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Chemical Hygiene Plan for the Luther College Chemistry Department

The intent of this chemical hygiene plan for the Chemistry Department is:
1. To protect laboratory employees and students from health hazards associated with the use of hazardous chemicals in our laboratories; and
2. To assure that our laboratory employees and students are not exposed to substances in excess of the permissible exposure limits (PEL's) as defined by the Occupational Safety and Health Administration (OSHA) and codified in 29 CFR 1910.1000, Table Z-1-A; and
3. To assist our laboratories' regulatory compliance with the OSHA Laboratory Standard as codified in 29 CFR 1910.1450.

This plan will be available to all employees and students for review; copies will be located in the following areas: Chemistry Stockroom (SHL 354), the Chemistry Study Lounge (SHL 390), and each faculty member's office.

This plan will be reviewed annually, or more frequently as needs might arise, and updated as necessary by the Department Chemical Hygiene Officer and the Chemistry Department.

Responsibilities under the Chemical Hygiene Plan

Responsible individuals are:
1. President of the College;
2. Academic Dean of the College;
3. Business Manager of the College (facilities management);
4. Chemistry Department Chair;
5. Laboratory Supervisor, each laboratory instructor or research director, listed in Appendix F;
6. Chemical Hygiene Officer
7. Stockroom Manager;
8. Laboratory workers.

Standard Operating Procedures

1. Specific standard operating procedures for our laboratories are attached to this plan as Appendix A.
2. Each laboratory supervisor has responsibility to maintain safe standard operating procedures and maintain or recommend revising the procedures as necessary.
3. The Chemical Hygiene Officer has responsibility to conduct periodic laboratory inspections. Inspections will be conducted on a yearly basis and should be conducted while the laboratory is in use to verify operating procedures.
4. The Academic Dean of this college and the Chair of this department shall have responsibility to see that this overall management plan is implemented and followed.
5. The Chair of this department shall designate a Chemical Hygiene Officer who has primary departmental responsibility for the implementation and maintenance of this plan.

Control Measures to reduce exposure to hazardous chemicals

1. See Appendix A for standard operating procedures.
2. Laboratory fume hoods shall be used for all operations which have the potential to produce hazardous levels of fumes, gases, or volatile solvent vapors.
3. Laboratory fume hoods shall not be used as chemical storage areas.
4. Chemical inventories shall be kept to a minimum in working laboratories. These minimal inventories shall be stored in a safe manner using chemical safety cabinets for flammable chemicals and acid cabinets (or other appropriate storage such as secondary containment trays lined with clay adsorbent) for corrosives. Chemicals shall be segregated by chemical characteristics to avoid incompatibilities such as strong acids and bases stored adjacent to each other. For example ammonium hydroxide should not be stored adjacent to acetic acid or hydrochloric acid and concentrated nitric acid (an oxidizer) should not be stored adjacent to glacial acetic acid (a flammable). Alphabetical storage sequences are not adequate if chemical characteristics are ignored.
5. All chemical containers shall be kept closed when chemicals are not being withdrawn - or not being added, as in the case of hazardous waste accumulation containers. Empty chemical containers will be triple-rinsed prior to being discarded or recycled.

6. Adequate ventilation is essential for maintaining safe levels of exposure. It shall be the responsibility of the laboratory supervisor to not permit laboratory operations to continue if ventilation is judged to be inadequate for any reason such as equipment breakdown or accidental spillage.

7. No food or beverages may be stored in the laboratory. If the laboratory experiment involves food or beverages they must be clearly labelled “Not for human consumption” (or equivalent).

8. Special attention to experimental design and procedures must be in place for any work with carcinogens, teratogens, or chemicals which have the potential to become acute hazardous wastes. The chemicals falling in this class in our laboratories are listed in Appendix H. The laboratory supervisor, Appendix F, must approve any such experimental procedures. Typical design and procedures for such work require work practices and engineering controls to isolate such substances from the environment. Such practices could include additional protective clothing and shower facilities to facilitate personal hygiene. Engineering controls could include completely closed containment systems such as glove boxes.

9. Routine laboratory personal protective equipment must include protective eyewear except as indicated in Attachment 1 of Appendix A. Gloves should be worn for work with strong corrosives or with acutely toxic chemicals. As noted above, special procedures may require special protective equipment on a case by case basis. If such special procedures are routinely encountered in the laboratory, they will be described here along with the special protective equipment necessary for safe operations.

10. Eye wash stations and emergency drench showers are necessary to minimize exposures in the event of an emergency. Eye wash stations will be inspected regularly by facilities management which will maintain a record of these inspections. Emergency drench showers will be inspected regularly by facilities management with a record of these inspections kept in the Business Manager’s Office.

Maintenance of fume hoods and other protective equipment

1. Fume hoods will be inspected at a minimum of every twelve months by the Chemical Hygiene Officer. Hood face velocities will be determined by velometer readings taken over a grid across the open hood face. A record of these inspections will be maintained at the Chemistry Department Stockroom Manager’s Office (SHL 354). Improper use of fume hoods for chemical storage will be reported to the department Chemical Hygiene Officer for corrective action. Inadequate hood operation - face velocities less than 100 ft/min - will be reported to the department Chemical Hygiene Officer and to the facilities management. Hoods with inadequate face velocities will be prominently marked as not suitable for use until repaired.

2. Fire extinguisher inspections will be conducted a minimum of once a year by facilities management personnel. Any deficiencies of fire extinguishers in terms of number of extinguishers or locations of extinguishers will be brought to the attention of the facilities management by the laboratory supervisor or the Chemical Hygiene Officer. Any use of the extinguishers will be reported to the facilities management personnel.

3. Eyewash inspections shall be conducted monthly by facilities management. Safety showers shall be inspected biannually by the facilities management and results should be reported to the Chemistry Department Chemical Hygiene Officer and filed in the Business Manager’s Office.

4. Routine laboratory inspections will be conducted by the Chemical Hygiene Officer. These inspections will occur at a minimum of once a year. The schedule of all inspections, checklists, and reports will be kept in the Chemistry Stockroom Manager’s Office (SHL 354).

Enforcement of Chemical Hygiene Plan

The Chemical Hygiene Officer in consultation with the Department Chair and the Laboratory Supervisor shall have the authority to suspend laboratory operations - in part, or in the whole - if deficiencies in laboratory procedures or equipment pose a significant threat to the safety of the laboratory personnel or students. If suspension of laboratory operations is necessary, a written report will be filed with the Business Manager and with the Dean of the College within 24 hours. A copy of the report with a written description of remedial actions taken to allow resumption of operations will be available at the Chemistry Department Stockroom Manager’s Office (SHL 354).

Signs

Appropriate signs will be placed on laboratory doors/entryways, in laboratory areas, and in chemical storage areas. These signs will include:
1. "Safety Glasses Required" (or equivalent) on all entryways leading to laboratories or to chemical storage areas. Eyewear protection is required at all times in laboratories or chemical storage areas except where specifically exempted in operating procedures.

2. Chemical storage area and laboratory doors will be posted with the National Fire Protection Association (NFPA) standard warning poster. This poster will be accurately filled in with the appropriate hazard codes by the Chemical Hygiene Officer in consultation with the Laboratory Supervisor, Appendix F, and with the assistance of the local Fire Department.

3. All bottles or other containers of chemicals in laboratory areas will be labeled with the NFPA standard warning label so that the potential hazard is obvious. The labeling and maintenance of the labeling is the responsibility of the Stockroom Manager.

4. Internal laboratory signs will be posted to minimize inadvertent sink disposal of chemicals.

5. All hazardous waste accumulation containers in the laboratory will be labeled "Waste" with an additional label listing the chemicals present in the waste [with approximate concentration if possible]. In some teaching laboratory situations labels reading Chemistry xx, Experiment xx is satisfactory. The responsibility for accurately labeling and maintaining such labels is that of the Laboratory Supervisor, Appendix F, in consultation with the Chemical Hygiene Officer.

**Employee and student information and training**

Employees covered under this standard will be provided with information and training to inform them of the hazards of the chemicals present in their work areas. This training by the Chemical Hygiene Officer and the Stockroom Manager will be provided at the time of their initial assignment and prior to any new assignments involving different exposure situations.

Student laboratory assistants will be provided training prior to their supervision over other students. This training will be provided at the beginning of each semester by the Laboratory Supervisor, Appendix F.

Student research assistants will be provided training prior to assumption of duties by the research director, Appendix F.

Custodians who work in laboratory areas should be provided training under employee right to know laws. The responsibility for such training should be in the facilities management area. Communication between facilities management and the department should be facilitated by the Chemical Hygiene Officer.

Students will be provided training during initial laboratory sessions of each course. Such training will be incorporated in the described curriculum, documented via student signature on a training acknowledgement form, and occasionally tested on laboratory exercises.

Documentation of all employee training sessions will be maintained by the Chemical Hygiene Officer.

Training will include:

1. The contents of 1910.1450, the Laboratory Standard, and its appendices. A copy of this regulation is available on the World Wide Web (See Appendix I).

2. The contents, availability, and location of the Chemistry Department Chemical Hygiene Plan.

3. Information concerning the OSHA permissible exposure limits including discussion of the meaning of all terms, significance of exposure, and location of copies of the exposure limits. A copy of the limits can be obtained from the Chemical Hygiene Officer.

4. Signs and symptoms associated with exposure to hazardous chemicals in laboratories.

5. Location of reference materials including all Material Safety Data Sheets (MSDS) for chemicals in the laboratories. The MSDS will be stored at the Chemistry Stockroom. MSDS will be reviewed to assure that all employees are familiar with their contents and can use such sheets to obtain additional information as necessary.

6. Informing workers that methods to detect the presence or release of chemicals in their work areas are available. This information will include air quality monitoring information, odor thresholds, etc.

7. Information concerning the physical and health hazards of the chemicals in laboratory work areas.

8. Information regarding the inventory of chemicals in the laboratory. The inventory list will be maintained at the Chemistry Stockroom. A master inventory list will also be maintained at the Business Manager's Office.

9. Information regarding measures to protect employees from chemical hazards including specific work practices, standard operating procedures, emergency procedures, and personal protective equipment.

Outside contractors, or campus-supplied workers from such areas as Maintenance/Physical Plant, must be informed of the hazards to which they might be exposed while working in the laboratory environment. The responsibility for such information lies with facilities management. Communication between facilities management and the department should be facilitated by the Chemical Hygiene Officer or Department Head.

**Medical consultation and examination**
The Laboratory Standard mandates that employers provide medical attention, examinations, and follow-up examinations at the physician's discretion. The standard does not specify that a physician be named by the Chemical Hygiene Plan. It is strongly recommended that each campus designate a locally accessible physician for the medical consultation purposes of the plan. Ideally, this physician should be experienced in occupational health and familiar with the requirements of these regulations. The local physicians chosen for medical consultations are the Luther College campus physicians or designees. This medical attention, etc. is required under the following circumstances:

1. Whenever an employee develops signs and/or symptoms associated with a hazardous chemical to which they may have been exposed; or
2. Whenever exposure monitoring reveals an exposure level above the OSHA action level or exposure above the permissible exposure level for OSHA regulated substances; or
3. Whenever an event takes place in the work area such as a spill, leak, explosion, or other occurrence which results in the likelihood of a hazardous exposure. Such an occurrence requires an opportunity for medical consultation for the purpose of determining the need for a medical examination.

The Chemical Hygiene Officer and the Laboratory Supervisor shall provide the examining physician the following information:

1. Identity of the hazardous chemical to which the employee may have been exposed,
2. A description of the conditions of exposure including exposure date if available,
3. A description of the signs and symptoms of exposure, if any, that the employee is experiencing, and
4. A copy of the relevant MSDS.

The employer shall request a written opinion from the physician including:

1. Recommendations for future medical follow-up,
2. Results of examination and associated tests,
3. Any medical condition revealed which may place the employee at increased risk as the result of a chemical exposure, and
4. A statement that the employee has been informed by the physician of the results of the examination or consultation and told of any medical conditions that may require additional examination or treatment.

The material returned by the physician shall not include specific findings and/or diagnoses which are unrelated to occupational exposure.

The Chemical Hygiene Officer has the responsibility to maintain a file concerning any events and resultant medical examinations or consultations.
Appendix A: LABORATORY SAFETY MANUAL of the LUTHER COLLEGE CHEMISTRY DEPARTMENT

As a chemistry student, you will spend many hours in a chemical laboratory. Some experimental procedures, if not performed properly, can result in accidents or even injuries. This we and you must prevent.

When working in a laboratory, you must be aware that your health and safety are the responsibility of yourself and your laboratory supervisor. Thus you must understand and practice three very important concepts of laboratory safety:

* BE AWARE: Know the hazards inherent in the experiment before you begin;

* BE PREPARED: Answer the questions:
  1. What can go wrong?
  2. What must I do to be prepared?
  3. What are the proper practices, equipment, and facilities necessary to minimize the anticipated hazards?

* BE PROTECTED: Make health and safety an integral part of your activity.

To assist you in learning good health and safety habits, a list of safety rules and recommended good practice procedures plus reporting forms are included. We hope that you will enjoy your laboratory experience and that you will assist the Chemistry Department by insisting on good health and safety standards and practices.
A. PERSONAL PROTECTION & SAFETY
1. No solitary work by students is permitted in laboratories unless supervised by responsible faculty. Permission from the laboratory supervisor, coauthorized by the department chair, is required for after hours work.
2. Unattended operations and/or short term absences from the laboratory which might cause a problem require the approval of the laboratory supervisor. Provisions must be made for secondary containment of chemicals in the event of spillage or container breakage. A note must be left identifying the experimenter and back-up personnel.
3. Careful planning should precede all laboratory operations. A written procedure should be in place, reviewed and understood prior to starting any experiment.
4. Perform only the assigned experiments. Unauthorized experiments are strictly forbidden.
5. A serious working atmosphere needs to be maintained. Absolutely NO horseplay, fooling around or practical jokes will be allowed.
6. NO eating, drinking or smoking is permitted in any laboratory.
7. Consult your lab supervisor if you are unsure of the hazards or proper use of any reagent or piece of equipment.
8. Maintenance of a safe and clean work area (personal housekeeping) is the responsibility of each lab worker and lab supervisor. This may be enforced by the Department Head or the Chemical Hygiene Officer.
9. Hands should be washed before leaving the laboratory.

B. PROTECTIVE CLOTHING AND EQUIPMENT SAFETY
1. Approved eye protection must be worn at all times when working in the laboratory, as specified in the "Eye Protection Standards for the Department of Chemistry" (Appendix A, Attachment 1). The use of contact lenses (especially soft contacts) in the laboratory is not recommended because chemicals can become trapped in, absorbed by or caught behind the lens, promoting eye irritation or causing damage to the eye.
2. Face shields or safety shields should be used in laboratory operations which have the potential to result in fires or explosions or which utilize pressurized or vacuum operations. Prior authorization of the lab supervisor is required. Check the safety equipment (fire extinguishers, shields, safety showers, etc.) prior to such operations.
3. Protective gloves may be needed for some procedures. The type of glove selected should protect against the chemical that you are using, or against heat, cold, and sharp objects. Consult your lab supervisor.
4. Clothing worn in the laboratory should be comfortable and not restrict motion yet not so loose (esp. sleeves) as to catch on equipment. The flammability of the fabric should be considered.
5. Sturdy shoes that cover your feet should be worn.
6. Long hair should be tied back to keep it away from flames and chemicals.

C. CHEMICAL SAFETY
1. Let knowledge, caution and common sense add up to chemical safety.
   a. Assume any unfamiliar chemical is hazardous.
   b. Consider a mixture to be at least as hazardous as its most hazardous component.
   c. Do not use unlabeled chemicals.
   d. Never combine substances unless you have been explicitly instructed to do so.
   e. Follow all chemical safety instructions and procedures to the letter.
2. Chemical exposure can be minimized by careful use of chemicals and good housekeeping.
   a. Promptly clean up and properly dispose of small chemical spills, including water spills.
   b. Clean up your work area prior to leaving the laboratory.
   c. Wash hands, face, and arms thoroughly if contaminated and always wash before leaving the laboratory.
   d. Always wash before eating, drinking, smoking or applying make-up after working in a laboratory.
   e. Depending on the chemicals used, a shower after working may be wise.
   f. Personal clothing and protective equipment like lab coats should be laundered or cleaned regularly and immediately after contamination.
3. All chemical use should be preceded by a knowledge of the characteristics and potential hazards of the chemical. Treat all chemicals with respect. Know the hazards before you handle the material.
   a. Check your lab write-up for special hazards.
   b. Read the chemical labels very carefully to assure that you have the correct chemical. Read labels 3 times: when you pick it up; just before you use it; and after you are finished. Match name, formula and concentration on the label to lab directions.
   c. Read the container labels. Material Safety Data Sheets (MSDS) are available in SHL 390 (Chemistry Library). They will tell you: 1) any hazardous ingredients; 2) physical and chemical characteristics; 3) health hazards; 4) precautionary measures; 5) proper storage and handling procedures; 6) how to handle leak and spill cleanup and proper disposal; 7) first-aid procedures.
   d. Beware of poisons.
      1. Never taste a chemical.
Luther College Chemistry Department Chemical Hygiene Plan

2. Check odors only if instructed to do so, by gently wafting some of the vapor towards your nose with your hand over the open container top.
3. Pipetting by mouth is forbidden.
4. Laboratory fume hoods should be used for all operations which have the potential to release fumes, gases, or volatile solvent vapors in excess of recommended exposure levels.
e. Work with corrosive agents such as acids and bases should be conducted with particular care to avoid skin and eye contact. If you spill acid or base on yourself, rinse the affected area with lots of water. If the outside of a reagent bottle is contaminated, handle with gloves and rinse the bottle before using the reagent.
f. Report broken thermometers to the lab supervisor. The mercury must be cleaned up thoroughly by the laboratory supervisor to avoid contamination of the lab with poisonous mercury vapor.
g. Always add acid to water. Pour water and acid into the mixing container in the order of the spelling of "water." The "w" for water precedes the "a" for acid.
h. Remember that organic compounds, especially solvents, are very flammable. Think twice before lighting a Bunsen burner and verify that no flammable vapors are present.
i. If any chemical is splashed or spilled on your skin or body, immediately wash off the chemical and rinse for 15 minutes. Remove contaminated clothing immediately. Notify your lab supervisor.
j. Use of low temperature chemicals and operations require special procedures. Such operations require the prior approval of your lab supervisor.
k. Compressed gases should be used and stored as specified by Appendix A, Attachment 2.

4. Chemicals should be stored and dispensed properly.
a. Flammable liquids should be dispensed in containers complying with NFPA (National Fire Protection Association) and OSHA (U.S. Occupational Safety and Health Administration) codes, and storage should be in special cabinets also complying with NFPA and OSHA codes.
b. The shelf-life of some chemicals is prolonged by storage at a low temperature. The refrigerators and freezers used for chemical storage must be clearly marked as either "explosion-resistant" or "explosion-proof." Absolutely NO storage of food is permitted in chemical coolers.
c. Hoods should not be used for chemical storage; bottles sitting in a hood interfere with the proper air flow.
d. Never return unused reagents to the reagent bottle. Be careful to take only what you need. Do not contaminate reagents by exchanging caps or stoppers or by laying stoppers on the bench top. Contact your lab supervisor for proper disposal of excess reagent.
e. Do not insert pipets or droppers into the reagent bottle (unless pipet or dropper is labelled for exclusive use with particular reagent). Instead transfer a small amount into a beaker and dispense from there. Contact the lab supervisor for proper disposal of excess chemical.
f. Keep only the chemicals needed for the immediate experiment in the lab. All others should be returned to the stockroom.
g. Report any deterioration of a chemical or broken containers or caps to your lab supervisor.
h. All chemicals should be stoppered or capped at all times when not in immediate use. This includes hazardous waste.
i. Hazardous chemicals stored in breakable containers should be provided with secondary containment.
j. Do not store chemicals near heat, in sunlight, or near other substances with which they might react.
k. Do not store chemicals and equipment on benches. They should be put away each day, or at the minimum, placed at the very back of the bench top away from the countertop edge.
l. Store dangerous items like biologicals, radioactives, carcinogens, poisons, water reactive chemical, etc. in special cabinets designed for their safe storage. Warning labels must be on such chemicals and cabinets.
m. Dispense reagents at the side table. Do not take reagent bottles to your desk.
n. Do not place reagents directly on the balance pan. A weighing container must be used.
o. Body fluids used in experimental techniques or from accidents should be handled in special ways. Contact your lab supervisor and follow the procedures outlined in Attachment 3.

5. It is the responsibility of the lab supervisor and lab worker to discard or dispose of chemicals in an environmentally sound manner and to assist with inventory procedures for complying with the Chemical Hygiene Plan.
a. Absolutely NO chemicals or chemical materials are to be put down the drain or placed in the trash without prior authorization. Any sink/sewer or trash disposal of chemicals from the laboratory is the responsibility of the laboratory supervisor. Such disposal activity is appropriate only with the permission of the local sewage facility. Consult Appendices B & C of the Chemistry Department Chemical Hygiene Plan for a list of chemicals which may be disposed of in this manner.
b. Chemicals which have a limited shelf life—such as peroxidizable solvents, e.g. Diethyl Ether; such as chemicals which decompose upon storage to form potentially dangerous pressures, e.g. Formic Acid; such as chemicals which can become unstable upon storage, e.g. moist Picric Acid which can become explosive upon water evaporation—require special procedures. The chemicals used in our laboratory requiring such procedures are listed in Appendix H of the Chemical Hygiene Plan. These chemicals should be ordered on an as-needed basis in quantities no greater than anticipated for six month usage. Container sizes should be minimized. Containers will be dated upon receipt and upon opening.
c. The Stockroom Manager has responsibility for maintaining the current stockroom inventory list and the associated required Material Safety Data Sheets (MSDS). All chemicals are to be ordered through the Stockroom Manager. A minimum inventory of chemicals should be stored in individual laboratories.
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d. Hazardous waste minimization is a requirement under Environmental Protection Agency (EPA) regulations. All laboratory procedures should reflect minimization efforts. A strong recommendation is made to include hazardous waste minimization efforts in laboratory procedures. Efforts in this area may well be furthered by consultations with the Chemical Hygiene Officer. Some suggested areas for hazardous waste minimization are:

1. Inventory control is an excellent starting point for waste minimization. Inventory is required under separate sections of the Chemical Hygiene Plan.
2. The production of characteristic hazardous wastes containing heavy metal salts may be minimized by the precipitation from solution. These procedures are legal if incorporated into the experimental procedures as a final step. Sulfide or hydroxide formation followed by filtration may allow discarding a non-hazardous filtrate with retention of the precipitate as a significantly minimized hazardous waste.
3. The production of cyanide wastes may be minimized by the incorporation of an oxidation procedure as the final step of an experiment. Hypochlorous oxidation of cyanides is readily accomplished in a fume hood. The cyanate formed is typically neither a characteristic nor listed hazardous waste. Consult the Chemical Hygiene Officer for appropriate disposal of this type of waste. Elimination of cyanide wastes is the elimination of an acute class of hazardous wastes which furthers significant cost savings.
4. Appendix H contains a list of potential acute hazardous wastes which are currently inventoried by the Luther Chemistry Department. A minimal inventory of potential acute hazardous wastes should be maintained.
5. Elementary neutralization of simple corrosive solutions will minimize this category of hazardous wastes. pH adjustment to near neutral (pH = 6-9) may permit sewer disposal of the resulting non-hazardous salt solutions. This procedure is not appropriate if the resulting solution contains dissolved chemicals otherwise regulated as hazardous wastes. If neutralization results in a hazardous-waste-regulated sludge or precipitate, filtration may allow retention of a small volume of hazardous waste followed by sink/sewer disposal of non-hazardous filtrates. Such procedures should be incorporated into the experimental directions so that generation of hazardous waste from the experimental procedure is eliminated. Neutralization of wastes already collected and defined as hazardous by characteristic of corrosivity is independently regulated and requires consultation with the Chemical Hygiene Officer.

6. Other possibilities for hazardous waste minimization should be discussed with the Chemical Hygiene Officer.

e. All emptied chemical bottles are to be triply rinsed and returned to the stockroom for removal from inventory records and proper disposal.
f. Bottles used for refill of solvents or stock solutions should be returned to the stockroom for refill but should NOT be rinsed.
g. NEVER take chemicals out of the laboratory without the knowledge and consent of your laboratory supervisor.
h. Carcinogens and mercury present special hazards and require special procedures. Inventoried carcinogens are listed in Appendix H.

D. EQUIPMENT AND GLASSWARE SAFETY

1. Beware of broken glass. Do not use damaged, cracked or broken glassware. Fire polish any chipped edges on beakers, test tubes, stirring rods, etc. or replace with a new item.
2. Dispose of broken glassware and dangerous items such as syringes in special containers as directed by your laboratory supervisor. Do not place in the regular trash. These items should be as clean as possible of chemical contamination before disposal.
3. Wrap evacuated glass containers to protect against implosion.
4. Broken glass cuts deeply. When inserting thermometers or glass tubing into stoppers or corks, lubricate them with water or glycerine and twist, using short strokes and minimum pressure. Covering the thermometer or tubing with a towel protects hands and fingers from injury in case the article being inserted breaks.
5. Treat a test tube as you would a gun. Never point a test tube at anyone, especially when it is being heated. Never look down into a test tube or flask in which an experiment is being conducted.
6. Be careful with Bunsen burners, hot plates, hot plate-stirrers and other hot objects.
7. Use carts, trays, boxes or other containers to transport materials between the stockroom and labs or between labs.
8. Do not store equipment, backpacks, coats, chemicals or other materials on the floor or in other places where laboratory workers can trip or knock over the item, or in places that would block fire exits.
9. Electrical equipment always means the chance of shock or fire. Do not touch with wet hands or while standing on a wet floor. Report any shocks and defective equipment to your laboratory supervisor using the Safety Maintenance Report form included as Appendix A, Attachment 4. Do not attempt to repair the equipment yourself. All electrical powered equipment should be wired with safety ground and 3-prong plugs. Extension cords are not appropriate. The Safety Maintenance Reports will be filed by the Chemical Hygiene Officer.
10. Be especially careful around equipment with moving parts. These items can catch your clothing or open up suddenly, showering you with dangerous material.
11. Never take equipment or glassware out of the Chemistry Department without the consent of your laboratory supervisor.
12. Before leaving the laboratory, clean up your equipment and lab area and put away all equipment. Assure that all gas and water valves have been turned off. Return borrowed equipment to the stockroom.

**E. EMERGENCY PROCEDURES AND REPORTING**

1. It is the responsibility of the lab supervisor to communicate the hazards of working with chemicals in the laboratory; to train students on the proper use and disposal of chemicals; to make this written policy readily available to lab students; and to keep a written record of lab student training. This will be accomplished by providing special notes in the laboratory manuals and experimental write-ups highlighting the dangers, demonstrating proper techniques, and directing the student in proper disposal of all chemicals; by directing the student to the MSDS provided in the Stockroom; by requiring the student to sign-off on a sheet, included as Appendix A, Attachment 6, indicating training has been provided; and by testing the student through quizzes, tests, homework assignments and lab reports on safety and health issues.

2. It is the responsibility of the student to follow directions, to pay close attention to labeling and MSDS information and to ask questions about use, technique or disposal when he/she has any doubt as to proper procedure. There are NO dumb safety questions.

3. Be sure that you know the location and proper use of:
   - Eye Wash Fountain
   - Fire Blanket
   - Safety Shower
   - First Aid Kit & Supplies
   - Fire Extinguisher
   - Emergency Exits
   - First Aid Manual
   - Emergency Phone #’s
   - Accident Report Forms
   - Nearest Phone
   - Chemical Hygiene Plan
   - Material Safety Data Sheets

4. Report any accidents, injuries or close calls to the lab supervisor immediately. Even minor injuries should be reported to insure appropriate treatment. Health Service can better treat cuts, burns, or inhalation of fumes. The laboratory supervisor can arrange transportation, if needed. The laboratory supervisor is responsible for filling out the Accident Report form, included as Attachment 5, and giving the form to the Chemical Hygiene Officer. The Chemical Hygiene Officer will distribute copies to the appropriate persons and will file the forms in the Chemistry Department Stockroom Manager’s Office (SHL 354).

5. Treat burns immediately by placing the burned area under cold water for at least 15 minutes. Cold water markedly reduces the subsequent pain and blisters.

6. Treat chemical spills to the body by flushing the contaminated area for 15 minutes with water. Remove contaminated clothing immediately.

7. Clean up any spilled reagents immediately, especially near the balances or reagent shelf. Acid or base spills must be cleaned up thoroughly and the affected area rinsed with water. For larger spills, use the solid sodium bicarbonate, NaHCO₃, provided to neutralize the spill, then clean-up thoroughly, take the NaHCO₃ bottle to the stockroom for refill for future clean-ups. Custodians are not trained for chemical spill clean-up; this is the responsibility of the lab students and lab supervisor.

8. Report any allergies to your lab supervisor.

9. If you are overexposed to a hazardous substance, inform your laboratory supervisor and get medical attention. Some general guidelines that are appropriate for most chemicals are included below:
   - **EYES:** Flush with water for 15 minutes
   - **INGESTION:** Follow the label and MSDS instructions
   - **SKIN CONTACT:** Stand under the emergency shower and remove contaminated clothing immediately for major spills. For minor spills, flush with water for 15 minutes and remove contaminated clothing.
   - **INHALATION:** Get to fresh air and get prompt medical attention

10. All larger chemical spills, accidents, fires, explosions, chemical exposure, etc. must be reported immediately to the Business Manager. See the reporting forms, Attachment 5.

11. Emergency shut-off locations for gas and other utilities shall be documented and clearly marked by facilities management.

12. If self-contained breathing apparatus, or respirators, are required for an emergency, the Decorah Fire Department will be called for such services.

13. Safety inspections, under the direction of the Chemical Hygiene Officer, will be conducted at least once per year and should be while the lab is in session. It will be the responsibility of the Chemical Hygiene Officer and the Chemistry Department Chairman to assure that any remediation recommended by the safety inspection team is completed.

14. A list of emergency phone numbers will be maintained at each department telephone. The Chemical Hygiene Officer has responsibility to maintain this list.
THE TEN COMMANDMENTS OF LABORATORY SAFETY*

1. Think in terms of Safe Practice continually.
2. Be familiar with every step of the job you are going to do.
3. Check each apparatus item and chemical at least twice before proceeding.
4. Maintain an awareness of the danger in handling chemicals.
5. Remember that the safe way to accomplish any job is the best way.
6. Guard your co-workers' safety and your own.
7. Prepare your counter-attack against possible accidents by forethought.
8. Act promptly and coolly when confronted with an emergency.
9. Suggest a safe practice immediately when you see the need for one.
10. Be certain your laboratory has safety equipment.

*REPRINTED from the Fisher Manual of Laboratory Safety.
Attachment 1: EYE PROTECTION STANDARDS FOR THE DEPARTMENT OF CHEMISTRY

I. Routine Hazards

All employees, visitors, and students must wear approved eye protection while in chemistry laboratories except as provided below in Section III. Approved eye protection includes the following:

1. Safety goggles that give full eye coverage.
2. For visitors only, plastic safety glasses with side shields.

The use of contact lenses in the laboratory is not recommended.

II. Special Hazards

Experiments that involve special hazards such as concentrated acids or bases, systems under high pressure, sodium fusions, etc., shall be conducted with extra precautions. The laboratory supervisor may require extra eye protection such as face shields, and may also require that the experiment be conducted in a hood with a safety window.

III. Low Risk Conditions

Eye protection will not normally be required in the following situations:
1. NMR room (SHL 355);
2. Instructional laboratories during a lecture presentation or quiz, or during a "nonchemical situation" such as a model building experiment;
3. The use of special instruments such as refractometers, polarimeters, etc., that require direct eye reading.
   However, proper eye protection must be worn when not actually involved in the readings.

IV. Chemistry Stockroom Personnel

Eye protection is required during solution preparation activities, transferring liquids between containers, when handling hazardous materials, and in general when a splash hazard is present.

V. Availability of Eye Protection

Students are required to have their own acceptable eye protection by the second laboratory period. Safety glasses or goggles can be checked out of the stockroom for the use of visitors, and in emergencies as determined by the instructor. Eye protection is available for purchase in the college bookstore.
Attachment 2: SAFETY POLICY REGARDING HANDLING OF COMPRESSED GAS CYLINDERS

1. Compressed gas cylinders must be securely strapped to a bench-top or wall at all times, except when being moved.
2. Whenever a gas cylinder is moved, the regulator must be removed and the protective cap must be in place.
3. If a cylinder is moved more than a few feet, a cylinder cart must be used, with the cylinder strapped down and the protective cap in place.
Attachment 3: SAFETY POLICY FOR BODY FLUIDS

A. Education
   1. Chemistry faculty responsible for courses or involved in research using body fluids are provided informational literature on handling and disposal precautions and procedures.
   2. Students are informed of the precautions and risks.

B. Precautions
   1. All control materials, patient samples, or accidental spills are assumed to be potentially infective.
   2. Mechanical pipetting devices are used for the manipulation of all liquids.
   3. Hoods and/or containment devices such as centrifuge safety caps are used whenever procedures are conducted that have a high potential for creating aerosols or infectious droplets. These include centrifuging, blending, sonicating and vigorous mixing.
   4. All students should wash their hands following completion of laboratory activity.
   5. No human body fluid samples will be used.

C. Disposal/Decontamination
   1. Glassware (e.g. beakers and graduated cylinders) used in collecting and processing of saliva are soaked for 10-15 minutes in freshly prepared 10% bleach (1:10 dilution of household bleach), washed and reused.
   2. Laboratory table surfaces, either contaminated or possibly contaminated, are cleaned with an appropriate disinfectant.
   3. Gloves are provided for glassware cleaning and decontamination.
   4. Solutions containing blood products are placed in a container made to 10% final concentration of bleach and stored overnight before disposal.
   5. The Laboratory Supervisor will be responsible for the autoclaving or proper disposal of all potentially-infectious waste.
Attachment 4: SAFETY MAINTENANCE REQUEST FORM

Please indicate within one week what corrective action will be taken

PROBLEM ___________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

LOCATION ________________________

REPORTED BY ________________________________________________________

COPY TO:
FACILITIES MANAGEMENT _____ DEPARTMENT HEAD _____ CHEMICAL HYGIENE OFFICER _____
Attachment 5: ACCIDENT REPORT FORM

Area or Room Number _______  Supervisor ___________________ Date ______________ Time __________

Person(s) Directly Involved ______________________________________________________________

DESCRIPTION OF ACCIDENT:

ACTION TAKEN:

APPARENT CAUSE OF ACCIDENT:

RECOMMENDATIONS:

copy to: Lab supervisor
        Department Head
        Chemical Hygiene Officer
        Person(s) involved

Signatures: Lab Supervisor _______________________________
           Person(s) involved _____________________________
           Witness ______________________________________
Each supervisor is responsible for discussing the following safety topics with new employees as part of their first day at work.

1. The Chemistry Department Chemical Hygiene Plan
2. The Laboratory Safety Manual
3. Emergency Procedures
4. Reference Materials
5. Safety practices and procedures & personal protective equipment (eye protection, etc.)
6. Accident reporting
7. The laws: OSHA, EPA, State regulations
8. Proper disposition of wastes
9. The employee’s responsibility for safety
10. Labeling
11. MSDS
12. Stockroom-specific training (Meeker-Gast)
13. Laboratory-specific training (Ebert, Ovans)

The topics listed above were discussed as part of conducting the New Employee Safety Training.

<table>
<thead>
<tr>
<th>Employee’s signature:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Employee’s printed name:</th>
<th>XXXXXXXXXXXXXXXXXXXXX</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Supervisor’s signature:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix B: Chemicals Approved for Sewer Disposal

This appendix is appropriate only if a written list of chemicals has been submitted to the local sewer treatment plant for their review and approval. A copy of the written list and letter requesting review must be on file in the same storage location as the written Chemical Hygiene Plan along with the written response from the sewer plant. Due to changing regulations under the Clean Water Act, the written list should be resubmitted annually to the sewer plant for their renewed authorization. The responsibility for such submittal is with the Business Manager.

The list of chemicals in Appendix C was submitted to the Decorah sewer treatment plant. This list is for reference only and should not be construed as approval to sewer.

Policy for chemical disposal via the sanitary sewer system.

Sewage treatment plants are under increasingly strict regulations regarding allowable discharge concentrations of pollutants. Compliance is achievable only by restricting the concentrations allowed to enter the sewer system.

Existing local regulations (Decorah) follow EPA guidelines and prohibit the discharge of the following specific pollutants at concentrations above the specified levels:

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Limit (mg/L)</th>
<th>Constituent</th>
<th>Limit (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>5.0</td>
<td>Hexachlorobenzene</td>
<td>0.13</td>
</tr>
<tr>
<td>Barium</td>
<td>100.0</td>
<td>Hexachloro-1,3-butadiene</td>
<td>0.5</td>
</tr>
<tr>
<td>Benzene</td>
<td>0.5</td>
<td>Hexachloroethane</td>
<td>3.0</td>
</tr>
<tr>
<td>Cadmium</td>
<td>1.0</td>
<td>Lead</td>
<td>5.0</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>0.5</td>
<td>Mercury</td>
<td>0.2</td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td>100.0</td>
<td>Methyl Ethyl Ketone</td>
<td>200.0</td>
</tr>
<tr>
<td>Chloroform</td>
<td>6.0</td>
<td>Nitrobenzene</td>
<td>100.0</td>
</tr>
<tr>
<td>Chromium</td>
<td>5.0</td>
<td>Pentachlorophenol</td>
<td>100.0</td>
</tr>
<tr>
<td>o-Cresol</td>
<td>200.04</td>
<td>Pyridine</td>
<td>5.0</td>
</tr>
<tr>
<td>m-Cresol</td>
<td>200.0</td>
<td>Selenium</td>
<td>1.0</td>
</tr>
<tr>
<td>p-Cresol</td>
<td>200.0</td>
<td>Silver</td>
<td>5.0</td>
</tr>
<tr>
<td>Cresol</td>
<td>200.0</td>
<td>Tetrachloroethylene</td>
<td>0.7</td>
</tr>
<tr>
<td>1,4-Dichlorobenzene</td>
<td>7.5</td>
<td>Trichloroethylene</td>
<td>0.5</td>
</tr>
<tr>
<td>1,2-Dichloroethane</td>
<td>0.5</td>
<td>2,4,5-Trichlorophenol</td>
<td>400.0</td>
</tr>
<tr>
<td>1,1-Dichloroethylene</td>
<td>0.7</td>
<td>2,4,6-Trichlorophenol</td>
<td>2.0</td>
</tr>
<tr>
<td>2,4-Dinitrotoluene</td>
<td>0.13</td>
<td>Vinyl Chloride</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Aqueous solution must be within a pH range of 6.0 < pH < 9.0 prior to discharge.

Radioactive wastes must be below concentrations set by reference to state or federal regulations. Total discharge limits also apply. The applicable federal regulation is 10 CFR 20, which sets limits:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Concentration limit (uCi/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-3</td>
<td>100.0</td>
</tr>
<tr>
<td>C-14</td>
<td>20.0</td>
</tr>
<tr>
<td>P-32</td>
<td>0.5</td>
</tr>
<tr>
<td>S-35</td>
<td>2.0</td>
</tr>
<tr>
<td>Ca-45</td>
<td>0.3</td>
</tr>
<tr>
<td>Cr-51</td>
<td>50.0</td>
</tr>
<tr>
<td>I-125</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Dilution with potable water is specifically prohibited by local ordinance to achieve acceptable pollutant concentration levels.

Specifically excluded from the sewer system are gasoline, benzene, naphtha, fuel oil, or other flammable or explosive fluids or solids. Flammable liquids, defined as those with closed cup flash point less than 100 deg F, should be excluded from the sewer. All flammable solids or explosives should be excluded from the sewer. Ethylene glycol - antifreeze - should be excluded from the sewer.

Any substance with a LD50, oral-rat toxicity between 0-500 mg/kg should be excluded from the sewer. Liquids containing or causing suspended solids, strongly colored solutions, liquids above 150 deg F (65.5 deg C), or those significantly increasing chemical oxygen demand should be excluded from the sewer.
Materials which may be safely disposed of in the sewer
1) Dilute, <20%, aqueous solutions of chemicals suitable for disposal via the normal trash. (See attached list.)
2) Dilute, <20%, aqueous solutions of potassium chlorate or sodium chlorate.
3) Dilute, <20%, aqueous solutions of
   - acetone
   - allyl alcohol
   - ethanol
   - glycerine
   - methanol
   - propanol
Appendix C: Chemicals Approved for Sanitary Landfill Disposal

This appendix is appropriate only if a written list of chemicals has been submitted to the local sanitary landfill for their review and approval. A copy of the written list and letter requesting review must be on file in the same storage location as the written Chemical Hygiene Plan along with the written response from the sanitary landfill. Due to changing regulations, the written list should be resubmitted annually to the sanitary landfill for their renewed authorization. The responsibility for such submittal is with the Business Manager's Office.

Following is a list of chemicals which was submitted to the Decorah sanitary landfill for their approval. This list is for reference only and should not be construed as approval to landfill dispose.

**Chemicals for the normal trash**

Many solid chemicals may be safely disposed via the normal trash if the containers are tightly capped and of good integrity. Examples are given on the following list. If disposal is intended of more than five pounds of any one of these chemicals, contact the Chemical Hygiene Officer for further evaluation.

---

**A**

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Chemical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acid, Ascorbic</td>
<td>Acid, Benzoic</td>
</tr>
<tr>
<td>Acid, Boric</td>
<td>Acid, Casamind</td>
</tr>
<tr>
<td>Acid, Citric</td>
<td>Acid, Lactic</td>
</tr>
<tr>
<td>Acid, Oleic</td>
<td>Acid, Phosphotungstic</td>
</tr>
<tr>
<td>Acid, Phthalic</td>
<td>Acid, Salicylic</td>
</tr>
<tr>
<td>Acid, Silicic</td>
<td>Acid, Stearic</td>
</tr>
<tr>
<td>Acid Succinic</td>
<td>Acid, Tartaric</td>
</tr>
<tr>
<td>Agar</td>
<td>Albumen</td>
</tr>
<tr>
<td>Aluminum Hydroxide</td>
<td>Aluminum Metal</td>
</tr>
<tr>
<td>Aluminum Oxide</td>
<td>Amino acids, alpha and salts (naturally occurring)</td>
</tr>
<tr>
<td>Ammonium Bicarbonate</td>
<td>Ammonium Carbonate</td>
</tr>
<tr>
<td>Ammonium Chloride</td>
<td>Ammonium Citrate</td>
</tr>
<tr>
<td>Ammonium Lactate</td>
<td>Ammonium Phosphate</td>
</tr>
<tr>
<td>Ammonium Sulfate</td>
<td>Ammonium Sulfamate</td>
</tr>
</tbody>
</table>

---

**B**

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Chemical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barium Carbonate</td>
<td>Barium Sulfate</td>
</tr>
<tr>
<td>Beef Extract</td>
<td>Buffer Solution</td>
</tr>
</tbody>
</table>

---

**C**

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Chemical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium Borate</td>
<td>Calcium Chloride</td>
</tr>
<tr>
<td>Calcium Carbonate</td>
<td>Calcium Floride</td>
</tr>
<tr>
<td>Calcium Citrate</td>
<td>Calcium Oxide</td>
</tr>
<tr>
<td>Calcium Lactate</td>
<td>Calcium Sulfate</td>
</tr>
<tr>
<td>Calcium Phosphate</td>
<td>Charcoal, Animal</td>
</tr>
<tr>
<td>Cerelose, Dextrose</td>
<td>Chromatographic absorbent</td>
</tr>
<tr>
<td>Cobalt Oxide</td>
<td>Copper Oxide</td>
</tr>
</tbody>
</table>

---

**D, E, F, G**

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Chemical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dextrose</td>
<td>Drierite</td>
</tr>
<tr>
<td>Extract, Malt</td>
<td>Extract, Yeast</td>
</tr>
<tr>
<td>Ferrous Ammonium Sulfate</td>
<td>Ferric Sulfate</td>
</tr>
<tr>
<td>Gelatin</td>
<td>Galactose</td>
</tr>
<tr>
<td>Gum, Arabic</td>
<td>Graphite</td>
</tr>
</tbody>
</table>
Luther College Chemistry Department Chemical Hygiene Plan

H, I, K, L --

Hematoxylin
Kaolin
Lithium Carbonate
Lithium Sulfate

Iron Oxide
Lactose
Lithium Chloride
Litmus, Mild

-- M --

Magnesium Borate
Magnesium Carbonate
Magnesium Chloride
Magnesium Lactate
Magnesium Phosphate
Maltose
Manganese Oxide
Methyl Salicylate

Magnesium Citrate
Magnesium Oxide
Magnesium Sulfate
Manganese Acetate
Manganese Dioxide
Manganese Chloride
Manganese Sulfate

-- P --

Paraffin
Peptone
Potassium Acetate
Potassium Bisulfate
Potassium Borate
Potassium Bromide
Potassium Chloride
Potassium Lactate
Potassium Phosphate
Potassium Sulfate
Potassium Sulfocyanate

Pepsin
Petroleum Jelly
Potassium Bicarbonate
Potassium Bitartrate
Potassium Bromate
Potassium Carbonate
Potassium Citrate
Potassium Iodide
Potassium Sodium Tartrate
Potassium Sulfate
Pumice

-- S --

SDS (Sodium Dodecyl Sulfate)
Sodium Ammonium Phosphate
Sodium Bicarbonate
Sodium Bisulfite
Sodium Bromide
Sodium Chloride
Sodium Formate
Sodium Lactate
Sodium Phosphate
Sodium Silicate
Sodium Sulfate
Sodium Tartrate
Sodium Thiosulfate
Starch
Strontium Phosphate
Sucrose
Sugars

Sodium Acetate
Sodium Benzoate
Sodium Bisulfate
Sodium Borate
Sodium Carbonate
Sodium Citrate
Sodium Iodide
Sodium Phosphate
Sodium Salicylate
Sodium Succinate
Sodium Sulfate
Sodium Thioglycollate
Sodium Tungstate
Strontium Carbonate
Strontium Sulfate
Sulfur
Sugar Alcohols

-- T, U, W, Z --

Talcum Powder
Tin Metal
Trypticase
Urea

Thymol
Tin Oxide
Tryptone
Appendix D: Peroxidizable Chemicals

List A: May form peroxides simply on storage after air exposure. Concentration by evaporation is not required for hazardous concentrations to develop.

List B: Peroxide-forming solvents which are typically not hazardous until concentrated.

List C: Monomers which may undergo explosive polymerization following peroxide formation.

<table>
<thead>
<tr>
<th>List A</th>
<th>List B</th>
<th>List C</th>
</tr>
</thead>
<tbody>
<tr>
<td>(12 months)</td>
<td>(18 months)</td>
<td>(18 months)</td>
</tr>
<tr>
<td>Diethyl ether</td>
<td>Acetal</td>
<td>Styrene</td>
</tr>
<tr>
<td>Isopropyl ether</td>
<td>Dioxane</td>
<td>Butadiene</td>
</tr>
<tr>
<td>Divinyl acetylene</td>
<td>Tetrahydrofuran</td>
<td>Tetrafluoroethylene</td>
</tr>
<tr>
<td>Vinylidene chloride</td>
<td>Vinyl ethers</td>
<td>Clorotrifluoroethylene</td>
</tr>
<tr>
<td>Ethylene glycol, Di-</td>
<td>Vinyl acetylene</td>
<td></td>
</tr>
<tr>
<td>Methyl ether (Glyme)</td>
<td>Vinyl acetate</td>
<td></td>
</tr>
<tr>
<td>Dicyclopentadiene</td>
<td>Vinyl chloride</td>
<td></td>
</tr>
<tr>
<td>Diacetylene</td>
<td>Vinyl pyridine</td>
<td></td>
</tr>
<tr>
<td>Methyl acetylene</td>
<td>Chlorobutadiene (Chloroprene)</td>
<td></td>
</tr>
<tr>
<td>Cumene</td>
<td>Methylcyclopentane</td>
<td></td>
</tr>
<tr>
<td>Tetrahydronaphthalene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyclohexene</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sodium and - especially - potassium metal are susceptible to peroxide formation; use 18 month limit.

1. Order only in small containers and only for anticipated next six months use.
2. Date containers upon receipt and upon opening.
4. Do not store if opened longer than limits listed.
5. Dispose of properly and promptly.
Appendix E: Air Quality Monitoring Procedures

BACKGROUND:

The language of the standard requires air quality monitoring "if there is any reason to believe that exposure levels for that substance routinely exceed the action level (or in the absence of an action level, the PEL)."

In a laboratory environment it is not expected that PEL's would be exceeded. The reason for this is that a PEL is a time-weighted average, and laboratory exposures are typically of short duration. This is certainly true of teaching laboratories in the college environment, and it is generally true for college research laboratories. PEL's are more likely to be exceeded if the following conditions exist:

1. The laboratory has defective ventilation.
2. Laboratory personnel spend longer periods of time in the laboratory while conducting operations which continuously release vapors or gases.
3. Accidental spills or releases of volatile chemicals or gases.

Excursion limits are recommended for short term exposures governed under PEL guidelines. Excursion limits are defined as exposures above the PEL for periods not to exceed three times the PEL, never to exceed five times the PEL, not to total more than 30 minutes, and never to exceed the eight hour time-weighted PEL.

Many of the hazardous chemicals listed by the Occupational Safety and Health Administration have Short Term Exposure Levels (STEL's) or Ceiling Levels (C). These short term levels or ceiling levels are more likely to be exceeded than are the time-weighted averages. A STEL is a 15-minute time-weighted average level which should not be exceeded at any time during the work day even if the eight-hour time-weighted average is within the guidelines. Exposures at the STEL should be no longer than 15 minutes and should not be repeated more than four times a day. A minimum of 60 minutes should elapse between successive exposures at the STEL. Ceiling exposures are those which should never be exceeded.

Some listed substances also have a "skin" notation. "Skin" refers to potential contribution to systemic exposure by cutaneous routes including mucous membrane and eye contact. Exposure may be by airborne or, more particularly, by direct contact.

In a laboratory environment particular attention should be paid to chemical exposures bearing STEL and "skin" contact notations. Such limitations are more likely to be exceeded than are PEL's.

PROCEDURES:

Air quality monitoring is a specific science and art unto itself. Such monitoring should only be conducted by personnel trained in the proper usage and limitations of the equipment. If litigation is anticipated, such monitoring should be conducted under the direction of a Certified Industrial Hygienist (CIH) using specialized equipment. In a college laboratory environment, air quality monitoring may be conducted by qualified individuals using a screening technique which employs indicator tubes. Indicator tubes are commercially available for a great variety of common contaminants. The tubes provide a cost-effective method of standard compliance. They are adsorbent tubes through which a specified volume of air may be drawn using an appropriate pump. An indicator dye stain is developed if the particular target contaminant is present. The length of the stain is directly related to the concentration of the contaminant. Accuracy is typically ± 25 percent.

Screening samples should always be drawn from the breathing zone of exposed personnel. Specific directions for the particular target contaminant must be reviewed prior to sampling. The directions and sample volumes will vary depending on the tube manufacturer and target contaminant.

It is recommended that some routine, background monitoring be conducted in laboratories. This procedure will document "normal" exposure levels and should provide a liability cushion against future potential claims of exposure. Priority should be given to large teaching laboratories where large numbers of students are simultaneously conducting similar experiments. Other priorities include laboratories where existing ventilation is judged to be inadequate by the laboratory supervisor, research laboratories which are occupied for long periods of time, any laboratory where indications of high exposures such as significant odors or spills are noted.

A minimum of two samples should be obtained during any sampling period. Three or four samples are recommended if significant levels are observed. The results of the sampling procedure should be logged into a permanent record to be maintained at the same location as the appropriate Chemical Hygiene Plan. Under 29 CFR 1910.1450 (d) (4) employees must be notified of monitoring results either individually in writing or by posting the information in an appropriate location accessible to the employees. This notification is required within 15 working days of the receipt of results.

For the purposes of air quality screening a contaminant level somewhat lower than the appropriate PEL should be used as a guideline. Since the indicator tube results have an accuracy of approximately ± 25 percent, a level of 50 percent of the PEL - or STEL or Ceiling - is suggested as a guideline. If monitoring indicates contaminants above 50 percent of the limit, additional monitoring is recommended under the guidance of a CIH. Levels above 75 percent of the limit require corrective action such as procedural modification or ventilation improvement prior to continuation of laboratory activities.

If the indicator tube accuracy is different than ± 25 percent the above guidelines may be appropriately modified. The point is to use the indicator tubes as a screening device, not as an absolute measurement.
If significant levels of contaminants are observed under initial or background sampling procedures, periodic, continuing sampling is required until results demonstrate that corrective actions have mitigated the problem.

SUGGESTED TARGET CHEMICALS:
A survey of several chemistry departments has led to the development of a list of common chemicals for which air-quality monitoring may be appropriate. This list is furnished for reference purposes.

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>Range (ppm)</th>
<th>PEL* (ppm)</th>
<th>STEL# (ppm)</th>
<th>Skin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone</td>
<td>100-12,000</td>
<td>750</td>
<td>1000</td>
<td>No</td>
</tr>
<tr>
<td>Acrylonitrile</td>
<td>0.5-20</td>
<td>2</td>
<td>10 (C)</td>
<td>Yes</td>
</tr>
<tr>
<td>Ammonia</td>
<td>2-30</td>
<td>25</td>
<td>35</td>
<td>No</td>
</tr>
<tr>
<td>Benzene</td>
<td>0.5-10</td>
<td>1</td>
<td>5</td>
<td>No</td>
</tr>
<tr>
<td>Carbon tetrachloride</td>
<td>1-15</td>
<td>2</td>
<td>2</td>
<td>No</td>
</tr>
<tr>
<td>Chlorine</td>
<td>0.3-5</td>
<td>0.5</td>
<td>1</td>
<td>No</td>
</tr>
<tr>
<td>Chloroform</td>
<td>2-10</td>
<td>2</td>
<td>2</td>
<td>No</td>
</tr>
<tr>
<td>Cyclohexane</td>
<td>100-1500</td>
<td>300</td>
<td>NA</td>
<td>No</td>
</tr>
<tr>
<td>Diethyl ether</td>
<td>100-4000</td>
<td>400</td>
<td>500</td>
<td>No</td>
</tr>
<tr>
<td>Ethyl acetate</td>
<td>200-3000</td>
<td>400</td>
<td>NA</td>
<td>No</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>0.2-5²⁵</td>
<td>1</td>
<td>2</td>
<td>No</td>
</tr>
<tr>
<td>Hydrochloric acid</td>
<td>0.4-25</td>
<td>NA</td>
<td>5 (C)</td>
<td>No</td>
</tr>
<tr>
<td>Hydrogen sulfide</td>
<td>0.5-75</td>
<td>10</td>
<td>15</td>
<td>No</td>
</tr>
<tr>
<td>Methyl alcohol</td>
<td>50-3000</td>
<td>200</td>
<td>250</td>
<td>No</td>
</tr>
<tr>
<td>Methylene chloride</td>
<td>50-2000</td>
<td>500</td>
<td>1000</td>
<td>No</td>
</tr>
<tr>
<td>Nitric acid</td>
<td>1-50</td>
<td>2</td>
<td>4</td>
<td>No</td>
</tr>
<tr>
<td>Ozone</td>
<td>0.05-1.4</td>
<td>0.1</td>
<td>0.3</td>
<td>No</td>
</tr>
<tr>
<td>n-Pentane</td>
<td>100-1500</td>
<td>600</td>
<td>750</td>
<td>No</td>
</tr>
<tr>
<td>n-Propanol</td>
<td>100-3000</td>
<td>200</td>
<td>250</td>
<td>Yes</td>
</tr>
<tr>
<td>Sulfur dioxide</td>
<td>0.1-3</td>
<td>2</td>
<td>5</td>
<td>No</td>
</tr>
<tr>
<td>Toluene</td>
<td>5-400</td>
<td>100</td>
<td>150</td>
<td>No</td>
</tr>
</tbody>
</table>

* Where applicable, the American Conference of Governmental Industrial Hygienists limits known as Threshold Limit Values are given. All values taken from the "Guide to Occupational Exposure Values-1990," published by the American Conference of Governmental Industrial Hygienists.

# Where applicable ceiling levels are given and marked (C). Where applicable the National Institute for Occupational Safety and Health limits known as Recommended Exposure Limits are used. All values taken from the "Guide to Occupational Exposure Values-1990," published by the American Conference of Governmental Industrial Hygienists.
## Appendix F: Laboratory Supervisor List
2014-2015

<table>
<thead>
<tr>
<th>Room (SHL unless otherwise indicated)</th>
<th>Use</th>
<th>Supervisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>336</td>
<td>research</td>
<td>Michels</td>
</tr>
<tr>
<td>335</td>
<td>Teaching &amp; research</td>
<td>Mottley, Hedstrom, specific research supervisor</td>
</tr>
<tr>
<td>334</td>
<td>Teaching &amp; research</td>
<td>Mottley, Hedstrom, specific research supervisor</td>
</tr>
<tr>
<td>333</td>
<td>Teaching &amp; research</td>
<td>Hedstrom, specific research supervisor</td>
</tr>
<tr>
<td>332</td>
<td>Special projects &amp; research</td>
<td>specific research supervisor</td>
</tr>
<tr>
<td>331</td>
<td>Teaching</td>
<td>Mottley, Hedstrom</td>
</tr>
<tr>
<td>372</td>
<td>Teaching</td>
<td>Winsauer, Jefferson, Zapiter, Mertzenich</td>
</tr>
<tr>
<td>353</td>
<td>Stockroom</td>
<td>Meeker-Gast</td>
</tr>
<tr>
<td>355</td>
<td>Teaching, research</td>
<td>All chem. dept faculty</td>
</tr>
<tr>
<td>373</td>
<td>Teaching, research</td>
<td>Hedstrom, specific research supervisor</td>
</tr>
<tr>
<td>356</td>
<td>Teaching, research</td>
<td>Hedstrom, Mottley</td>
</tr>
<tr>
<td>357</td>
<td>Teaching</td>
<td>Michels, Chamberlain</td>
</tr>
<tr>
<td>374</td>
<td>Research</td>
<td>Mertzenich, Chamberlain</td>
</tr>
<tr>
<td>233</td>
<td>Teaching</td>
<td>Jefferson, Mertzenich, Winsauer, Zapiter, Michels, Chamberlain</td>
</tr>
<tr>
<td>251</td>
<td>Research</td>
<td>Jefferson</td>
</tr>
<tr>
<td>253</td>
<td>Teaching</td>
<td>Jefferson</td>
</tr>
<tr>
<td>Valders 364</td>
<td>Prep room</td>
<td>Meeker-Gast</td>
</tr>
</tbody>
</table>
Appendix G: Laboratory Worker List

Contact LuAnn Meeker-Gast (stockroom manager) for current list.
Appendix H: Inventoried Carcinogens, Teratogens, Peroxidizable Chemicals, Controlled Substances, and Potential Acute and Toxic Hazardous Wastes

Known or Probable Carcinogenic Chemicals

Suspect Teratogenic Chemicals

Potential Acute Hazardous Wastes

Potential Toxic Hazardous Wastes

Peroxidizable Chemicals

Controlled Substances
Appendix I: OSHA Regulations

