments, the students must be informed on the nature of the corrosive and any precautions that must be followed.
- **Perchloric acid** is a powerful oxidizing agent. Most fume hoods are not suitable for the using perchloric acid. Sims is not equipped with a perchloric acid hood.
- Because dry **picric acid** is a highly explosive. Therefore, picric acid should only be purchased if no suitable alternative is available. Before purchasing picric acid, permission

form the chair must be obtained, and a thorough investigation into the hazards of picric acid must be completed. A maintenance schedule to ensure that picric acid does not dry out must be established.

- Dry picric acid is explosive. Any old container of picric acid that dried up must be disposed of only with expert assistance. Do not move the container.
- **Hydrogen fluoride** is very toxic both as a gas and in solution. Do not use hydrogen fluoride until you have thoroughly familiarized yourself with its properties and safe handling procedures. Even contact with dilute solutions of hydrofluoric acid can result in a serious burn.

4. Cryogenic Liquids

Definition- Liquefied gases that condense oxygen from the air create an oxygen rich atmosphere and increase the potential for fire if flammable or combustible materials and a source of ignition are present.

General Guidelines

- A number of hazards may be present from the use of cryogenic liquids. All employees and students should be properly trained in using such materials prior to use.
- Tissue damage, similar to a thermal burn, will result with even very brief contact with a cryogenic liquid including any surface cooled with the liquid.
- Always wear safety glasses with side shields or goggles when handling. Wearing a face shield is also recommended.
- Gloves should be impervious and sufficiently large to be readily thrown off should a cryogen spill.
- Watches, rings, and other jewelry should not be worn.
- All rooms were cryogenic liquids are used, must have an oxygen sensor.

Storage and Handling Guidelines

- Containers and systems containing cryogens should have pressure relief mechanisms.
- Containers and systems should be capable of withstanding extreme cold without becoming brittle. Do not transfer any cryogenic liquid into a nonapproved container. Transfer liquid nitrogen only into glass Dewar flask approved for cryogenic liquids.
- Adequate ventilation is required when using liquid nitrogen or helium. Oxygen can be condensed out of the atmosphere creating a potential explosive situation. Also, oxygen can be displaced from the atmosphere causing an oxygen deficiency resulting in asphyxiation.
- Never ride on the elevator when transporting a cryogenic liquid.

5. Flammable and Combustible Liquids

Definitions:

- **Flammable liquids- any liquid having a flashpoint* below 38 ? C (100 ? F).**
- **Combustible liquids – any liquid having a flashpoint at or above 38 ? C (100 ? F)**

These liquids are further subdivided into three groups:

	Flashpoint	***Boiling Point***	***Examples***
Flammables			
Class IA	< 22.8 ? C (73 ? F)	< 37.8 ? C (100 ? F)	acetaldehyde, ethyl ether, cyclohexane
Class IB	< 22.8 ? C (73 ? F)	? 37.8 ? C (100 ? F)	acetone, benzene, toluene, ethanol
Class IC	? 22.8 ? C (73 ? F)	< 37.8 ? C (100 ? F)	Xylene, butanol
Combustibles			
Class II	? 37.8 ? C (100 ? F) & < 60 ? C (140 ? F)		acetic acid
Class IIIA	? 60 ? C (140 ? F) & < 93.3 ? C (200 ? F)		cyclohexanol, formic acid, nitrobenzene
Class IIIB	? 93.3 ? C (100 ? F)		formalin, picric acid

*The flashpoint is defined as the minimum temperature at which a liquid gives off vapor in sufficient concentration to form an ignitable mixture with air near the surface of the liquid.

Storage Guidelines

- Bulk quantities of flammable chemicals larger than four liters should be stored in the flammable storage room of the chemical storage building.
- Flammable chemicals stored in the laboratories should be stored in flammable storage cabinets and the quantity should be kept to a minimum.
- Flammables should not be stored in areas exposed to direct sun light.
- Appropriate fire extinguishers and/or sprinkler systems and spill control materials will be available in all areas where flammable chemicals are stored.
- All chemical storage rooms must have a raised area in the doorway to contain spills.
- Any flammable chemical that must be stored in the refrigerator or freezer must be stored in an explosion proof refrigerator/freezer.
- Keep containers of flammable substances tightly closed.

Handling Guidelines

- Large amounts of flammable chemicals should be used only in vented hoods and away from sources of ignition, which includes not only flames, but also electrical equipment, static electricity and, for some material even hot surfaces.
- Smaller working amounts of flammable chemicals should be used in vented hoods whenever possible and away from sources of ignition.
- Heat flammable substances in steam, water, oil, hot air baths or heating mantles only.
- To prevent differences in electrical potential when transferring a flammable chemical from a large container (5 gallons or larger) to a smaller container, the containers must be grounded and bonded. Nonmetallic containers must also be grounded and bonded.

6. Peroxide-Forming Chemicals

Definition- chemicals, which undergo autoxidation reactions (a reaction with oxygen in the air) to form peroxides, which can explode with impact, heat, friction, shock, sparks or light

- Peroxides and peroxide forming chemicals are among the most hazardous chemicals handled in the laboratory. Organic peroxides are particularly unstable and very sensitive to impact. Anyone using such chemicals should consider the following general information and should thoroughly research information regarding any specific chemical to be used.

Storage Guidelines

- Date all chemicals that are known peroxide formers upon receipt and upon opening.
- Store away from heat and light sources
- Label such chemicals as known peroxide formers.
- Limit stock of such chemicals to a three-month supply.
- Keep the stocks of peroxide forming chemicals to a minimum. Potential peroxide formers will not be allowed to evaporate to dryness.
- Do not use metal storage containers to store peroxide forming chemicals.
- Check for peroxide formation every three months to a year depending on the chemical. See **Appendix I**.
- Do not open any container, which has solid forming around its lid.

Handling Guidelines

- Before distilling any known or suspected peroxide former, it must be checked for peroxides. Peroxide test stripes are located in the refrigerator in Sims 304.
- When distilling peroxide forming chemicals, the distillation apparatus should be assembled in a hood and in such a way that it is possible to remove the heat source.
- Never return unused peroxide forming chemicals to the original storage container.
- Do not use metal spatulas when working with such chemicals.
- Follow the same handling procedures outlined for flammable chemicals.

7. Water Reactive Chemicals

Definition- a material that when comes into contact with water becomes spontaneously flammable or gives off a flammable or toxic gas and presents a health hazard. Examples include alkali and alkaline earth metals (sodium, magnesium, etc.), anhydrous metal halides (aluminum bromide, etc), anhydrous metal oxides (calcium oxide, etc), nonmetal oxides (sulfur trioxide, etc), nonmetal halide oxides (phosphoryl chloride, etc), and organometallics.

Storage

- Chemicals must be stored in a dry area, such as a chemical storage cabinet.
- Should not be stored in the same area as other combustible materials.
- Water reactive chemicals should be clearly labeled as such.

Handling

- The utmost care must be taken to avoid the contact of such chemicals with water.
- When using such chemicals, one should thoroughly research information of their use.

Section F: Emergency and Medical Procedures

Accidents to employees involving exposure to hazardous chemicals. Requirements of the OSHA laboratory Standard (29 CFR 1910.1450)

1. Medical Procedures for Employees Exposed to Hazardous Chemicals

Medical Attention

- All employees who work with or are potentially exposed to hazardous chemicals must be given the opportunity to receive medical attention under the following circumstances:
  - Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed to in the laboratory.
  - Where exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements.
  - Whenever an event takes place in the work area such as a spill, leak, explosion, or other occurrence resulting in the likelihood of the employee being exposed to hazardous chemicals.

Requirements and Responsibilities

- In the event that an employee was exposed or potentially exposed to a hazardous chemical, the chair must be immediately informed as to the situation. In the event that the chair is not available, the accident must be reported to the department's secretary or the safety officer for relay to the University safety officer. Accidents during evening classes must be reported to public safety - 3333.
- All necessary medical examinations must be authorized by the University safety officer who will instruct the employee as to where to report for medical attention.

  - **University Environmental Health and Safety Office 323-2328 or (803) 242-9545**

- **In the event of a life threatening accident, call –3333 or 9-911.**
- All necessary medical examinations must be performed by or under the direct supervision of a licensed physician and must be provided without cost to the employee, without loss of pay, and at a reasonable time and place.
- The chair is responsible for establishing the need for employee medical examination.

Information Provided to the Physician (Appendix J)

- The following information should be provided to the physician:

  - The identify of the hazardous chemical to which the employee may have been exposed.
  - The MSDS of the chemical
  - A description of the conditions under which the exposure occurred
  - A description of the signs and symptoms of exposure that the employee is experiencing, if any.

Physician's Report (Appendix K)

- A written report from the physician is required for any examination required under the chemical hygiene plan. The report from the examining physician should include the following:
    1. Any recommendation for further medical follow-up;
    2. The results of the medical examination and any associated testes;
    3. Any medical condition which 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;
    4. A statement that the employee has been informed by the physician of results of the examination and any medical condition that may require further examination or treatment.
    5. The written opinion must not reveal specific findings of diagnoses unrelated to occupational exposure.

2. Procedures for Employee Incidents Involving Bodily Injury

- All employees, including student assistants, who sustain an injury on the job, must adhere to the following guidelines.
    - Notify the chair of the department immediately. If the chair is unavailable, the incident must be reported to the department's secretary for relay to the university's safety manager, ext. **2328 or (803) 242-9545**.
    - **If someone's life is in danger, call –3333 immediately.**
    - Incidents during evening classes must be reported to public safety.
    - An incident report form (see **Appendix L**) must be completed by the employee or in case of injury to a student employee; the report must be filled out by the student employee and the faculty/staff member in charge of the area in which the accident occurred. The completed form must be submitted to the chair.
- Accident report forms are available on line from the chemical hygiene plan. The completed form must be submitted to the chair.

3. Procedures for Student Incidents Involving Bodily Injury

- For all student incidents involving bodily injury, the employee in charge of the lab at the time of the incident must
    - **If someone's life is in danger, call –3333 immediately.**
    - Notify the chair of the department immediately. If the chair is unavailable, the incident must be reported to the department's secretary or the departments safety officer
    - Incidents during evening classes must be reported to public safety.
    - An incident report form (see **Appendix M**) must be completed by the employee and the student. The completed form must be submitted to the chair.
    - For minor incidents, the student must go to Crawford Health Services
- Accident report forms are available on line from the chemical hygiene plan. The completed form must be submitted to the chair.

4. Emergency Procedures in Case of Bodily Injury

University Employees[1]

Very Serious[3]	Call -3333
Serious[4]	Call University Safety Manager –2328 or (803) 242-9545, and you will be instructed as to where to go
Minor[5]	Minor first aid treatment

Non-working Students[2]

Very Serious[3]	Call -3333
Serious[4]	Call Public Safety -3333
Minor[5]	Report to Crawford Health Services -2206

[1]University employees include all faculty and staff employees, and also include student assistants who are performing their work duties at the time of the accident.
[2]Non-working students include all students not receiving any University pay for services rendered and all students who were not performing their work duties at the time of the accident.
[3]Very serious injury would involve an injury where the person is unconscious, seriously burned either by fire or chemicals, bleeding seriously, and/or ingested chemicals in any way.
[4]Serious injury would involve an injury where the person is in need of medical attention, but is able to walk.
[5]Minor injury would involve a minor cut, burn, etc.

5. Guidelines for Employees for Dealing with Various Hazards in the Laboratory

If you are attempting to assist someone else who is injured, do not become injured yourself or you will no longer be of much help.

If you are attempting to assist someone covered in chemicals, wear safety goggles and gloves so that you too do not become injured.

Chemical Burns

Chemicals on the Skin in Confined Areas

- Immediately flush the area with cool water for at least 15 minutes. Remove all jewelry to facilitate removal of any residual material.
- Check the MSDS to see if any delayed effects should be expected.

- If a delayed reaction is noted (often the next day), call the University safety manager at **–2328 (or (803) 242-9545)** who will instruct you as to where to report for medical attention and carefully explain to medical personnel what chemicals were involved.
- If there is any doubt, call the university safety manager **–2328 (or (803) 242-9545)**.

Chemicals Spilled over a Large Area of the Body

- Remove victim's clothes.
  - Remove victim's shoes so that chemicals do not collect in the shoes.
  - Rinse the area with large quantities of water for at least 15 minutes under a safety shower.
  - Call public safety -3333 immediately.

Chemicals in the Eyes

- Get the victim to an eyewash station immediately, and rinse the eyes for at least 15 minutes.
- Eyelids have to forcibly opened to ensure effective washing behind the eyelid.
- Remove contact lenses as soon as possible so that the eyes can be thoroughly rinsed.
- All eye injuries must be treated by a doctor.
- Call public safety at –3333 immediately for help or call the university safety manager at -2328.

Fires

- **A** fire contained in a small vessel often can be suffocated, for example by placing a watch glass over its opening.
- If the fire is too large to be suffocated quickly, activate the fire alarm and notify everyone around you. Use the stairs when evacuating the building. Do not use the elevator during the evacuation.
- It is easy to underestimate a fire. Fires spend quickly. **Never attempt to use a fire extinguisher unless you have been trained in its use**. Locate yourself between the fire and the exit. Always be sure you can escape.
- If a person's clothes are on fire, get them to stop, drop, and roll or lead them to a safety shower and douse them with water.
- Cover the victim with what ever is available (most labs have fire blankets), but leave the head uncovered. **Do not cover a person with a fire blanket until the flames have been extinguished.**
- Get medical attention immediately (public safety-3333 or 9-911).

Ingestion of Chemicals

- Identify the chemical ingested and call –3333 immediately.
- Wrap the injured person in a blanket to prevent shock.

Inhalation of Chemicals

- Evacuate the area and move the victim into fresh air.
- Call -3333

Wounds

Small cuts and scratches

- Cleanse area with soap and water preferably in a restroom and not in lab.
- Place a clean dressing over the wound.
- If you are assisting someone with a minor wound, wear safety glasses and disposable latex gloves, which are located in all first aid kits.
- If assisting a student, send them to Crawford Health Services.

Significant bleeding

- Call -3333 immediately

FIRST AID KITS

- There is a first aid kit located on each floor of the chemistry building. All accidents must be reported to the chair or the safety coordinator. The faculty or stuff member must inform the safety coordinator of all accidents so that a record of all accidents can be maintained and first aid kits can be restocked.
- No oral medication can be stocked in the first aid kits.

6. Cleaning up Chemical Spills

Treat a chemical spill as an emergency situation and call public safety **(-3333)** immediately if there is an injured person, a fire or fire hazard exists, or there is significant fumes preventing anyone from getting close to the spill.

General Rules for Identifying and Cleaning up Chemical Spills

- Any student generating or finding a spill must inform a faculty member, the chemical hygiene officer, or lab personnel.
- Identify the chemical if possible.
- It is the responsibility of the faculty member, the chemical hygiene officer, the laboratory chemist, or the lab instructor to determine whether the spill is a simple spill or a complex spill.

Simple Spills

Simple spills are non-emergency situations. A spill can be identified as a simple spill if it meets the following criteria

1. Does not spread rapidly	The spilled chemical or toxic vapors are not spreading beyond the immediate area
2. Does not endanger people or property except by direct contact	A person has not been injured

	A fire is not present or an explosion has not occurred
	Flammable vapors and ignition sources are not present
	Toxic vapors or dust are not present
	The spilled chemical is not a strong oxidizer
	The spilled chemical is not air, water, or otherwise highly reactive
	The identify of the chemical is known
3. Does not endanger the environment	No risk of spilled chemical entering a sewer or contaminating soil

If a spill has been identified as a simple spill, it can ***safely be cleaned up if***:

? ***A knowledgeable person can make an informed decision as to the safety and health hazards associated with the chemical and is comfortable doing it.***
? ***The spill can be cleaned up with the material contained in the spill control kits.***
? ***Personal protective equipment is available***
? ***The cleanup can be completed in a normal work day***

If a spill does not meet the above criteria, treat it as a **complex spill and an emergency situation--Evacuate the area and call public safety -3333**.

Complex spills are defined as:

- ? Causes personal injury or chemical exposure that requires medical attention
- ? Presents a fire hazard
- ? Requires the need for a breathing apparatus to handle the material involved

Procedures for Cleaning Up Simple Spills

? Shut off all possible ignition sources
? Notify your lab instructor
? Wear appropriate personal protective equipment
? Identify the spill

? Isolate the spill area. Evacuate the immediate area

? Locate the appropriate spill cleanup kit. Each laboratory should be equipped with spill cleanup kits. If not, get the appropriate kit from the chemistry storage room (SIMS 107)

? After the spilled chemical has been identified, obtain the proper absorbent material from the spill control kit. When using the **Spill-X Chemical Spill Treatment Kits**, you must make sure that the adsorbent is approved for the chemical that is being cleaned up. See **Appendix N** for a list of chemicals that can safely be cleaned up using the **Spill-X Chemical Spill Treatment Kits.**

- For acid spills, **Spill-X-A**
- For caustic spills, **Spill-X-C**
- For solvent spills, **Spill-X-S**

? Pour the spill agent around the perimeter of the spill first, and then continue to cover the spill with spill agent evenly working your way around to the center of the spill.

? Using the scraper provided carefully mix agent into the spill for the most complete reaction.

? If **SPILL-X-A** or **SPILL-X-C** was used, the spill residue must be tested for pH. See below for direction on testing the pH*.

? If **SPILL-X-S** agent was used, solvent is adsorbed onto the agent and the final spill residue should be dry and powdery.

? After spill residue cools, use scraper and pan to put the spill residue into a waste disposal bag and label with

-Spill type such as "neutralized acid/base, pH = ____" or "adsorbed solvent: solvent name"

-Date

? Wash utensils including gloves, if not disposable, with soap and water and put back in the spill control kit if still in good condition. If not, inform the chemical hygiene officer that those items need to be replaced.

? Decontaminate the spill area by mopping the area with a conventional cleaning agent

? Ventilating the spill area may be necessary.

? If the chemical that was spilled was a highly toxic substance, then the scraper and scoop that was used to pick up the spilled material should be discarded as waste.

*If **SPILL-X-A** or **SPILL-X-C** was used, the spill residue must be tested for pH.

? Place about 10 mL of the spill residue in a 150-mL beaker.
? Slowly add distilled water until the mixture volume reaches 100 mL. **Note: Severe foaming and high heat generation is a sign of incomplete neutralization.** Stir contents for about 3 minutes.
? Using a pH meter or the pH test strips provided in the kit, test the solution's pH. The pH should be between 2.0 to 12.0. If the pH is unacceptable, mix more of the neutralizer into the spill and retest the pH. Repeat the procedure until an acceptable pH is reached.
? Record the final pH on the waste disposal bag.

Reference: ***The ACS Guide for Chemical Spill Response Planning in Laboratories*****, the American Chemical Society, 1995.**

7. Mercury Spills

? **Caution:** Mercury is toxic, easily vaporizes, is absorbed directly through the skin and by inhalation, and threshold values of mercury and mercury vapors are very low

? Mercury spill kits are available in the stock room and chemistry electives lab.
? A mercury spill due to a broken thermometer can be safely cleaned up by a knowable person by:

- Inform others around you that there is a mercury spill to prevent personal injury and further contamination of the area, i.e. you do not want to step in it and tack the mercury all over the room.
- Personal protective equipment must be worn, i.e. safety glasses, gloves, and preferably a lab coat.
- Ventilate the contaminated area.
- Collect all visible mercury using either an aspirator bottle or a mercury collector, which is a jar with a screw type lid, which contains a foam pad for picking up the mercury. If using the mercury collector, press the foam pad firmly onto the spill to collect the mercury. Then screw the lid back onto the jar, which compresses the pad against a perforated plate inside the jar and releases the mercury into the bottom of the jar. **The mercury in the jar must now be disposed of as waste. Do not leave the collected mercury in the jar**.

? If the mercury spill occurred on a non-smooth surface, the following steps should be taken to ensure that all of the mercury gets cleaned up.

- Use the mercury absorber (the name will vary depending on the manufacturer such as MERCSORB powder, Hg Absorb powder, etc.) located in the kit.
- The different brands require different clean up instructions. Be sure to following the directions precisely.
- This procedure will convert elemental mercury to an amalgam, which stops dangerous mercury vapors from being emitted.
- Next, use the mercury indicator to ensure that all the mercury was cleaned up.

- Clean up all waste and dispose of in a waste container, which is clearly labeled as to its contents. Such as "Hazardous waste. Mercury" include the date
- The broken thermometer must be disposed of in a glass container that is properly labeled.

8. Reporting Unsafe Conditions

Any employee or student can and should report any condition or situation that may be a potential hazard. See **Appendix O**, Reporting Unsafe Conditions.

Section G: Student Information

1. Rules for Handling Chemicals in the Laboratory

Students are responsible for reading all safety precautions for performing each experiment. Part of the educational program in chemistry is to learn how to handle potentially hazardous materials in a safe and efficient manner. As with any activity where there is the potential for a serious accident, the fundamental responsibility lies with the individual. The principle effort in conducting a safe laboratory program is through preparation and constant vigilance. Whenever there is any doubt about the safety of a procedure or what precautions should be taken, ask a faculty member or lab supervisor before beginning the experiment. The following rules will strictly enforced. If you violate these rules, you will be asked to leave for the safety of the other students.

- ? Always wear safety glasses. It is your responsibility to provide department approved safety glasses. Chemical splash goggles (NOT GLASSES) are required. Goggles must be worn by everyone, including those who wear eyeglasses or contact lenses. The bookstore sells the appropriate goggles.
- ? It is poor personal hygiene to share eye protection.
- ? The American Chemical Society Committee on Chemical Safety has studied and reviewed the wearing of contact lenses in the laboratory. They recommend that contact lenses can be worn in most laboratory environments provided the same approved eye protection is worn as required of other workers in the lab. Chemical splash goggles are required whenever a splash hazards exist.
- ? Closed-toe shoes, preferably leather, that cover the entire foot are required for everyone entering a lab. Shoes with high heels or made with woven material do not provide adequate protection. Open toe shoes, shoes with holes, and sandals are not acceptable.
- ? Avoid loose clothing that could become caught in equipment or easily knock over containers.
- ? Rubber aprons and lab coats are available and should be worn while working in the laboratory. When working with certain class of chemicals, a lab coat is required.
- ? No eating, drinking, or tobacco use in the laboratory. Also, be sure to wash your hands prior to leaving lab for the day.
- ? "Horseplay" and unauthorized experiments are strictly forbidden
- ? Pull back long hair, especially around flames and caustic chemicals.
- ? Learn the location of all safety equipment such as eyewash stations, safety showers, fire blankets, and fire exits before beginning work in the laboratory.
- ? Keep aisles and exits clear. There are areas designated for storing book bags. Do not store your book bag on the floor.
- ? Close your lab drawer after removing laboratory equipment.
- ? Practice good housekeeping; leave the lab cleaner than you found it. Clean up small chemical spills immediately. For larger spills, notify your instructor immediately.
- ? Return equipment and chemicals to the appropriate storage area when you are finished using them.
- ? Be sure to inspect glassware before using. Discard any glassware that is cracked, chipped, scratched or has any other obvious defect.
- ? Discard broken glassware in the broken glass container in the front of the lab.
- ? Do not insert glass tubing into a rubber stopper without advanced training. There is special equipment that should be used in order to minimize the risk of injury.
- ? Never leave an open flame or rapid reaction mixture unattended. In the evident of a fire, turn off your Bunsen burner and exist the building.
- ? Always add acids to water never water to acids.

- Keep substances with irritating fumes under your fume hood at all times.
- Return caps and lids to all reagent bottles immediately after use. Don't assume the next person will do that for you. If you remove it, put it back.
- Never return reagents to stock bottles. This contaminates the stock and may cause a violent reaction.
- Dispose of unused or contaminated reagents in labeled containers as directed by the instructor. Do not put any chemicals down the drain unless otherwise directed by your instructor.
- Use extreme caution when testing odors.
- Never pipet by mouth. Always use a rubber bulb.
- Report any accident to your instructor immediately.
- Never work alone in the laboratory.
- If for any reason your instructor feels that your safety is in jeopardy or that you are jeopardizing the safety of others, you will be asked to leave the lab. You will not be allowed to return to make up missed work and you will receive a zero for that day's work. You will not be allowed to return to future labs until the situation is corrected.

2. Student Guidelines for Dealing with Accidents and Accident Prevention

- There are many potential hazards that exit in the laboratory. The best way to deal with such hazards is to prevent accidents from happening in the first place. The following are some guidelines for dealing with and preventing the more common accidents. When in the laboratory, use common sense, pay attention to what you are doing, and be alert as to what is going on around you.

- For any type of accident, notify your instructor immediately.

- If you are attempting to assist someone, do not become a victim yourself. Wear safety glasses and gloves so that you do not become a victim.

Chemicals on the Skin in Confined Areas

- Immediately flush the area with cool water for at least 15 minutes. Remove all jewelry to facilitate removal of any residual material.
- Have someone else notify your laboratory instructor.
- Seek medical attention from Crawford Health Services
- If a delayed reaction is noted, report immediately for medical attention and explain carefully what chemicals were involved.

Chemicals Spilled over a Large Area of the Body

- Have someone notify your laboratory instructor.
- Call -3333
- Remove victim's clothes
- Remove victim's shoes so that chemicals do not collect in the shoes.
- Rinse the area with large quantities of water for at least 15 minutes under a safety shower.
- Get medical attention immediately.

Chemicals in the Eyes

- Get the victim to an eyewash station immediately, and rinse the eyes for at least 15 minutes.
- Eyelids have to be forcibly opened to ensure effective washing behind the eyelid.
- Remove contact lenses as soon as possible so that the eye can be thoroughly rinsed.
- Get medical attention immediately. All eye injuries must be treated at the Crawford Health Services.

Ingestion of Chemicals

- Identify the chemical ingested and call -3333 immediately.

Chemical Spills

- Turn off all sources of ignition.
- Notify individuals in the area of the spill.
- Notify your instructor immediately of the spill and the chemical that was spilled.
- If it can be done safely, attend to injured or contaminated persons and remove them from exposure.
- Do not clean up the spill yourself. Your instructor will determine what needs to be done in order to clean up the spilled chemical.

Wounds

- **Small cuts and scratches**
    - Cleanse area with soap and water in a restroom not in lab
    - Cover the wound with a clean towel
    - Report to Crawford Health Services for medical attention

- **Significant Bleeding**
    - Call public safety at –3333

Fires

- If possible, turn off all sources of ignition.
- **A** fire contained in a small vessel often can be suffocated, for example by placing a watch glass over its opening.
- If the fire is too large to be suffocated quickly, activate the fire alarm and notify everyone around you. Use the stairs when evacuating the building. Do not use the elevator during the evacuation.
- It is easy to underestimate a fire. Fires spend quickly. **Never attempt to use a fire extinguisher unless you have been trained in its use**. Locate yourself between the fire and the exit. Always be sure you can escape.
- If a person's clothes are on fire, get them to stop, drop, and roll or lead them to a safety shower and douse them with water.
- Cover the victim with what ever is available (most labs have fire blankets), but leave the head uncovered. **Do not cover a person with a fire blanket until the flames have been extinguished.**
- Get medical attention immediately (public safety-3333 or 9-911).

Prevention

Preventing Accidents

- Keep your workspace clean of clutter.
- Do not store any items on the floor of a laboratory, i.e. book bags. There are storage areas provided.
- Keep the sinks clear of waste. No solids of any kind ever go into the sink.
- Do not work with chipped or broken glassware.
- There are specially marked containers for all broken glass. **Do not throw glass in a trashcan**.

Fires

- The best way to handle fires is to prevent them.
- The following is a list of some of the things you can do to help prevent fires from starting:
  - Keep your work area free of clutter
  - **Never leave a Bunsen burner unattended** and always turn off the gas when finished. Even if you plan on using the Bunsen burner again during the lab period, always turn the gas off after each use.
  - If the fire bell rings while you are working, **turn your Bunsen burner off** and exit the building calmly.
  - Never use an open flame to heat a flammable liquid.
  - When working with an open flame, keep your hair pulled back if it is long and watch that your clothing does not catch fire. Do not wear long, loose fitting clothing.

3. Laboratory Etiquette

? Other students also use the equipment you use in this laboratory. In addition, the equipment is usually quite expensive. Always treat the equipment with great care.
? Always leave your workspace cleaner than you found it. Laboratory instructors may deduct penalty points for poor housekeeping. There are detergents and paper towels available at each workstation. You may want to bring a hand towel or liquid soap to keep in your lab drawer.
? If you find a piece of equipment that is not in good working order, notify your instructor immediately.
? When working with "community reagents", take the reagent bottle to your desk, use immediately for your step and return the bottle to the correct location. Many chemicals have strong or toxic odors and should be used in your fume hood only. For example, acids and bases can be particularly hazardous. If you are not sure, be on the safe side and use your hood. Community reagents are in alphabetical order by name and type (solid, solution, acid, base), not chemical formula. Make sure you spend a good deal of time learning the chemical naming systems (nomenclature).
? NEVER put excess reagents back into the bottle. If you get more than you need, treat the excess as if it were waste. Residues in your container or spatula may contaminate it.
? Dispose of excess chemicals according to directions by your instructor. Never put anything down the sink unless you are directed to do so. Most waste will go in labeled containers. Let's protect the environment.
? Balances are sensitive, expensive devices. Never weigh chemicals directly on the pan. Use a container such as a beaker or flask. Remove the container from the balance, add the chemical, and then replace the container. The difference in the before weight (tare) and the final weight will tell you how much chemical

you have in your container. This is known as "weighing by difference" and is the correct method for balance use.

? If you spill anything onto the balance, notify the instructor immediately.

? Never lay a stopper from reagent bottles on the lab bench. They may become contaminated. In addition, the residue on the bench may be hazardous and linger for days or weeks. This could injure someone well after the fact. Hold the stopper in your other hand while you get the material out of the bottle. Replace stoppers immediately.

? If you make a mess, clean it up or at least inform your instructor. Don't leave it for someone else to find.

4. Procedures for Student Incidents

All students sustaining an injury in a laboratory must adhere to the following guidelines:

- All injuries, including minor cuts and burns, must be reported to the instructor in charge immediately.
- If someone's life is in danger, call -3333 immediately.
- An accident report form (see **Appendix K**) must be completed by the student and the faculty member or laboratory instructor involved. In the case of a serious accident, the report form will have to be completed at a later time, but it is the responsibility of the faculty member or laboratory instructor to complete what is required of them.
- All students must be familiar with the accident guidelines given to them by their laboratory instructor.

Appendix A: List of Laboratories in the Chemistry Department

A current list of laboratories affected by the OSHA laboratory standard is outlined below.

Location	Principle Investigator or Laboratory Supervisor	Description	Waste Satellite Collection Designated Area
Sims 103/104	Janie Moser/ Kathie Snyder	General Chemistry Labs	No
Sims 106 Sims 107	Janie Moser/Kathie Snyder	General Chem Prep Area Stock Room	Yes, Fume Hood No
Sims 202 A	Gwen Daley	Geology Research	No
Sims 204 D	Ponn Mahes	Physics Research	No
Sims 210	Gwen Daley	Geology Research	No
Sims 303 Sims 303A Sims 303B Sims 303D	Kim McKinney/ Chasta Parker/ Takita Sumter	Biochemistry Laboratory Biochemistry Prep Area Biochemistry Equipment Room Cold Room	Yes, Fume Hood No No No
Sims 304	Aaron Hartel	Chemical Synthesis Lab	Yes, Fume Hood
Sims 305 Sims 305 A Sims 305 B	Lennart Kullberg	Physical Chemistry Laboratory Physical Chemistry Prep Area Physical Chemistry Storage	Yes, Fume Hood No No
Sims 306	Aaron Hartel/ Jay Hanna	Organic Chemistry Prep Area	Yes, Fume Hood
Sims 307	Aaron Hartel	NMR Room	No
Sims 308	Aaron Hartel/ Jay Hanna	Organic Chemistry Laboratory	No
Sims 310 Sims 311	Cliff Calloway	Analytical/Instrumentation Laboratory Analytical Prep Area	Yes, Fume Hood and cabinet under fume hood
Sims 311 A	Robin Lammi	Research Laboratory	Yes, Fume Hood

Sims 312	Cliff Calloway	Molecular Modeling Lab	No
Sims 314 E	Takita Sumter	Biochemistry Research	No
Sims 315	Chasta Parker	Biochemistry Research	No
Sims 315A	Organic Research	Jay Hanna	No
Sims 316A	Kim McKinney	Tissue Culture Room	No
Sims 317	Jay Hanna/ Jason Hurlbert		No

Last updated 19 December 2006

Appendix B: A List of Reference Material Maintained by the Chemistry Department

The chemistry department will maintain a reference library of materials on the hazards and the use and storage of hazardous chemicals. The following is an up to date list of such reference materials and their location within the department.

All of the following reference materials are located in SIMS 109B

Hazardous Waste Management for Small Quantity Generators

Improving Safety in the Chemical Laboratory: A Practical Guide

Prudent Practices in the Laboratory: Handling and Disposal of Chemicals (National Research Council)

Safety in the Academic Chemistry Laboratories (The American Chemical Society)

Science Lab Safety (Cambridge Educational Video)

Spill-X Spill Kit Treatment Guide

Starting with Safety: An Introduction for the Academic Chemistry Laboratory (The American Chemical Society-Video)

Threshold Limit Values for Chemical Substances and Physical Agents Biological Exposure Indices (ACGIH)

Winthrop University Department of Chemistry, Physics, and Geology's Chemical Hygiene Plan

Appendix C: Laboratory Safety Inspection Check List

Lab:	Inspection Date:

GENERAL SAFETY	YES	NO	N/A	COMMENTS
? Emergency phone numbers posted on the lab door?				
? Warning signs posted on doors and/or in the lab?				
? Emergency procedures and evacuation routes posted?				
? Is a copy of the CHP accessible?				
? MSDS' maintained and readily available?				
? Current inventory of chemicals is maintained and available?				
? Exits unobstructed?				
? Are refrigerators and freezers for storage of food labeled as such and located in an area were chemicals are not stored or used?				
Laboratory Safety	YES	NO	N/A	COMMENTS
? Fume hood available?				
? Fume hood free of clutter?				
? Has fume hood been inspected within the last 6 months?				
? Aisles are unobstructed?				
? Lab benches and work areas free of clutter?				
? Shelves have lips?				
? Shelves and cabinets secured to the wall?				
? Fire blanket available?				
? Fire extinguishers readily available and unobstructed?				
? Fire extinguishers tagged and inspected in the last month				
? Safety showers/eye wash stations accessible and clearly labeled?				

? Have Safety showers/eye wash stations been inspected and tested in the past 3 months?				
? Refrigerators and freezers for chemical use clearly labeled as such?				

Compressed gases	YES	NO	N/A	COMMENTS
? Cylinders stored upright and properly secured at all times, including empty cylinders?				
? Are caps properly secured on cylinders not in use?				
? Cylinders in use equipped with a regulator?				
? Cylinders in good condition and clearly marked with the name of contents, the appropriate hazard warnings, and a status tag?				
Chemical Storage	YES	NO	N/A	COMMENTS
? Chemicals stored according to compatibility? (see appendix E)				
? Flammables stored in flammable cabinets and labeled appropriately?				
? Ignition sources avoided when using/storing flammables?				
? Corrosive chemicals stored in acid cabinets and labeled appropriately?				
? Storage of chemicals above 5 feet is minimized?				
? Chemical containers in good condition?				
? Chemicals clearly labeled with the name of the chemical and the appropriate hazards?				
? Containers labeled with the receipt date and date opened?				
? Containers closed unless actively being used?				
? Spill control materials readily available?				
Waste Chemicals	YES	NO	N/A	COMMENTS
? Hazardous waste containers properly labeled with yellow University hazardous waste labels?				
? Waste containers properly closed?				

Appendix D: New Chemical Record

Ordering Form for Chemicals and Supplies
Winthrop University
Department of Chemistry, Physics, and Geology
520 Cherry Road
Rock Hill, SC 29733
Fax: (803) 323-2246

Ordered by: Date:

Budget Name: Number: Class Code:

Justification:

Order Total:

Item Ordered:

Item #	Quantity Ordered	Unit	Catalog #	Description	Unit Price	Total Price	Date Rec'd	Lab area
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								

Appendix E: Faculty/Staff Training Record

Date:

Employees that attended:

The following information was covered in the training session:

Problems/Questions that arose:

Solutions/answers to the above mentioned problems/questions:

Trainer's Signature: Date:

Chair's Signature Date:

Appendix F: Incompatibility of Common Laboratory Chemicals

The improper storage or mixing of chemicals can result in serious accidents and even disasters. Violent reactions could occur due to the storing or mixing incompatible chemicals. The following is a list of some incompatible common laboratory chemicals. Before storing or mixing any chemicals, consult this list or the chemicals' MSDS. This is only a partial list that includes some of the more common academic laboratory chemicals.

Chemical	**Incompatible with**
Acetic acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Acetone	Concentrated nitric acid and sulfuric acid mixtures
Alkali and alkaline earth metals	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens
Ammonia (anhydrous)	Mercury(e.g., in manometers), chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid (anhydrous)
Ammonium nitrate	Acids, powered metals, flammable liquids, chlorates, nitrites, sulfur, finely divided organic combustible materials
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
Chlorates	Ammonium salts, acids, powered 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 and inorganic)
Cyanides	acids
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Fluorine	All other chemicals
Hydrocarbons (such as butane, propane, benzene)	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
Hydrocyanic acid	Nitric acid, alkali
Hydrofluoric acid (anhydrous)	Ammonia (aqueous or anhydrous)
Hydrogen sulfide	Fuming nitric acid, oxidizing gases
Hypochlorites	Acids, activated carbon
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Mercury	Acetylene, fulminic acid, ammonia
nitrates	Acids
Nitric acid (concentrated)	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids and gases, copper, brass, any heavy metals
Nitrites	Acids
Nitroparaffins	Inorganic bases, amines
Oxalic acid	Silver, mercury
Oxygen	Oils, grease, hydrogen, flammable liquids, solids, and gases
Perchloric acid	Acetic acid, anhydride, bismuth and its alloys, alcohols, paper, wood, grease, oils
Peroxides, organic	Acids (organic or mineral), avoid friction, store cold
Phosphorus (white)	Air, oxygen, alkalies, reducing agents
Potassium chlorate	Sulfuric and other acids

Potassium perchlorate (see also chlorates)	Sulfuric and other acids
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, sulfuric acid
Selenides	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 and methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethylacetate, methyl acetate, furfural
Sulfides	Acids
Sulfuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate (similar compounds of light metal, such as sodium, lithium)
Tellurides	Reducing agents

Reference: *Safety in academic chemistry laboratories*, The American Chemical Society, 1995.

Appendix G: List of Known and Suspected Carcinogens

A list of known human carcinogens and suspected carcinogens can be found at the 11th Annual Report of Carcinogens- National Toxicology Program (2004). A list of chemicals known to be human carcinogens is provided below. A list of suspected carcinogens can be found at the following web site.

http://ntp.niehs.nih.gov/ntp/roc/eleventh/reason.pdf

Names and Synonyms of Carcinogens

Aflatoxins
Alcoholic Beverage Consumption
4-Aminobiphenyl
Analgesic Mixtures Containing Phenacetin (See Phenacetin and Analgesic Mixtures Containing Phenacetin)
Arsenic Compounds, Inorganic
Asbestos
Azathioprine
Benzene
Benzidine (See Benzidine and Dyes Metabolized to Benzidine)
Beryllium and Beryllium Compounds
1,3-Butadiene
1,4-Butanediol Dimethanesulfonate (Myleran®)
Cadmium and Cadmium Compounds
Chlorambucil
1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea (MeCCNU)
bis(Chloromethyl) Ether and Technical-Grade Chloromethyl Methyl Ether
Chromium Hexavalent Compounds
Coal Tar Pitches (See Coal Tars and Coal Tar Pitches)
Coal Tars (See Coal Tars and Coal Tar Pitches)
Coke Oven Emissions
Cyclophosphamide
Cyclosporin A
Diethylstilbestrol
Dyes Metabolized to Benzidine (See Benzidine and Dyes Metabolized to Benzidine)
Environmental Tobacco Smoke (See Tobacco Related Exposures)
Erionite
Estrogens, Steroidal
Ethylene Oxide
Hepatitis B Virus
Hepatitis C Virus
Human Papillomas Viruses: Some Genital-Mucosal Types
Melphalan
Methoxsalen with Ultraviolet A Therapy (PUVA)
Mineral Oils (Untreated and Mildly Treated)
Mustard Gas
2-Naphthylamine
Neutrons (See Ionizing Radiation)
Nickel Compounds (See Nickel Compounds and Metallic Nickel)
Radon (See Ionizing Radiation)
Silica, Crystalline (Respirable Size)
Smokeless Tobacco (See Tobacco Related Exposures)

Solar Radiation (See Ultraviolet Radiation Related Exposures)
Soots
Strong Inorganic Acid Mists Containing Sulfuric Acid
Sunlamps or Sunbeds, Exposure to (See Ultraviolet Radiation Related Exposures)
Tamoxifen
2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (TCDD); "Dioxin"
Thiotepa
Thorium Dioxide (See Ionizing Radiation)
Tobacco Smoking (See Tobacco Related Exposures)
Vinyl Chloride
Ultraviolet Radiation, Broad Spectrum UV Radiation (See Ultraviolet Radiation Related Exposures)
Wood Dust
X-Radiation and Gamma Radiation (See Ionizing Radiation)

Bold entries indicate new or changed listing in *The Report on Carcinogens, Eleventh Edition.

Appendix H: Common Corrosive Chemicals

The following is a list of some of the common corrosive chemicals found in the academic laboratory.

Inorganic Acids	**Inorganic Bases**	**Oxidizing Agents**
Chromic acid	Ammonia, ammonium hydroxide	Bromine
Hydrochloric acid	Calcium hydroxide	Chlorine
Hydrofluoric acid	Calcium Oxide	Chromic acid
Nitric acid	Potassium hydroxide	Fluorine
Perchloric acid	Sodium hydroxide	Nitric acid
Phosphoric acid		Perchloric acid
Sulfuric acid		

Organic Acids	**Dehydrating Agents**	**Other Compounds**
Butyric acid	Calcium oxide	Tin chloride
Formic acid	Glacial acetic acid	Potassium chromate
Glacial acetic acid	Phosphorous pentoxide	Phosphorus pentoxide
Oxalic acid	Sodium hydroxide	Phosphorous trichloride
Phenol	Sulfuric acid	
Salicylic acid		
Trichloroacetic acid		

References:

Improving Safety in the Chemical Laboratory: A Practical Guide, J.A. Young, 1991.

Chemical Safety in the Laboratory, S.K. Hall, 1994.

Safety in the Chemistry and Biochemistry Laboratory, A. Picot and P. Grenouillet, 1995.

CRC Handbook of Laboratory Safety, 4th ED., A.K. Furr, 1995.

Appendix I: Common Chemicals That Are Likely to Form Peroxides During Storage (this list is not exhaustive)

Class III Risk of Peroxidation during Storage	Class II Risk of Peroxidation upon Concentration	Class I Risk of Polymerization by Peroxidation
Divinyl ether	Acetal	Acrylic acid
Divinyl acetylene	Bis(2-methoxyethyl) ether	Acrylonitrile
Isopropyl ether	Cumene	Butadiene
Vinylidene chloride	Cyclohexene	Chloroprene
Potassium	Cyclooctene	Chlorotrifluoroethylene
Potassium amide	Cyclopentene	Methyl methacrylate
Sodium amide	1,2-dimethoxyethane	Styrene
	2-ethoxyethanol	Vinyl acetate
	Diethyl ether	Vinyl chloride
	Dioxane	Vinyl pyridine
	Isobutyl alcohol	
	Isopropyl alcohol	
	Isobutyl methyl ketone	
	Methyl acetylene	
	Methyl cyclopentane	
	Tetrahydrofuran	
	Tetralin	
	Vinyl ethers	

Class III contains materials that readily form explosive peroxides without evaporative concentration. They should be tested for the presence of peroxides at least every three months after opening and if tested positive should be disposed of.

Class II contains materials that peroxidize but become hazardous only on evaporative concentration. They should be tested at least once a year after opening and disposed of if peroxides are detected.

Class I contains peroxidizable materials that also can polymerize exothermically when initiated by the peroxide content. Testing and disposal requirements are the same as for Class II.

References:

Improving Safety in the Chemical Laboratory: A Practical Guide, J. Young, 1991.

Safety in the Chemistry and Biochemistry Laboratory, A. Picot and P. Grenouillet, 1995.

Appendix J: Employee Overexposure Information

The following information should be provided to the examining physician.

Employee Name: Date of Incident:

Department: Chair:

Identity of the hazardous chemical(s) to which the employee may have been exposed:

Duration of exposure:

Amount of chemical(s) involved:

Description of the incident:

Control measures used at time of incident (fume hood, personal protective equipment etc.)

Location of injuries or sites of contact, e.g. eyes, skin:

Signs and/or symptoms, if any:

Are signs and symptoms same as indicated on MSDS?

Witnesses (include telephone numbers):

_____ _____

Signature Date

Appendix K: Medical Examination Results

The physician must inform the employee of the results of the examination and provide the University with a written opinion.

The Physician must complete the following information, either on this form or on a separate attachment and must not reveal specific findings of diagnoses unrelated to occupational exposure.

Physician's name:

Employee's name:

Date of visit:

Description of incident:

Recommendations for further medical follow-up? _____ Yes _____ No Please explain.

Results of the medical examination and associated tests:

Was there any medical condition discovered which might place the employee at increased risk due to the hazardous chemicals found in the laboratory?

____ Yes _____ No. Please explain.

Additional Comments:

The employee has been informed of the results of the medical examination and any medical condition that may require further examination or treatment.

Physician's Signature: _____ Date: _____

Appendix L: Employee Incident Report Form

This report must be completed by the employee for any injury that happens in any laboratory and given to the Chair.

Date:

Name of injured person:

Date of accident:

Time of accident:

Location of accident:

Name of chemicals involved, if any:

Type and location of injury:

Brief Description of the accident:

Action taken: Date:

Signature of Chair

Comments:

Appendix M: Student Incident Report Form

This report must be completed by the employee for any injury that happens in any laboratory and given to the Chair.

Date:

Name of injured person:

Date of accident:

Time of accident:

Location of accident:

Name of chemicals involved, if any:

Type and location of injury:

Brief Description of the accident:

Action taken: Date:

Signature of Chair

Comments:

Appendix N: Chemical Spills

Spill-X Chemical Spill Treatment Kits

If using the **Spill-X Chemical Spill Treatment Kits,** the chemical that was spilled must be on the following list. Do not use the Spill-X agents on any chemical that does not appear in the following list.

Acids	Caustics	Solvents	
		Flammable	Nonflammable
Acetic	Ammonium hydroxide	Acetone	1-Amino-2-propanol
Adipic	Aniline	Acrylonitrile	Aniline
Acrylic	Diethanolamine	Avgas 100	2-Butoxyethanol
Butyric	Diethylenetriamine	Benzene	Carbon tetrachloride
Chlorosulfonic	Dimethylformamide	Butylacetate	Chloroform
Cyanoacetiic	Ethylenediamine	Butylether	Diethanolamine
Formic	Hydrazine	Butyraldehyde	Diethyleneglycol
Hydriodic	Morpholine	Carbon disulfide	Dimethylether
Hydrocholoric	Potassium hydroxide	Cumene	Diethylene triamine
Hydrofluoric	Pyridine	Cyclohexane	Ethanolamine
Methacrylic	Sodium hydroxide	Decane	5-ethyl-2-methylpyridine
Nitric		1,2-Dichloroethane	Toluene diisocyanate
Propionic		Diethylamine	1,1,1-trichlorothane
Perchloric		1-Diethylamino-2-Propanol	1,1,2-Trichloroethane
Phosphoric		N,N-Diethyethanolamine	Triethylene tetramine
sulfuric		Ethanol	
		Ethylenediamine	
		Ethylene-glycoldimethylether	
		Fuel oil #2	
		Gasoline (50-100 octane)	
		Gasoline (100-130 Octane)	

Gasoline, unleaded

Heptane

Hexane

Isopropylalcohol

Isoproplyamine

Jet A-1 Avtur

Methanol

Methyl ethyl ketone

Methylisobutylketone

Morpholine

Nonane

Octane

Pentane

Petroleum ether

Pyridine

Styrene

Toluene

Triethylamine

Vinyl acetate

Xylene, O-

Xylene, P-

Appendix O: Hazard Report Form

Any hazardous condition identified by an employee or student should be reported as soon as possible.

After filling out the form, give to the Chair of the Department, 312A Sims, or to the department safety officer, 109B Sims or the departmental secretary, 101 Sims, if the Chair is not available.

Date:

Location (room number, hallway, stairwell, etc.):

Brief Description of the hazard:

Your Name:

Received by: Date:

Action taken:

Problem solved by: Date: