Chemical Hygiene Plan*

Department of Chemistry, Physics, and Geology at Winthrop University

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Section A: Responsibilities

1. Year-Round Responsibilities

- As stated in official Department reports to the University, the central focus of Winthrop′s chemistry program is year-round student-centered research. Implementation of this overriding learning goal often requires chemistry faculty to work in Winthrop laboratories during periods of time that Winthrop is not paying them or when they are not teaching. Similarly, students will often be working in laboratories conducting research or other learning activities during times in which they are not enrolled in any courses or being paid by Winthrop. During all of these periods, faculty and students are considered by Winthrop University and by the Department to be acting in their official capacities and to be covered by the existing University insurance policies. During these times, both students and faculty are expected to comply with all requirements of the Department Chemical Hygiene and Safety Plan.

2. Chair of the 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.

3. Department Chemical Hygiene Coordinator

- 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.

4. 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 eyewash stations 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, 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.

5. 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.
  - Requiring the use of appropriate personal protective equipment.
  - Requiring visitors to use the proper eye protection when visiting the laboratory.
  - 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 coordinator.
  - Participating in chemical hygiene training.
  - Ensure responsible chemical storage and waste deposal.
  - Informing all students of safety precautions and supervising students to ensure they work safely in the laboratory.
  - Ensuring that all students conducting research in lab attend the required departmental safety training.
  - Provide the appropriate training to research students beyond departmental safety training and maintain records of all training.
- 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.

6. 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

7. 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.
- Participate in Department′s safety training program.

8. Safety Committee

- Members:
    - Chemical Hygiene Coordinator
    - 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.

9. 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 coordinator 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 chemicals must be maintained and up to date. See **Appendix A**.
- Emergency phone numbers are 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
- Emergency telephone numbers should be posted in all laboratories with the following numbers:
    - Fire 9-911 (campus phone); -911 (cell phone)
    - Public Safety -3333 (campus phone); (803)323-3333 (cell phone)
    - Environmental Health and Safety- (803)323-2328 (EHS office); (803)242-9545 (EHS′s cell phone number)
- 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

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 hard 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. Eyewash stations should be flushed once a month. A log of these inspections will be kept. Safety showers should be tested and flushed every three months and is the responsibility of the Office of Environmental Health and Safety. Inspection records should be obtained from the Environmental Health and Safety Office.
- 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 should 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 1) to smother small fires, 2) as a shower curtain for someone using the safety shower, 3) as a wrap after someone used the safety shower, 4) to keep someone warm while waiting for emergency help to arrive. A fire blanket can also be used to help smother the flames if someone′s clothing is on fire, but should not be used to wrap someone in to extinguish a clothing fire. The process of wrapping a fire blanket around a person with burning clothing traps the heat while creating a chimney effect, directing the hot, toxic gases and flames into the victims face.
- 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 yearly and replaced when depleted.
- Personal protective equipment such as safety goggles, aprons, gloves, face shield, and lab coats are available for employees handling concentrated acids, bases, and other hazardous chemicals. Students must purchase their own splash goggles.
- 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 checklist.

4. Procurement and Inventory of Chemicals

- 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.
- 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. Request an electronic copy of the ordering from at aikenw@winthrop.edu.
- 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 added to the chemical inventory system and that a copy is placed in the MSDS notebook in the lab where the chemical will be used.
    - 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 chemical 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**

5. Training

All employees, including faculty, staff, student research and teaching assistants, 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.

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.
- Faculty and staff training:
    - Participation in the Chemistry Department′s annual safety training session is required.
    - Training will be conducted by the department′s chemical hygiene officer.
- Research students and student employees:
    - Research students must attend safety training yearly. In addition, any student working with hazardous chemicals in the summer must attend the summer safety training session.
    - All students required to participate in the department′s safety training program must take a safety quiz yearly and pass with a 100%.
    - Research students must be farther trained by their research advisors to ensure that they are properly trained in the specific hazards involved in their research.
- Non-departmental 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.

Documentation of Training Programs

- The chemical hygiene officer will maintain records of safety training for faculty and staff and all students who participate in the departmental safety training program.
- Research advisors must maintain records of training that they provide to their students which is in addition to the departmental safety training. Appendix D

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 should wear proper personal protection wherever chemicals are stored or used.
- Visitors must wear the appropriate eye protection when visiting any chemical work area.
- 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.
- 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)
- Confine long hair and loose clothing when in the laboratory.
- Be sure to wash your hands thoroughly after working in the lab.
- Sims is a non-smoking building.

2. Personal Protective Equipment (PPE)

- The proper eye protection is required for everyone, including visitors, 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 and students. Heavy duty aprons are available when using concentrated acids and bases. Flame resistant lab coats should be worn when working with flammable chemicals.
    - Face shields are available and are recommended when greater protection to the face and neck is required. Face shields must always be used with goggles; face shields alone will not provide adequate protection.

- Work in a chemical hood to reduce exposure through inhalation particularly whenever chemical operations are performed that will generate aerosols, vapors and/or gases that may be harmful to one′s health.

- Maximizing Chemical Hood Efficiency
    - Keep exhaust fans on at all times
    - The hoods should maintain an average face velocity of 100 linear ft/min. If the emergency alarm sounds, notify the Chemistry Instrumentation Manager at 323-4931 or the Chemistry Laboratory Manager at 323-4926.
    - Keep the interior of the hood uncluttered so that airflow is not impeded
    - Always keep sash closed when not actively using the hood
    - Position sash so that work is performed by extending arms under the sash
    - Avoid swift arm and body movements in front of the hood
    - Place chemicals 6 inches behind the face of the hood
    - Place equipment as far to the back as possible without blocking the bottom baffle slot
    - Do not use large pieces of equipment that block the back baffle
    - Do not use a hood to store chemicals or equipment

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.
- Store bought items that are used for laboratory experiments must be labeled as ″For Lab Use Only″.

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 104, 106 and 308)**
    - **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. However, if the employee or student who made the transfer leaves the work area or the container is moved to another work area, the container must be labeled appropriately.
- Unknown chemicals assigned to students for analysis in teaching or research laboratories do not need to be labeled as long as there is a procedure in place to identify the unknown substances.
- Food and over the counter store bought items purchased for laboratory use must be labeled as ″For Lab Use Only″.

5. Transporting Chemicals and Equipment

- Use caution when transporting chemicals:
    - Use a nonbreakable, secured secondary container for transporting a hazardous chemicals or transport chemicals on a cart with sides that can contain a spill.
    - Use the elevator when transporting chemicals between floors. Chemicals cannot be transported up and down the stairwells. Do not ride the elevator with the chemicals when transporting large quantities of chemicals. Place a prominent sign on the cart warning others not to board the elevator.
    - 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.
- In an effort to reduce the transport of concentrated acids and bases to the 2nd and 3rd floors, large quantities (2.5-L bottles) of concentrated acids and base will not be stored on the 2nd or 3rd floors whenever practical and will be replaced with smaller working quantities. If you need a 2.5 L bottle of concentrated acid, notify the laboratory chemist.
- Use the elevator when transporting supplies and equipment between floors.

6. Waste Disposal Procedures

- General Waste Information
    - Broken mercury thermometers may contain mercury in the fragment and should be disposed of in a hazardous waste container designated for broken thermometers.

- Containers:
    - Containers used to accumulate waste must be in good condition (no severe rusting or apparent structural defects).
    - The container used to store waste must be compatible with the waste.
    - Use a container of appropriate size with a screw caped lid. Containers with glass stoppers, rubber stoppers, corks or Parafilm are not acceptable.
    - 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.
    - Waste containers must remain closed except when it is necessary to add waste to the container.
    - Funnels are not permitted in waste containers except when waste is being added to the container. After addition of waste, remove funnel and tightly close the waste container.
    - When disposing of chemicals, keep each different class of chemicals in a separate clearly labeled disposal container.
    - The maximum size allowable for waste collection containers is 4 liters for hazardous wastes and 100 mL for acutely hazardous wastes.
    - Do not fill waste containers more than 80% full.
    - The outside of waste bottles must be free of chemical residue.

- Labeling
    - All hazardous waste containers must be labeled at the time waste is first added to the container.
    - For hazardous waste, the words "hazardous waste" must be clearly marked on the container.
    - In satellite accumulation point, the contents of the waste must be clearly marked on the container with chemical names, abbreviations and chemical formulas are not acceptable.
    - When a hazardous waste container is full and ready to be moved to the waste accumulation point (the chemical storage building), the container must be labeled with a University, pre-printed, self-adhesive yellow hazardous waste label. The label must be completely filled out with the following information:
        - Name and phone number of Principal Investigator/Laboratory Supervisor (waste generator)
        - University department, building and laboratory number
        - Contents of the container, listing the names of all chemicals added to the container (use chemical names, abbreviations and chemical/structural formulas are not acceptable)
        - The percentage of each chemical if more than one chemical is added to the container. For mixtures, the name of the chemicals must be listed from greatest percentage to least percentage.
    - When completing the University, pre-printed yellow hazardous waste label, do not fill in the **accumulation date** or the **EPA Hazardous Waste Code**. The accumulation date is added to the label when the container is move to the waste accumulation area and inventoried. The **EPA Hazardous Waste Code** is determined by the Office of Environmental Health and Safety and added to the container when it is moved to the waste accumulation area.

- Accumulation Points (the outside chemical storage building):
    - 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. The Office of Environmental Health and Safety is responsible for the inspection of the accumulation points.
    - All hazardous waste containers must have a yellow hazardous waste label on the bottle before being transported to the chemical storage building.
    - When the Chemistry Department puts a hazardous waste container in the accumulation point, the laboratory chemist will notify EHS.
    - EHS maintains an inventory of the accumulation points.
    - Must have the appropriate spill control materials available.

- Satellite Accumulation Points:
    - The satellite accumulation point must be under the control of the operator of the process that generates the waste and must be near the point of generation.
    - 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
    - Full hazardous waste containers or hazardous waste containers that are no longer being used must be moved to the accumulation point within 3 days. The faculty member responsible for the lab in which the waste was generated must be sure the container is properly labeled with a University yellow waste label completely filled out and notify the laboratory chemist who will inventory the waste, move it to the appropriate accumulation point and notify EHS.
    - 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.
    - Must have the appropriate spill control materials available.

- Waste Generator Responsibilities:
    - Select chemicals carefully, become familiar with the hazards of each chemical and to manage and dispose of all hazardous wastes in compliance with EPA/DHEC regulations and Winthrop University policies.
    - Properly identify hazardous waste, select compatible containers and to segregate and store hazardous wastes to ensure the safety of those working in the laboratory.
    - Ensure that all hazardous waste containers are properly labeled and kept clean of waste residue.
    - Ensure that hazardous waste containers are always kept closed except when adding or removing waste from the container. A funnel in a waste container is not considered closed.
    - Ensure that different waste streams (i.e. radioactive, chemical or biological) are not mixed together. Separate waste materials as much as is feasibly possible- if you must combine materials, try to keep the chemistry as pure as possible. Do not mix incompatible wastes.
    - Initiate a meaningful waste minimization plan through substitution, scale reduction, purchase control and/or recycling.
    - Ensure that students working in the laboratory understand and follow these responsibilities.
    - Faculty must ensure that all waste has been removed from 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.

    - 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.

7. Special Safety Considerations

Centrifuges

- For tabletop centrifuges, make sure that they are properly secured and anchored in a location where vibration will not cause glassware or equipment to fall.
- Never leave the centrifuge until full operating speed has been obtained and the machine appears to be running safely without excessive 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.

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 must 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. Do not handle lamps with bare skin. Use disposable gloves or Kimwipes to handle light sources.
- 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.

Cold Room

- General Cold Room Procedures
    - Keep your 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 unless their research advisor is present.
    - Always 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 for the Cold Room
    - 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 in the Cold Room
    - Do not use any 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 in the Cold Room
    - 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. Use the spill kit when cleaning up hazardous materials.
    - 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.

- Cold Room Maintenance
    - The oxygen sensor in the room must be inspected and tested to ensure its accuracy. The power/batteries to the oxygen sensors should be tested weekly and the alarm should be tested monthly.
    - The oxygen sensor will be replaced at least every two years.

- The cold room will be inspected yearly by facilities management for leaks, temperature control, and piping integrity.

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:
        1. Ethylene glycol or propylene glycol in a 3:2 ratio with water and thinned with isopropyl alcohol
        2. Isopropyl alcohol
        3. 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

8. 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 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′s Chemical Hygiene Plan.

Laboratory Supervision Requirements for Students

- 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 during the hours of 8 am to 6 pm.
    - 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 not allowed 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:

- 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

- 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 coordinator will train research students in general laboratory procedures and students are required to take a safety quiz yearly and pass with a 100%.
- 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.

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 equipment
    - 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 Management

- 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.

9. Faculty Research Project Summary Requirements

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 Friday of the first week of classes in January.
- 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
- Include your lab′s policy on the use of personal protective equipment.
- 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 notified 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

Section D: Storage and Inventory Control Requirements

1. 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.

2. 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.

3. General 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 E**.
- 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.

4. 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.

5. 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”.

6. Inventory Control

- An inventory of all chemicals must be maintained in an electronic data base.
- All chemical will be entered into the chemical inventory and bar-coded when received by the department.
- 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.
- Bar-code labels have a place for recording the date opened. 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

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 F**.
- **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, carcinogen and chemicals of high acute toxicity will not be used unless no suitable alternative is available. Approval from the safety committee must be obtained before ordering any carcinogen or chemical of high acute toxicity.
- 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.
- Containers of prepared solutions that contain a chemical of chronic or high acute toxicity must be stored in a secondary container large enough to contain a spill.
- All containers must be clearly labeled (Labeling Procedures) 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 coordinator.
- 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 ºC (70 ºF), or a pressure exceeding 104 psia at 54 ºC (130 ºF), or any flammable liquid material having a vapor pressure exceeding 40 psia at 38 ºC (100 ºF).

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 goggles 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 coordinator so that the proper procedures for that gas can be 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.

- Paper tags will be used on all cylinders to indicate the state of the tank as: Full, In Service, or Empty.
- Contents of the cylinder must be visibly labeled including hazard class. To ensure that the name of the gas and hazard class are easy to see when a regulator is installed, the user of the gas will attach a tag indicating the name of the gas, that the cylinder is "In Service" and the appropriate hazard class as indicated 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.
    - 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.
- Be sure the cylinder has a hazard class tag, is labeled as ″In Service″, and the name of the gas can be easily seen. If the manufacturer label is against the wall, write the name of the gas on the hazard class tag.
- 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 (25 psi) 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.
- Use only in a chemical hood.
- Lecture bottles must be secured
- 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 G.**

General Guidelines

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

Concentrated 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.
Concentrated 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 severe 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.
- In an effort to reduce the transport of concentrated acids and bases to the 2nd and 3rd floors, large quantities (2.5-L bottles) of concentrated acids and bases will not be stored on the 2nd or 3rd floors whenever practical and will be replaced with smaller working quantities. If you need a 2.5 L bottle of concentrated acid, notify the laboratory chemist.
- 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 ºF (16 ºC)
- 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. Nitric acid should be stored by itself in an acid cabinet if possible.

- 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. Nonvented splash goggles are the best protective eyewear to use when working with concentrated acids and bases.
- 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, 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. Before purchasing hydrogen fluoride or hydrofluoric acid, permission form the chair must be obtained, and a thorough investigation into the hazards of hydrofluoric acid must be completed. Even contact with dilute solutions of hydrofluoric acid can result in a serious burn.

Transporting Guidelines

- Use caution when transporting corrosive chemicals:
    - Use a nonbreakable, secured secondary container for transporting a corrosive chemicals or transport chemicals on a cart with sides that can contain a spill.
    - Use the elevator when transporting corrosive chemicals between floors. Corrosive chemicals cannot be transported up and down the stairwells.

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 splash 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 Liquids

Definition:

- **Flammable liquids- any liquid having a flashpoint* below 93 °C (200 °F).**

	Flashpoint	Boiling Point	Examples
Flammables			
Class 1	< 23ºC (73 ºF)	< 35 ºC (95 ºF)	acetaldehyde, ethyl ether, cyclohexane
Class 2	< 23 ºC (73 ºF)	≥ 35ºC (95 ºF)	acetone, benzene, toluene, ethanol
Class 3	≥23 ºC (73 ºF)	< 60 ºC (140 ºF)	Xylene, butanol
Class 4	≥60 ºC (140 ºF)	≤ 93 ºC (200 ºF)	

*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

- Flammable chemicals should not be purchased in containers larger than four liters.
- 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 used and 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.

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.
- Ensure containers of peroxide forming chemicals are tightly sealed after each use.
- 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 H**.
- 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, 308, and 107. If the solvent tests positive for peroxides, it must be disposed of immediately.
- 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: Biosafety Guidelines

Biosafety Level 1 Laboratory

Biosafety Level 1 is suitable for work involving well-characterized agents not known to consistently cause disease in immunocompetent adult humans, and present minimal potential hazard to laboratory personnel and the environment. Laboratory personnel must have specific training in the procedures conducted in the laboratory and must be supervised by a scientist with training in microbiology or a related science.

The following standard practices, safety equipment, and facility requirements apply to BSL-1.

A. Standard Microbiological Practices

1. Controlled access
   The laboratory supervisor must enforce the access to the laboratory is controlled. Lab doors should be closed at all times and when no one is present in the lab, doors should be locked.

2. Hand washing
   Persons must wash their hands with soap and water after working with potentially infectious materials. Hands should also be washed before leaving the laboratory and before touching common use surfaces. Be especially careful not to inadvertently touch the face or eyes with unwashed hands.

3. Eating, drinking, handling contact lenses, and applying cosmetics
   Eating, drinking, handling contact lenses, applying cosmetics and storing food for human consumption is not permitted in laboratory areas. Food must be stored outside the laboratory area in cabinets or refrigerators designated and used for this purpose.

4. Smoking
   Smoking is prohibited in all campus buildings including Sims. Smoking is permitted on campus grounds in designated smoking areas only.

5. Pipetting
   Mechanical pipetting devices must be available and used. Mouth pipetting is prohibited.

6. Safe handling of sharps
   Careful management of needles and other sharps are of primary importance.
   - Students should be trained in safe sharps handling procedures by their research mentor.
   - Use disposable sharps devices whenever possible.
   - Do not bend, break, or recap needles.
   - Used disposable needles and syringes must be carefully placed in conveniently located puncture-resistant containers used for sharps disposal.
   - Broken glassware must not be handled directly. Instead, it must be removed using a brush and dustpan, tongs, or forceps. Plastic ware should be substituted for glassware whenever possible.

7. Minimize splashes and aerosols
   Perform all procedures in a manner which will minimize the creation of splashes and/or aerosols. To help minimize splashes and aerosols, centrifuge tubes must have caps and the rotor must be covered with the lid. Additionally, mechanical pipettors, and/or conducting work inside of a biological safety cabinet will help minimize splashes and aerosols.

8. Decontaminate work surfaces
   Work surfaces must be decontaminated after completion of work and after any spill or splash of potentially infectious material with appropriate disinfectant (70% ethanol or 10% bleach solution).

9. Door signage
   A sign incorporating the universal biohazard symbol must be posted at the entrance to the laboratory when infectious agents are present. The sign may include the name of the agent(s) in use, and the name and phone number of the laboratory supervisor or other responsible personnel. Laboratory doors must have general contact information including the PI′s name, office number and office phone.

10. Decontamination of waste
    Decontaminate all cultures, stocks, and other potentially infectious materials before disposal using an effective method, such as autoclaving. Refer to Biohazard Waste Procedures below for additional information regarding proper decontamination of biohazardous waste. Depending on where the decontamination will be performed, the following methods should be used prior to transport.

    - Materials to be decontaminated outside of the immediate laboratory must be placed in a durable, leak proof container and secured for transport.

    - Materials to be removed from the facility for decontamination must be packed in accordance with applicable local, state, and federal regulations.

11. Pest management program
    A pest management program is managed through Facilities Management. If you a problem in your lab, contact the Department′s Instrumentation Manager who will contact Facilities Management.

12. Training
    Students

    - ❖ Students must receive general laboratory safety training as administered by the Chemistry Department. Records will be maintained by the Department′s Chemical Hygiene Coordinator.

- ❖ Students will be farther trained by their research mentors. Research mentors are responsible for ensuring that students have been adequately trained and must maintain documentation of such training.
- ❖ All students are required to take a yearly safety quiz covering both general laboratory safety and biosafety topics.

Faculty and staff

- ❖ Faculty and stall must complete biosafety training provided by the CITI program. Instructions for completing CITI compliance training can be found at http://www.winthrop.edu/SPAR/default.aspx?id=36697. The Director of SPAR will maintain a record of all researchers having completed CITI Training and will send out renewal notices for refresher training within 90 days of expiration of the training certificate. CITI Training certificates will be valid for three years after the completion date of the training.
- ❖ Faculty mentors must also provide annual updates or additional training when procedural or policy changes occur. Personal health status may impact an individual′s susceptibility to infection, ability to receive immunizations or prophylactic interventions. Therefore, all laboratory personnel and particularly women of childbearing age should be provided with information regarding immune competence and conditions that may predispose them to infection. Individuals having these conditions should be encouraged to self-identify to the institution′s healthcare provider for appropriate counseling and guidance.

B. Safety Equipment (Primary Barriers and Personal Protective Equipment)

1. Personal protective equipment (PPE)
   - Protective laboratory coats are recommended to prevent contamination of personal clothing.
   - Splash goggles must be worn when there is the potential for splashes of microorganisms or hazardous materials. Personnel who wear contact lenses in laboratories must also wear eye protection.
   - Gloves must be worn to protect hands from exposure to hazardous materials. Glove selection should be based on an appropriate risk assessment. Alternatives to latex gloves should be available. Wash hands prior to leaving the laboratory. In addition, BSL-1 workers should:
     - ❖ Change gloves when contaminated, glove integrity is compromised, or when otherwise necessary.
     - ❖ Remove gloves and wash hands when work with hazardous materials has been completed and before leaving the laboratory.
     - ❖ Do not wash or reuse disposable gloves. Dispose of used gloves with other contaminated laboratory waste. Hand washing protocols must be rigorously followed.

C. Laboratory Facilities (Secondary Barriers)

1. Doors
   Laboratories should have doors for access control and should be kept locked when no one is present in the laboratory.

2. Sink
   Laboratories must have a sink for hand washing and supplied with soap and paper towels.

3. Laboratory Cleaning
   The laboratory should be designed so that it can be easily cleaned. Carpets and rugs in laboratories are not appropriate.

4. Laboratory furniture
   Laboratory furniture must be capable of supporting anticipated loads and uses. Spaces between benches, cabinets, and equipment should be accessible for cleaning. Bench tops must be impervious to water and resistant to heat, organic solvents, acids, alkalis, and other chemicals. Chairs used in laboratory work must be covered with a non-porous material that can be easily cleaned and decontaminated with appropriate disinfectant.

5. Laboratory windows
   Laboratories windows that open to the exterior should be fitted with screens.

6. Laboratory waste
   All biohazardous laboratory waste must be properly decontaminated before disposal. The following biohazard waste procedures must be followed when decontaminating biohazard waste:

   Biohazard Waste Procedures

   - All biohazard waste is doubled bagged in autoclave bags and taped with autoclave tape.
   - The biohazard waste must then be autoclaved on the waste cycle. If the autoclave, indicator tape changed colors, then the autoclaved waste bag is placed in a dark, plastic garbage bag, sealed with regular tape and disposed with the regular waste stream.
   - If the autoclave indicator tape did not change colors, the waste must be run through another waste cycle. If the indicator type did not change colors after the second waste cycle, the autoclave must be serviced by a trained technician.

Biosafety Level 2 Laboratory

Biosafety Level 2 is suitable for work involving agents that pose moderate hazards to personnel and the environment. It differs from BSL-1 in that: 1) laboratory personnel have specific training in handling pathogenic agents and are supervised by scientists competent in handling infectious agents and associated procedures; 2) access to the laboratory is restricted when work is being conducted; and 3) all procedures in which infectious aerosols or splashes may be created are conducted in biological safety cabinets or other physical containment equipment.

A. Standard Microbiological Practices

1. Controlled access
   The laboratory supervisor must enforce the access to the laboratory is controlled. Lab doors should be closed at all times and when no one is present in the lab, doors should be locked.

2. Hand washing
   Persons must wash their hands with soap and water after working with potentially infectious materials. Hands should also be washed before leaving the laboratory and before touching common use surfaces. Be especially careful not to inadvertently touch the face or eyes with unwashed hands.

3. Eating, drinking, handling contact lenses, and applying cosmetics
   Eating, drinking, handling contact lenses, applying cosmetics and storing food for human consumption is not permitted in laboratory areas. Food must be stored outside the laboratory area in cabinets or refrigerators designated and used for this purpose.

4. Smoking
   Smoking is prohibited in all campus buildings including Sims. Smoking is permitted on campus grounds in designated smoking areas only.

5. Pipetting
   Mechanical pipetting devices must be available and used. Mouth pipetting is prohibited.

6. Safe handling of sharps
   Careful management of needles and other sharps are of primary importance.
   - ❖ Students should be trained in safe sharps handling procedures by their research mentor.
   - ❖ Use disposable sharps devices whenever possible.
   - ❖ Do not bend, break, or recap needles.
   - ❖ Used disposable needles and syringes must be carefully placed in conveniently located puncture-resistant containers used for sharps disposal.
   - ❖ Broken glassware must not be handled directly. Instead, it must be removed using a brush and dustpan, tongs, or forceps. Plastic ware should be substituted for glassware whenever possible.

7. Minimize splashes and aerosols
   Perform all procedures in a manner which will minimize the creation of splashes and/or aerosols. To help minimize splashes and aerosols, centrifuge tubes must have caps and the rotor must be covered with the lid. Additionally, mechanical pipettors, and/or conducting work inside of a biological safety cabinet will help minimize splashes and aerosols.

8. Decontaminate work surfaces
   Work surfaces must be decontaminated after completion of work and after any spill or splash of potentially infectious material with appropriate disinfectant (70% ethanol or 10% bleach solution).

9. Decontamination of waste
   Decontaminate all cultures, stocks, and other potentially infectious materials before disposal using an effective method, such as autoclaving. Refer to **Biohazard Waste Procedures** below for additional information regarding proper decontamination of biohazardous waste. Depending on where the decontamination will be performed, the following methods should be used prior to transport.

   - Materials to be decontaminated outside of the immediate laboratory must be placed in a durable, leak proof container and secured for transport.

   - Materials to be removed from the facility for decontamination must be packed in accordance with applicable local, state, and federal regulations.

10. Door signage
    A sign incorporating the universal biohazard symbol must be posted at the entrance to the laboratory when infectious agents are present. Posted information must include: the laboratory′s biosafety level, the Laboratory Biosafety Level Criteria: BSL-2 35, faculty′s name, telephone number and required procedures for entering and exiting the laboratory. Laboratory doors must have general contact information including the PI′s name, office number and office phone.

11. Pest management program
    A pest management program is managed through Facilities Management. If you a problem in your lab, contact the Department′s Instrumentation Manager who will contact Facilities Management.

12. Training

Students

- Students must receive general laboratory safety training as administered by the Chemistry Department. Records will be maintained by the Department′s Chemical Hygiene Coordinator.
- Students will be farther trained by their research mentors. Research mentors are responsible for ensuring that students have been adequately trained and must maintain documentation of such training.
- All students are required to take a yearly safety quiz covering both general laboratory safety and biosafety topics.

Faculty and staff

- Faculty and stall must complete biosafety training provided by the CITI program. Instructions for completing CITI compliance training can be found at http://www.winthrop.edu/SPAR/default.aspx?id=36697. The Director of SPAR will maintain a record of all researchers having completed CITI Training and will send out renewal notices for refresher training within 90 days of expiration of the training certificate. CITI Training certificates will be valid for three years after the completion date of the training.
- Faculty mentors must also provide annual updates or additional training when procedural or policy changes occur. Personal health status may impact an individual′s susceptibility to infection, ability to receive immunizations or prophylactic interventions. Therefore, all laboratory personnel and particularly women of childbearing age should be provided with information regarding immune competence and conditions that may predispose them to infection. Individuals having these conditions should be encouraged to self-identify to the institution′s healthcare provider for appropriate counseling and guidance.

B. Special Practices

1. Laboratory entrance

   Anyone entering the laboratory must be made aware of the potential hazards and meet specific entry/exit requirements (PPE requirements, immunization requirements, etc.).

2. Medical surveillance

   Laboratory personnel must be provided medical surveillance, as appropriate, and offered available immunizations for agents handled or potentially present in the laboratory.

3. Laboratory specific biosafety manual

   A laboratory-specific biosafety manual must be prepared by the PI and include information that is specific to the laboratory. The biosafety manual must be available and accessible.

4. Training
   The laboratory supervisor must ensure that laboratory personnel demonstrate proficiency in standard and special microbiological practices before working with BSL-2 agents.

5. Containers for potentially infectious materials
   Potentially infectious materials must be placed in a durable, leak proof container with a lid during collection, handling, processing, storage, or transport within a facility. Containers must be properly labeled with its contents and a biohazard symbol.

6. Decontamination of laboratory equipment
   Laboratory equipment should be routinely decontaminated, as well as, after spills, splashes, or other potential contamination. Spills involving infectious materials must be contained, decontaminated, and cleaned up by staff properly trained and equipped to work with infectious material. Equipment must be decontaminated before repair, maintenance, or removal from the laboratory.

7. Non-research related animals and plants in the laboratory
   Animals and plants not associated with the work being performed are not permitted in the laboratory.

8. Aerosol generating procedures
   All procedures involving the manipulation of infectious materials that may generate an aerosol should be conducted within a BSC or other physical containment devices.

9. Exposure incidents
   Incidents that may result in exposure to infectious materials must be immediately evaluated and treated according to the following procedures. All such incidents must be reported to the laboratory supervisor. Medical evaluation, surveillance, and treatment should be provided and appropriate records maintained.

What to do in the Event of an Exposure

When an exposure incident occurs, immediate action is essential. Follow these guidelines:

1. **Flush exposed area with water for 15 minutes**. If your eyes were exposed, rinse eyes in an eyewash station for 15 minutes holding your eyelids open. If you skin was exposed, wash with soap and water and continue to rinse with water for 15 minutes.
2. **Notify your research advisor immediately**.
3. **Report all exposure incidents according to the following guidelines and inform medical personnel what infectious agent was involved:**

Incidents involving employees:

- In the event that an employee was exposed or potentially exposed to a hazardous chemical or biological agent or sustained an injury on the job, the chair must be immediately informed as to the situation. In the event that the chair is not available, the incident must be reported to the department's secretary or the safety coordinator. Accidents during evening classes must be reported to public safety 323-3333.

- When medical treatment is needed, the supervisor must contact Compendium Services at 877-709-2667 to file a First Report of Injury and to receive authorization for treatment. All non-emergency medical treatment must be pre-approved by Compendium Services. Medical treatment is provided by: Occumed at Riverview Medical Center, 1393 Celanese Road, Rock Hill, SC 29732, 803-327-0033
- The PI must also report the injury or illness to Thadd Bridges, Workers′ Compensation Administrator at 323-2392.

Incidents involving students:

- Notify the chair of the department immediately. If the chair is unavailable, the incident must be reported to the department's secretary or the department′s safety coordinator.
- Incidents during evening classes must be reported to public safety at 323-3333.
- For minor incidents, the student must go to Crawford Health Services. The student′s supervisor (or a designated University representative) should accompany them to ensure the student makes it safety.

C. Safety Equipment (Primary Barriers and Personal Protective Equipment)

1. Biological safety cabinet
   Properly maintained BSCs, other appropriate personal protective equipment, and/or other physical containment devices must be used whenever:

   a. Procedures with a potential for creating infectious aerosols or splashes are conducted. These may include pipetting, centrifuging, grinding, blending, shaking, mixing, sonicating, opening containers of infectious materials, inoculating animals intranasally, and harvesting infected tissues from animals or eggs.
   b. High concentrations or large volumes of infectious agents are used. Such materials may be centrifuged in the open laboratory using sealed rotor heads or centrifuge safety cups.

2. Personal protective equipment
   Protective laboratory coats designated for laboratory use must be worn while working with hazardous materials. Remove protective clothing before leaving the laboratory. Lab coats are laundered through the department′s lab coat program. Disposable protective clothing must be disposed of with other contaminated waste.

   Splash goggles must be worn when there is the potential for splashes of microorganisms or hazardous materials. Personnel who wear contact lenses in laboratories must also wear eye protection.

   Gloves must be worn to protect hands from exposure to hazardous materials. Glove selection should be based on an appropriate risk assessment. Alternatives to latex gloves should be available. Wash hands prior to leaving the laboratory. In addition, BSL-2 workers should:

   - Change gloves when contaminated, glove integrity is compromised, or when otherwise necessary.
   - Remove gloves and wash hands when work with hazardous materials has been completed and before leaving the laboratory.
   - Do not wash or reuse disposable gloves. Dispose of used gloves with other contaminated laboratory waste. Hand washing protocols must be rigorously followed.

D. Laboratory Facilities (Secondary Barriers)

1. Doors
   Laboratory doors should be self-closing. Doors must be kept closed when work is in progress and kept locked when no one is presenting the laboratory.

2. Sink
   Laboratories must have a sink for hand washing and supplied with soap and paper towels.

3. Laboratory Cleaning

The laboratory should be designed so that it can be easily cleaned. Carpets and rugs in laboratories are not appropriate.

4. Laboratory furniture
   Laboratory furniture must be capable of supporting anticipated loads and uses. Spaces between benches, cabinets, and equipment should be accessible for cleaning. Bench tops must be impervious to water and resistant to heat, organic solvents, acids, alkalis, and other chemicals. Chairs used in laboratory work must be covered with a non-porous material that can be easily cleaned and decontaminated with appropriate disinfectant.

5. Laboratory windows
   Laboratories windows that open to the exterior should be fitted with screens.

6. Laboratory waste
   All biohazardous laboratory waste must be properly decontaminated before disposal. The following biohazard waste procedures must be followed when decontaminating biohazard waste:

   Biohazard Waste Procedures
   - ❖ All biohazard waste is doubled bagged in autoclave bags and taped with autoclave tape.
   - ❖ The biohazard waste must then be autoclaved on the waste cycle. If the autoclave, indicator tape changed colors, then the autoclaved waste bag is placed in a dark, plastic garbage bag, sealed with regular tape and disposed with the regular waste stream.
   - ❖ If the autoclave indicator tape did not change colors, the waste must be run through another waste cycle. If the indicator type did not change colors after the second waste cycle, the autoclave must be serviced by a trained technician.

7. Biological safety cabinets (BSC)
   BSCs must be installed so that fluctuations of the room air supply and exhaust do not interfere with proper operations. BSCs should be located away from doors, windows that can be opened, heavily traveled laboratory areas, and other possible airflow disruptions. BSCs must be inspected and certified to manufacture specifications by an outside agency on a yearly basis. Each BSC must be identified with a certification date which must be displayed on the hood. Yearly certification of all BSC will be initiated by the Chemistry Instrumentation Manager.

8. Vacuum lines
   Vacuum lines should be protected with liquid disinfectant traps.

9. Eyewash stations
   An eyewash station must be readily available.

10. Exhaust air from Class II BSC
    HEPA filtered exhaust air from a Class II BSC can be safely recirculation back into the laboratory environment if the cabinet is tested and certified at least annually and operated according to manufacturer′s recommendations. BSCs can also be connected to the laboratory exhaust system by either a thimble (canopy) connection or directly exhausted to the outside through a hard connection. Provisions to assure proper safety cabinet performance and air system operation must be verified.

Section G: Radiation Safety

The requirements and procedures outlined in this plan are provided in addition to the requirements outlined in the University's Radiation safety Plan.

1. Responsibilities

Chair of the Department

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

Radiation Safety Officer

The Radiation Safety Officer (RSO), who is also the university Environmental Health and Safety Manager, will oversee the university's Radiation Safety Program and ensure that the policies established by the program are followed by all individuals whose work involves the use of analytical x-ray equipment. The RSO will communicate with senior management regarding program implementation and compliance status and will serve as a liaison between the University and regulatory agencies. In addition, the RSO will:

- Review and approve requests for the procurement of any additional analytical x-ray equipment.
- Maintain a current inventory of x-ray equipment on campus.
- Review and approve applications for principal user designation.
- Maintain a current list of principal users of x-ray equipment.
- Perform routine radiation surveys and any special radiation surveys as deemed necessary.
- Provide training for principal users, maintain training records, and monitor departmental training activities.
- Develop and implement a personnel monitoring program, should it become necessary due to changes in equipment use or an individual request for monitoring. (Current equipment does not require personnel monitoring).
- Conduct periodic laboratory inspections to ensure compliance with this program.
- Suspend any operation, as rapidly as possible, that is causing or may cause an excessive radiation hazard.
- Respond to and provide direction in radiation accidents or emergencies.

Department Radiation Safety Coordinator
The Department Radiation Safety Coordinator (DRSC) will have the following responsibilities:

- Assist the University Radiation Safety Officer (RSO) with implementation of the University's Radiation Safety Program within the academic department.
- Develop and implement a departmental radiation safety plan which incorporates the equipment manufacturer's standard operating and safety procedures.
- Verify that the manufacturer's standard operating and safety procedures are posted near the x-ray equipment and available to all designated users.
- Verify that all x-ray equipment users have completed radiation safety training appropriate to their level of responsibility, as well as other department-specified safety training, and maintain department training records.
- Conduct periodic laboratory inspections to verify compliance with the department radiation safety plan.
- Respond to accident and emergency situations.

Principal Users
A principal user will be a faculty member who has been approved by the Department Chair to independently possess and use analytical x-ray equipment with direct responsibility for the equipment and any individual user thereof. Principal users will be responsible for:

- Satisfactory completion of Radiation Safety Training
- Training of individual users (faculty/staff and students)
- Ensuring that each individual user working in the laboratory has completed radiation safety and laboratory safety training as specified by the department and reporting training information to the DRSC.
- Providing individual users with initial and annual refresher in-laboratory training which includes equipment-specific operating and safety procedures, and verification of the user's competence through personal observation.
- Ensuring that equipment-specific standard operating and safety procedures are posted near the equipment and providing a copy of the procedures to all individual users under their direction.
- Ensuring that all x-ray equipment under their control is registered with the RSO and notifying the RSO of any changes to registered equipment or personnel authorized to use it.
- Notifying the RSO of plans to procure additional x-ray equipment prior to initiating the purchase.
- Conduct equipment and area surveys, including testing of equipment safety devices, as dictated by the departmental radiation safety plan. Maintain records of all surveys and tests.
- Schedule the required annual calibration of all survey equipment with the RSO.
- Responding to incidents and emergencies in the x-ray diffraction laboratory and reporting incidents to the DRSC.

Individual Users- Faculty/Staff Members and Students
An individual user will work with analytical x-ray equipment under the supervision of a principal user, but is capable of doing independent work or research. An individual user has the following responsibilities:

- To satisfactorily complete all required laboratory and radiation safety training.
- To follow equipment-specific standard operating and safety procedures.
- To observe the radiation safety rules for analytical x-ray equipment as presented in this manual.
- To immediately notify the principal user, the DRSC, or the RSO of any defects or deficiencies in radiation protective devices and procedures.
- To utilize appropriate protective equipment and personnel monitoring devices, should they be issued.
- To know what to do in the event of a radiation emergency.
- To perform all work with radiation in a manner that will keep exposures as low as reasonably achievable (ALARA).

Student User
A student user works with analytical x-ray equipment only as part of a classroom requirement approved by the Department Chair. Student users must be under the **direct** (in-the-room) supervision of a principal user at all times. Student users are not allowed to perform independent work using the analytical x-ray equipment.

2. Safety Requirements

Labeling
The x-ray diffraction laboratory, Sims 306, must be posted with a sign bearing the radiation symbol and a warning such as ″CAUTION- X-RAY EQUIPMENT″.

A label must be placed near the switch which energizes the x-ray tube indicating to the user that the instrument produces radiation when energized, such as ″Caution- Radiation. This Equipment Produces Radiation when Energized″.

A label must be placed on the X-ray source housing with wording such as ″Caution-X-Ray Equipment″.

Warning Lights
An easily visible warning light that is illuminated only when the tube is energized must be located near the switch that energizes an X-ray tube.

Safety Devices
Interlocks are put in place to prevent access and exposure to the primary beam. The Rigaku MiniFlex system is fully interlocked so that the x-rays will turn off if a cover is removed. When opening the door of the MiniFlex in order to mount or dismount a sample, a shutter is closed to block the x-rays and protect the user from any radiation exposure. Once the door is closed, the shutter will open.

Users must not disable, alter, modify or bypass any safety interlocks associated with X-ray equipment. Bypassing or manipulating the interlocks presents the potential for dangerous exposure.

Safety interlocks shall not be used to de-activate the X-ray beam except in an emergency or during testing of the interlock system.

Unused ports shall be secure in a manner which will prevent accidental opening. Open beam unit shall have a shutter over the port which cannot be opened unless a collimator or coupling has been connected.

Each port is equipped with a shutter that cannot be opened unless a collimator or a coupling device has been connected to the port.

Radiation Surveys
A radiation survey meter must be available to user and stored in x-ray diffraction laboratory. The survey instrument shall be kept clean, batteries shall be checked periodically and the instrument calibrated at intervals not to exceed one (1) year.

Radiation surveys shall be performed and documented in the x-ray maintenance/inspection section of the x-ray diffractometer log book:

- Upon installation of the equipment and at least once every six months thereafter to monitor leakage radiation.
- Following any change in the initial arrangement, number, or type of local components.
- Following any maintenance which requires the disassembly or removal of a local component.
- During the performance of maintenance and alignment procedures which requires the presence of a primary beam and the disassembly or removal of a local component.
- When a visual inspection of the local components reveals an abnormality.

Users of the x-ray diffractometer must perform **daily radiation surveys**. The survey should include monitoring for stray radiation in the immediate vicinity. The results of the daily radiation survey will be recorded in the x-ray usage section of the x-ray diffractometer log book.

When conducting a **daily radiation survey**,

- The survey meter should be set at x0.1 dial setting.
- The radiation level around the immediate vicinity of the instrument with the instrument door closed must be compared to the background radiation. The background radiation level outside the room (in the hallway) will serve as the standard. Survey the hallway outside the room. Survey the immediate vicinity around the instrument with the instrument door open and the shutters closed. Compare the maximum reading at the instrument to the maximum background reading outside the room in the hallway. Record the maximum reading of both locations in the instrument usage log book in cpm (counts per minute).
- If the maximum radiation level around the instrument is less than the maximum background reading, the instrument is safe to use.
- If the maximum radiation level around the instrument is higher than the background reading, the instrument is not safe to use. Immediately report these levels to Pam Jaco, Maria Gelabert, Cliff Calloway or Kathie Snyder.

Repairs
No operation involving removal of covers, shielding materials or tube housings or modifications to shutters, collimators or beam stops can be performed without ascertaining that the tube is off and will remain off until safe conditions have been restored. The main switch, rather than interlocks, must be used for routine shutdown in preparation for repairs.

Safety Device Tests

Tests of all safety devices such as interlocks and warning lights and a radiation exposure survey will be conducted for the Rigaku MiniFlex 600 XRD system by a principle user. Records of all tests will be maintained in x-ray maintenance/inspection section of the x-ray diffractometer log book kept in Sims 306. Tests will be conducted:

- annually
- upon installation of the instrument
- after any major changes in equipment configuration
- after any maintenance to the instrument
- when visual inspection of the local components in the system reveals an abnormal condition

A hand held radiation monitoring instrument is available to all users. The survey meter will remain in Sims 306.

X-Ray Radiation Safety-General Precautions

The Rigaku MiniFlex 600 XRD system is a closed system. Under normal operation, exposure to scattered radiation from the instrument is extremely low.

No personnel dosimeter is required for routine operations.

The Rigaku MiniFlex system is fully interlocked so that the x-rays will turn off if a cover is removed. When opening the door of the MiniFlex in order to mount or dismount a sample, a shutter is closed to block the x-rays and protect the user from any radiation exposure. Once the door is closed, the shutter will open.

User should always verify that the beam shutter is closed before reaching into primary beam.

Pregnant Radiation Workers

A Winthrop University employee/student has the responsibility of deciding when or whether to formally declare her pregnancy to the University. To make such a declaration, the employee or student should submit a completed ***Declaration of Pregnancy Form*** (Appendix I) to the RSO (Environmental Health and Safety). In the event of such a declaration, the RSO, DRSC and/or the principal user will ensure that the declared pregnant employee/student is fully aware of the potential risks to the embryo/fetus and will also ensure that radiation dose to the embryo/fetus is below the limits established by state regulations. In addition, the principal user working with the RSO will determine if additional precautions or engineering controls are necessary to reduce potential radiation exposure. Detailed information concerning this matter can be found in the NRC Regulatory Guide 8.13, "Instructions Concerning Prenatal Radiation Exposure".

General Requirements for Using the Diffractometer

All users must be trained before using the diffractometer and adhere to all training requirements. See TRAINING REQUIREMENTS below.

All personnel involved in the installation, maintenance, repair or use of the Rigaku MiniFlex system must be registered with the Radiation Safety Office.

The first user of the day must perform a radiation survey using the hand held radiation monitoring instrument. The results of this daily pre-operational check must be recorded in the x-ray usage section of the x-ray diffractometer log book

An instrument usage log book must be maintained. The log book must be located by the instrument and every user must log their usage of the instrument.

3. Training Requirements

Classifications of Users

Principal User- A principal user is a faculty or staff member who has been approved by the Department Chair to independently possess and use analytical x-ray equipment with direct responsibility for the equipment and training of individual users and/or student users.

Individual User – An individual user may be an employee (faculty or staff) or student who works with analytical x-ray equipment under the supervision of a principal user, but is capable of doing independent work or research.

Student User - A student user works with analytical x-ray equipment only as part of a classroom requirement approved by the Department Chair. Student users must be under the **direct** (in-the-room) supervision of a principal user at all times. Student users are not allowed to perform independent work using the analytical x-ray equipment.

No person is permitted to operate the x-ray diffractometer unless such person has received instruction and demonstrated competence in radiation safety and proper instrument use.

Training of Principle Users

Principle users of the instrument must be trained by the University Office of Environmental Health and Safety in general radiation safety before using the instrument. This training, offered in various formats, will cover the following topics and include a written examination:

- General properties of ionizing radiation
- Principles of radiation detection
- Radiation hazards associated with the use of the equipment
- Biological effects of ionizing radiation
- Procedures to minimize exposure
- Radiation safety regulations for the equipment
- Emergency procedures
- Proper operating procedures for the equipment
- Purposes and functions of equipment radiation warning and safety devices
- Winthrop University's Radiation Safety Program

Training of all principal users must be recorded in the training log book located in Sims 306 and reported to the Department Radiation Safety Coordinator who will maintain records of all trained principle users. All training and reporting of training must be completed before using the instrument.

The Department Radiation Safety Coordinator will maintain records of all trained principle users and will provide such information to the University Radiation Safety Officer. Training of all principle users will be recorded in the faculty/staff training log book located in Sims 306 with an additional copy (hard copy or digital copy) of all records located in Sims 109B **Appendix J**.

The vendor will train at least two principle users in the use of the instrument which will include detailed instructions on the operations, hazards and radiation warning devices of the instrument. Any faculty or staff member who needs training on the use of the instrument can be trained by a principle user.

In summary, before a principle user can use the x-ray diffractometer,

- The principle user must complete radiation safety administrated by the University's Office of Environmental Health and Safety;
- Be trained in the use of the instrument by a principle user who is already trained;
- Complete and pass the radiation safety quiz with an 80%.
- A ***Training Acknowledgment Form*** (Appendix K) must be completed, signed by the principal user and kept on file in Sims 306. A copy must be submitted to the DRSC.

Training of Individual Users- Faculty/Staff Members
Principal users will determine the extent of training necessary for individual users under their control, based on the intended use of the equipment and the anticipated degree of supervision. At a minimum, individual users must receive training in:

- Radiation hazards associated with the use of the equipment
- Biological effects of ionizing radiation
- Procedures to minimize exposure
- Emergency procedures
- Standard operating procedures for the equipment
- Purposes and functions of the radiation warning and safety devices

In summary, before an individual user can use the x-ray diffractometer,

- The individual user must complete radiation safety administrated by the University's Office of Environmental Health and Safety or the Chemistry Department;
- Be trained in the use of the instrument by a principle user who is already trained
- Complete and pass the radiation safety quiz with an 80%.

Individual users who will be monitoring analytical x-ray equipment should also read the Department's Radiation Safety Plan in its entirety. Competence should be demonstrated by passing a written examination administered by either the principal user or the DRSC. A ***Training Acknowledgment Form*** (Appendix K) must be completed, signed by the individual user and the trainer, and kept on file in Sims 306. A copy must be submitted to the DRSC.

Training of Individual Users- Students
Before a student can use the x-ray diffractometer, the student must:

- attend chemical safety training before working in the x-ray diffraction lab;
- take and pass the general safety training quiz with a 100%;
- receive training in basic radiation safety as indicated above; See **Training Individual Users-Faculty/Staff**
- take and pass the radiation safety training quiz with an 80%;
- receive training from a trained principle user before using the instrument;
- the principle user must observe the student using the instrument and the student must demonstrate competence in radiation safety principles before being allowed to use the instrument.

A ***Training Acknowledgment Form*** (**Appendix K**) must be completed, signed by the individual user and the trainer, and kept on file in Sims 306. A copy must be submitted to the DRSC.

Students cannot perform the daily pre-operational checks without the assistance of a principal user.

Students are not allowed to use the x-ray diffractometer outside the hours of 8:00 am and 6:00 pm unless there is a principal user present in the room.

Training of all students must be recorded in the training log book located in Sims 306. Additionally, research mentors must also maintain training records.

Training of Student Users
Students using x-ray equipment as part of a classroom requirement under the **direct** supervision (in the room) of a principal user are not required to take the radiation safety test.

4. Lab Access

Visitors are not permitted in the lab unless prior approval is obtained from the Chair of the Department and must be accompanied by a principal user.

Custodial personnel will not enter Sims 306. Trash cans will be placed outside the door in the hallway for trash removal.

5. Survey Meter Maintenance

Instrument maintenance consists of keeping the instrument clean and periodically checking the batteries and the calibration. The Model 3 instrument may be cleaned with a damp cloth (using only water as the wetting agent). Do not immerse instrument in any liquid.

Never store the meter over 30 days without removing the batteries.

Recalibration must be accomplished annually and after maintenance or adjustments have been performed on the meter. Recalibration is not normally required following instrument cleaning, battery replacement, or detector cable replacement.

The survey meter will be sent to Ludlum Measurements (or a similar capable company) at least once a year for recalibration.

RADIOLOGICAL EMERGENCY PROCEDURES
306 Sims Science Building

1) Turn the x-ray equipment off, if possible, and have the person remain in the area until an authorized individual arrives. Do not stay in the room if the equipment is on.

2) Remove an unconscious victim from the room as quickly as possible if the equipment cannot be immediately turned off.

3) Call the Radiation Safety Officer (RSO), **Mitzi Stewart - 803-242-9545.**

4) Notify at least one person from the Chemistry Department line of authority below:

    - **Kathie Snyder**, Radiation Safety Coordinator – **803-323-4947**
    - **Pam Jaco,** Sims 306 Principal User – **803-323-4931**
    - **Pat Owens**, Department Chair – **803-323-4925**

5) Call **Campus Police** at **803-323-3333** to initiate emergency medical response if needed. ***Individuals exposed to x-rays are not radioactive and cannot harm others. No precautions for radiation are needed when handling victims.***

South Carolina Bureau of Radiologic Health
Normal Work Hours: (803) 545-4400
After Hours, Weekends, Holidays: (803) 690-8286 (pager)

Section H: Emergency and Medical Procedures

1. Employee Workplace Injuries

Students are considered employees if their incident happens while receiving monetary compensation at the time of the incident.

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

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 employee exposure to hazardous chemicals.

The following procedures are to be followed for any employee incident needing medical attention.

In the event of a life threatening incident, call 323-3333 or 911 (9-911 from a campus phone).

Minor Injuries or Work-Related Illnesses

- In the event that an employee was exposed or potentially exposed to a hazardous chemical or sustained an injury on the job, the chair must be immediately informed as to the situation. In the event that the chair is not available, the incident must be reported to the department's secretary or the safety coordinator. Accidents during evening classes must be reported to public safety 323-3333.

- When medical treatment is needed, the supervisor must contact Compendium Services at 877-709-2667 to file a First Report of Injury and to receive authorization for treatment. All non-emergency medical treatment must be pre-approved by Compendium Services and is provided by:

  Occumed at Riverview Medical Center
  1393 Celanese Road
  Rock Hill, SC 29732
  803-327-0033

- The supervisor must also report the injury or illness to Thadd Bridges, Workers′ Compensation Administrator at 323-2392.

- The chair is responsible for establishing the need for employee medical examination.

- The following information should be provided to medical personnel if the employee incident involves exposure to a chemical:

    - The identity 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.

Employees should report all injuries and work-related illnesses to their supervisor no matter how minor they may seem at the time. An employee who fails to report an injury or work-related illness may risk being denied benefits by the State Accident Fund (SAF) should medical treatment be needed at a later time.

Medical Emergencies

- In the event of a serious or life-threatening injury that requires immediate or emergency medical attention, call 9-911 for an emergency operator or call Winthrop University Campus Police at 323-3333. Compendium Services (877-709-2667) and the Campus Administrator (Thadd Bridges, Workers′ Compensation Administrator at 323-2392) should be contacted as soon as the situation allows.

- When an injured employee is transported to an emergency treatment facility for care, the supervisor or a designated University representative should accompany them to the facility and remain until the employee has been admitted or released.

- The supervisor or designated representative should notify the treating facility that workers′ compensation may be filed for the injured employee and provide the following insurance information, if needed**:**

    For case management and treatment authorization:
    Compendium Services, Inc.
    877-709-2667

2. Procedures for Student Incidents Requiring Medical Attention

- For all student incidents requiring medical attention, the employee in charge of the lab at the time of the incident must
    - Call -911 (9-911 from a campus phone) or 323-3333 immediately in the event of a serious or life-threatening injury.
    - Notify the chair of the department immediately. If the chair is unavailable, the incident must be reported to the department's secretary or the department′s safety coordinator.
    - Incidents during evening classes must be reported to public safety at 323-3333.
    - An incident report form 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. The student′s supervisor (or a designated University representative) should accompany them to ensure the student makes it safety.

- Accident report forms are available on line from the chemical hygiene plan. The completed form must be submitted to the chair.

3. Summary Emergency Procedures and Contact Numbers

University Employees[1]	
Very Serious[3]	Cell phone call -911 or (803) 323-3333 Campus phone dial 9-911 or -3333
Serious[4]	Notify supervisor and contact Compendium Services at 877-709-2667
Minor[5]	Minor first aid treatment
Students[2]	
Very Serious[3]	Cell phone call -911 or (803) 323-3333 Campus phone dial 9-911 or -3333
Serious[4]	Call Public Safety Cell phone (803) 323-3333 Campus phone dial -3333
Minor[5]	Report to Crawford Health Services - Cell phone (803) 323-2206 Campus phone dial -2206

[1]University employees include all faculty and staff employees, and also include student employees who are performing their work duties at the time of the incident.

[2]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 requiring immediate medical attention.

[4]Serious injury would involve an injury where the person is in need of medical attention, but the incident is not life-threatening or the injured is not in need of immediate emergency medical attention.

[5]Minor injury would involve a minor cut, burn, etc.

Report Forms
Appendix L: Possible Chemical Overexposure Report
Appendix M: Incident Report Form Involving Injury
Appendix N: Near Miss Incident
Appendix O: Hazard Report Form

4. Guidelines 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.
- If medical attention is required, follow the above procedures. Be sure to inform medical personnel as to what chemical was involved.
- Check the MSDS to see if any delayed effects should be expected.

Chemicals Spilled over a Large Area of the Body

- The person should immediately head to the nearest safety shower.
- Notify an instructor- Treat as a life threatening emergency. Call -911 or 323-3333.
- Once in the shower, rinse first, and then remove clothes taking care not to spread chemicals especially into the eyes.
- Wash head and remove clothing before removing goggles.
- Flush skin for 15 minutes, and seek immediate medical attention.
- If a fire blanket is available it can be used as a shower curtain for someone using the safety shower and then used to keep someone warm while waiting for emergency help to arrive.
- Avoid putting anything on the affected area; it may worsen the condition and cause irritation.
- Send MSDS with the injured person

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. Follow the above procedures.

Ingestion of Chemicals

- Identify the chemical ingested and call 323-3333 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 323-3333

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.

Significant bleeding

- Call 323-3333 immediately

Fires

- A fire contained in a small vessel often can be suffocated, for example by placing a watch glass over its opening or using a fire blanket.
- 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 whatever 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 323-3333 or -911).

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.

5. Cleaning up Chemical 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 coordinator, or lab personnel.
- Identify the chemical if possible.
- It is the responsibility of the faculty member, the chemical hygiene coordinator, the laboratory chemist, or the lab instructor to determine whether the spill is a simple spill or a complex spill.

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

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 identity 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 323-3333**.

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 106)
- 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 a yellow University hazardous waste label. The label must be completely filled out with the name of the spilled chemical along with the pH if appropriate.
- 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 coordinator 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 hazardous 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.

6. 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. If possible, do not use mercury thermometers. Ethanol thermometers are available in Sims 106.

- A mercury spill kit (containing amalgamation powder, indicator powder, aspirator bottle, waste collection bottle) is available in Sims 106 and most of chemistry elective labs and research labs have a mercury collector in their spill kits.
- A mercury spill due to a broken thermometer can be safely cleaned up by a knowable person.

    - Inform others around you that there is mercury spill to prevent personal injury and further contamination of the area, i.e. you do not want to step in it and track the mercury all over the room.
    - Personal protective equipment must be worn, i.e. safety goggles, 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**.
    - The broken thermometer must also be disposed of as hazardous waste.

- 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. You must obtain the mercury spill kit from Sims 106.

    - Use a mercury absorber (the name will vary depending on the manufacturer such as MERCSORB powder, Hg Absorb powder, etc.) located in the mercury spill kit located in Sims 106.
    - 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".
    - The broken thermometer must be disposed of as hazardous waste.

7. 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 I: 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.

- Splash goggles are required whenever a splash hazard exist. Proper eye protection is required whenever working with UV light. It is your responsibility to provide department approved safety goggles. 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

- The person should immediately head to the nearest safety shower.
- Notify an instructor- Treat as a life threatening emergency. Call -911 or 323-3333.
- Once in the shower, rinse first, and then remove clothes taking care not to spread chemicals especially into the eyes.
- Wash head and remove clothing before removing goggles.
- Flush skin for 15 minutes, and seek immediate medical attention.
- If a fire blanket is available it can be used as a shower curtain for someone using the safety shower and then used to keep someone warm while waiting for emergency help to arrive.
- Avoid putting anything on the affected area; it may worsen the condition and cause irritation.
- Send MSDS with the injured person

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 323-3333 or call -911.

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 whatever 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 323-3333 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.
- If you find a piece of equipment that is not in good working order, notify your instructor.
- When working with "community reagents", take the reagent bottle to your desk, pour the amount needed for the experiment into a beaker and return the bottle to the correct location.
- Many chemicals have strong or toxic odors and should be used under a fume hood only. For example, acids and bases can be particularly hazardous. If you are not sure, be on the safe side and work under a bench top 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 may contaminate the stock solution.
- 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 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/burns, must be reported to your instructor immediately.
- If someone's life is in danger, call 9-911 (campus phone), -911 or (803) 323-3333 immediately.
- An accident report form (see **Appendix M**) 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.
- 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
Sims 103	Willie Ruth Aiken/ Kathie Snyder	General Chemistry Lab
Sims 104	A. Hartel/ C. Grattan/ J. Hanna	Organic Chemistry Lab
Sims 106/107	Willie Ruth Aiken/Kathie Snyder	General Chem Prep Area/ Stock Room
Sims 202 A	Gwen Daley	Geology Research
Sims 204 B	Fatima Amir	Physics Research
Sims 210	Scott Werts	Geology Research
Sims 303 Sims 303A/B Sims 303D	Jason Hurlbert/ Takita Sumter	Biochemistry Laboratory Biochemistry Prep Area / Equipment Room Cold Room
Sims 304	Aaron Hartel	Chemical Synthesis Lab
Sims 305/305A Sims 305 B	Maria Gelabert	Physical Chemistry Laboratory Physical Chemistry Storage
Sims 306	Maria Gelabert/Pam Jaco	X-Ray Diffraction Laboratory
Sims 307	Cliff Calloway	NMR Room
Sims 308	Christian Grattan/Jay Hanna	Organic Chemistry Research Lab
Sims 310 Sims 311	Cliff Calloway	Analytical/Instrumentation Lab Analytical Prep Area
Sims 311 A	Robin Lammi	Research Laboratory
Sims 312	Cliff Calloway	Molecular Modeling Lab
Sims 314 E	Takita Sumter	Biochemistry Research
Sims 315	Nick Grossoehme	Biochemistry Research
Sims 315A	Clifton Harris	Organic Research
Sims 316A	Jason Hurlbert	Tissue Culture Room
Sims 317	Jason Hurlbert	Bioanalytical Instrumentation Lab

Last updated 25 January 2015

Appendix B: 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.

The following reference materials are located in SIMS 109B

- Improving Safety in the Chemical Laboratory: A Practical Guide
- Prudent Practices in the Laboratory: Handling and Disposal of Chemicals by the National Research Council
    - There are several hard copies located throughout the department or it can be downloaded for free, http://www.nap.edu/catalog.php?record_id=12654#toc

OSHA Documents

- Laboratory Standard
  http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10106
- Hazard Communication Standard
  http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10099
- PART 1910 Occupational Safety and Health Standard
  http://www.osha.gov/pls/oshaweb/owasrch.search_form?p_doc_type=STANDARDS&p_toc_level=1&p_keyvalue=1910

- Safety in the Academic Chemistry Laboratories (The American Chemical Society)
- Spill-X Spill Kit Treatment Guide
- 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

The following reference materials are located in SIMS 107

- Hazardous Chemicals Desk Reference
- Hazardous Waste Management for Small Quantity Generators
- Video- Introduction to Laboratory Safety (Flinn Scientific, Inc.)
- Video- Science Lab Safety (Cambridge Educational)
- Video- Starting with Safety: An Introduction for the Academic Chemistry Laboratory (The American Chemical Society)

Appendix C: Laboratory Safety Inspection Check List

The following will be checked during lab inspections:

General Safety

- 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?
- Emergency lights working?

Laboratory Safety

- Fume hoods free of clutter?
- Aisles are unobstructed?
- Lab benches and work areas free of clutter?
- Shelves and cabinets secured to the wall?
- Fire blanket available if open flames or flammable chemicals are used routinely?
- Fire extinguishers readily available and unobstructed?
- Fire extinguishers tagged and inspected in the last month?
- Safety showers/eye wash stations accessible and clearly labeled?
- Safety shower inspected and tested in the past year?
- Eye wash station inspected and tested in the past week?
- Refrigerators and freezers for chemical use clearly labeled as such?

Compressed gases

- Cylinders stored upright and properly secured?
- 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

- Chemicals stored according to compatibility?
- 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, date opened and barcode?
- Containers closed unless actively being used?
- Spill control materials readily available- Absorbent, scraper and scoop, waste bag, waste labels, goggles, gloves, sharpie?

Satellite Accumulation Areas for Hazardous Waste

- Hazardous waste containers properly labeled with hazardous waste and contents of container?
- Waste containers properly closed?
- Waste containers free of chemical residue on outside of bottle?
- Satellite accumulation point labeled?
- Waste is stored only in the satellite accumulation point?
- Waste containers not filled more than 80%?

Appendix D: Student Training Log

Student Name:	**Term:**

I. I have attended a departmental safety training session within the last year and successfully completed the required safety quiz.

Item	Date Completed	Student Signature	Instructor Initials
Departmental Safety Training			
Online Safety Quiz			

II. I have been shown and am aware of the location of the following safety equipment:

Item	Date Completed	Student Signature	Instructor Initials
Eye wash, Safety shower, Fire blanket, First aid kit, Spill kit, MSDS folders, CHP, Lab exits			

III. I have read and understand the contents of the following safety documents and I have discussed any questions I had with my research advisor.

Document	Date Completed	Student Signature	Instructor Initials

IV. My signature documents that: 1) I have researched and discussed with my research advisor the hazards involved in the specified procedure; 2) I have been shown and practiced the proper technique/methods of the procedure; 3) I am confident that I can safely carry out the procedure independently. My instructor's initials indicate that I have undergone training and observation by the instructor and am qualified to conduct the procedure independently.

Procedure	Date Completed	Student Signature	Instructor Initials

Appendix E: 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 F: List of Known and Suspected Carcinogens

A list of known human carcinogens and suspected carcinogens can be found at the 12th Annual Report of Carcinogens- National Toxicology Program (2011).

http://ntp.niehs.nih.gov/?objectid=035E57E7-BDD9-2D9B-AFB9D1CADC8D09C1

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/twelfth/ListedSubstancesReasonablyAnticipated.pdf

Names and Synonyms of Carcinogens
(http://ntp.niehs.nih.gov/ntp/roc/twelfth/ListedSubstancesKnown.pdf)

Aflatoxins
Alcoholic Beverage Consumption
4-Aminobiphenyl
Analgesic Mixtures Containing Phenacetin (See Phenacetin and Analgesic Mixtures Containing Phenacetin)
Aristolochic Acids
Arsenic Compounds, Inorganic
Asbestos
Azathioprine
Benzene
Benzidine (See Benzidine and Dyes Metabolized to Benzidine)
Beryllium and Beryllium Compounds
Bis(chloromethyl)Ether and Technical-Grade Chloromethyl Methyl Ether
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)
Erionite
Estrogens, Steroidal
Ethylene Oxide
Formaldehyde
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)
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 Smoke, Environmental (See Tobacco Related Exposures)
Tobacco Smoking (See Tobacco Related Exposures)
Tobacco, Smokeless (See Tobacco Related Exposures)
Ultraviolet Radiation, Broad Spectrum UV Radiation (See Ultraviolet Radiation Related Exposures)
Vinyl Chloride
Wood Dust
X-Radiation and Gamma Radiation (See Ionizing Radiation)

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

Appendix G: 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	Fluorine
Nitric acid	Potassium hydroxide	Chromic acid
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 H: Common Chemicals That Are Likely to Form Peroxides During Storage (this list is not exhaustive)

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

- Butadiene
- Chlorobutadiene (Chloroprene)
- Divinyl acetylene
- Divinyl ether
- Isopropyl ether
- Potassium amide
- Potassium metal
- Sodium amide (sodamide)
- Tetrafluoroethylene
- Vinylidene chloride

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.

- Acetal
- Acetaldehyde
- Benzyl alcohol
- 2-Butanol
- Cumene
- Cyclohexanol
- 2-Cyclohexen-1-ol
- Cyclohexene
- Decahydronaphthalene
- Diacetylene
- Dicyclopentadiene
- Diethyl ether
- Diethylene glycol
- Dimethyl ether (diglyme)
- Dioxanes
- Ethylene glycol dimethyl ether (glyme)
- 4-Heptanol
- 2-Hexanol
- Methylacetylene
- 3-Methyl-1-butanol
- Methylcyclopentane
- Methyl isobutyl ketone
- 4-Methyl-2-pentanol
- 2-Pentanol
- 4-Penten-1-ol
- 1-Penylethanol
- 2-Phenylethanol
- 2-Propanol
- Tetrahydrofuran
- Tetrahydronaphthalene
- Vinyl Ethers
- Other secondary alcohols

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.

- Acrylic acid
- Acrylonitrile
- Butadiene
- Chloroprene
- Chlorotrifluoroethylene
- Methyl methacrylate
- Styrene
- Tetrafluoroethylene
- Vinyl acetate
- Vinylacetylene
- Vinyl chloride
- Vinylpyridine
- Vinyladiene chloride

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 I

WINTHROP UNIVERSITY
RADIATION SAFETY PROGRAM

Declaration of Pregnancy Form

This form complies with the requirements of South Carolina Regulation 61-63 and 61-64 for declaration of pregnancy and for limiting dose to the embryo/fetus. The occupational exposure dose to an embryo/fetus during the entire term of a declared pregnancy must not exceed 0.5 rem.

Name of Employee/Student_____

SSN or Winthrop ID #_____

Principal X-Ray User (Supervisor/Instructor)_____

List the type of x-ray equipment that has or will be used during the term of the pregnancy:

_____

Estimated date of conception_____

Estimated due date_____

Please inform the Radiation Safety Officer when your condition changes, i.e., birth, termination or loss of pregnancy.

All records will be kept confidential.

I am voluntarily informing Winthrop University of my pregnancy for the purpose of monitoring radiation dose to the embryo/fetus.

Signature_____ Date_____

OFFICE USE:

Department_____

Badge # _____

Begin Month/Yr_____

End Monty/Yr_____

Appendix J- X-Ray Safety Training
Faculty/Staff Users

Name	Date Training	Quiz Score	Date Hands-On Training	Type of Training Principle, Individual or Basic Radiation Safety

Appendix J- X-Ray Safety Training
Student Users

Name	Date Completed Online Training	Exam Score	Date Completed Hands-On training

Appendix K- Training Acknowledgement Form

Department_____

Type of Equipment and Location_____

Principal X-Ray User (Supervisor/Instructor)_____

This record certifies that the named employee/student has been instructed in the proper use of the x-ray equipment, informed of the hazards of working with x-ray equipment, and the laboratory safety rules to be followed to ensure its safe operation.

In addition, it also certifies that the following topics were included in the training received:

1. The general properties of ionizing radiation.
2. Radiation hazards associated with the use of x-ray producing equipment.
3. Biological effects of ionizing radiation.
4. Procedures to minimize exposure.
5. Survey equipment used to detect radiation.
6. Emergency procedures.
7. Proper operating procedures for specific equipment.
8. Purposes and functions of the radiation warning and safety devices.
9. Radiation safety regulations.
10. Winthrop University's Radiation Safety Program

Certification

I certify that I have received training in the topics indicated above and understand the training.

Employee/Student

Printed Name_____

Signature_____Date_____

As a Principal User of the x-ray producing equipment identified above, I certify that I have trained the named individual in its safe operation and the hazards of working with x-ray equipment. In addition, I certify that the topics outlined above were included in the training provided and the named individual is competent to operate the equipment in a safe and responsible manner. I can also confirm that the named individual has passed a proficiency test administered by myself, the DRSC, or the RSO, and is classified as an Individual User per the Winthrop University Radiation Safety Program.

Principal User

Printed Name_____

Signature_____Date_____

Appendix L: Possible Chemical Overexposure Report

The following information should be provided to the examining physician if possible. Send an electronic copy to the Chair and the department chemical hygiene officer.

Name: Click here to enter text.

Date of Incident: Click here to enter a date.

Time of Incident: Click here to enter a date.

Department: Click here to enter text.

Chair/PI: Click here to enter text.

Identity of the hazardous chemical(s) in use: Click here to enter text.

MSDS attached to this report? If not, explain why: Click here to enter text.

Duration of exposure: Click here to enter text.

Estimated amount of chemical(s) involved: Click here to enter text.

Control measures used at time of incident (fume hood, personal protective equipment etc.) Click here to enter text.

Description of the incident, include location of where incident took place: Click here to enter text.

Location of injuries or sites of contact, e.g. eyes, skin: Click here to enter text.

Signs and/or symptoms, if any: Click here to enter text.

Are signs and symptoms same as indicated on MSDS? Click here to enter text.

Witnesses (include telephone numbers): Click here to enter text.

Signature of Injured Employee:

Date:

Click here to enter a date.

Signature of Chair:

Date:

Click here to enter a date.

Comments: Click here to enter text.

Appendix M: Incident Report Form Involving Injury

This report must be completed by the employee for any injury that happens in any laboratory. Send an electronic copy to the Chair and the department chemical hygiene officer.

Name of injured person: Click here to enter text.

Date of accident: Click here to enter text.

Time of accident: Click here to enter text.

Location of accident: Click here to enter text.

Chair/PI: Click here to enter text.

Name of chemicals involved (include concentration is applicable), if any: Click here to enter text.

Type and location of injury: Click here to enter text.

Brief Description of the accident: Click here to enter text.

Action taken: Click here to enter text.

Signature of Chair:

Date: Click here to enter a date.

Comments: Click here to enter text.

Appendix N: Near Miss Incident

Send an electronic copy to the Chair and the department chemical hygiene officer.

Name of reporting person: Click here to enter text.

Date of incident: Click here to enter text.

Time of incident: Click here to enter text.

Location of incident: Click here to enter text.

Description of the incident including who was involved and what exactly happened:

Click here to enter text.

What training did the employee or student receive prior to the incident: Click here to enter text.

What safety practices did the employee or student follow: Click here to enter text.

What corrective action was taken to prevent a similar incident: Click here to enter text.

Action taken: Click here to enter text.

Signature of Chair:

Date: Click here to enter a date.

Comments: Click here to enter text.

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.

Date: Click here to enter a date.

Department: Click here to enter text.

Location of hazard (room number, hallway, stairwell, etc.): Click here to enter text.

Your name (unless you prefer to remain anonymous: Click here to enter text.

R received by: Click here to enter text. **Date:** Click here to enter text.

Action taken: Click here to enter text.

Issue solved by Click here to enter text. **Date:** Click here to enter text.

Signature of Chair:

Date:

Click here to enter a date.

Comments: Click here to enter text.