Bennington College Chemical Hygiene Plan

Emergency Contact Information

Campus Safety: dial x767 (SOS) from a campus phone

- do **not** call 911, as this will delay the emergency response
- non-emergency: Dial x0 from a campus phone or (802)-447-4250

Bennington Fire Department: (802) 442-1051

Bennington Police Department: (802) 442-1030

Southern Vermont Medical Center: (802) 442-6361

Completed: June 2019 Next Review: April 2022

1. INTRODUCTION

The purpose of the written Chemical Hygiene Plan at Bennington College is to specify procedures, equipment, personal protective equipment, and work practices that are capable of protecting employees from the health hazards associated with hazardous chemical use in the laboratory. The intent of the program is to minimize risks associated with hazardous chemical use by reduction, elimination (where feasible), and adherence to the standard personal exposure level (PEL) and threshold limit values (TLV) established for safe use. The document is adapted from the Chemical Hygiene Plan from Wittenberg University, from which much of the text and organizational structure was obtained. It is the responsibility of all faculty, staff, and students who work in the laboratories and studios of Dickinson Hall and the Visual and Performing Arts (VAPA) building to know and follow the provisions of this Plan.

Because knowledge concerning the hazards involved and the best means of reducing those hazards increases constantly, the College reserves the right to modify this document at any time as new information becomes available which would affect something contained within this plan. It shall be the policy of the College to review this document at least once per year.

1.1 History of the OSHA Laboratory Standard

On November 25, 1983, the Occupational Safety and Health Administration (OSHA) published the Hazard Communication Standard (HazComm) which applied to certain manufacturers and in part to certain laboratories. HazComm requires that employers inform employees about the presence and use of hazardous substances in the workplace. HazComm applies to all employees in all workplaces. OSHA received many comments regarding whether the procedures of the Hazard Communication Standard should apply to laboratories where the staff is highly educated. OSHA decided that although "...31.9% of all laboratory workers have bachelors degrees, 20.6% have masters degrees, and 20.9% have doctorates...there is some question as to whether laboratory workers actually make themselves as knowledgeable as they should be and some laboratory employees are not professionally trained." (51 CFR 2664). Thus, while HazComm may seem inappropriate for employees with scientific training, OSHA was not convinced that these workers should not fall under some (other) set of guidelines.

Other unique differences for laboratories (compared to production facilities) were noted: the small amounts of chemicals used, the vast number of different chemicals involved, and nearly half of the laboratories in one survey could not accurately predict their chemical needs even one month in advance.

OSHA decided "...Despite the existence of the unique characteristics of laboratory work places, in actual practice incidents of acute adverse health effects resulting from exposure to toxic substances in laboratories do occur. Furthermore, some studies...have shown increased risks of certain types of diseases for laboratory workers. In addition, although laboratory workers are, in general, a well-educated work force, there is evidence that many laboratories do not have health and safety programs...". Therefore, OSHA proposed the Occupational Exposures to Hazardous Chemicals in Laboratories rule from which this Chemical Hygiene plan originates.

On January 31, 1990, The Department of Labor has published in the Federal Register an amendment to 29 CFR 1910, Subpart Z, identified as Section 1910.1450 (URL: http: //gabby.oshaslc.gov/

OshStd_data/1910.1450. html.) The title of that amendment is "Occupational exposures to hazardous chemicals in the laboratory", better known as the "Laboratory Standard".

A part of the Laboratory Standard is the requirement for the development of a Chemical Hygiene Plan. The fact that Bennington is primarily a teaching institution is irrelevant to the Laboratory Standard; the Laboratory Standard applies to (relatively small) companies that have labs that do not produce chemicals.

1.2 Role of the Chemical Hygiene Plan

This Chemical Hygiene Plan describes the Bennington College laboratory safety program, including, but not limited to, standard operating procedures for safe use of hazardous chemicals, criteria for selecting control measures including personal protective equipment, engineering controls, control-equipment inventory and operations (such as vented hoods), employee training programs, medical programs, and safety inspections. This document is intended to comply with 29 CFR 1910.1450 as well as other applicable Federal and State regulations. Where references exist within this document to other documents, those documents will be considered fully applicable here as if those documents had been reproduced here. The Chemical Hygiene Plan is designed as a tool to coordinate safety procedures.

This Chemical Hygiene Plan is a public document and shall be readily available to affected employees, their representatives, and other parties upon request.

2. FACILITIES AND PERSONNEL TO BE COVERED UNDER THIS PLAN

The laboratories and studios (referred to collectively as laboratories from here on out) of the College and all of the work in these laboratories currently meets, and is expected to continue to meet, the definition of "Laboratory" and "Laboratory Scale" given in 29 CFR 1910 subpart Z. This plan covers all work in all laboratories in Dickinson Hall, including but not limited to, the chemistry, cell biology, animal physiology, ecology, geology and physics labs, all work in all studios in the Visual and Performing Arts building (VAPA), including but not limited to, the ceramics, photography, 3D-printing, scene shop, costume shop, sculpture, and print making studios, and all work involving chemicals and equipment outlined in the Chemical Hygiene Plan in Buildings & Ground (B&G).

This Chemical Hygiene Plan strictly applies only to trained laboratory employees, including student employees. Students working in labs and studios as part of regular courses and tutorials must be familiar with the contents of this Plan and follow the safety practices described herein but are not subject to the formal training requirements specified for employees. Custodial, maintenance, and other College personnel who enter the laboratories and studios as part of their job functions are covered by Bennington College’s Hazard Communication Program, available from Buildings & Grounds.

3. RESPONSIBILITIES

3.1 President of the College

The President of the College has ultimate responsibility for implementation of the Chemical Hygiene Plan.

3.2 Dean of the College

The Dean of the College has the responsibility for approval of the Chemical Hygiene Plan and for the appointment of a qualified individual as the Chemical Hygiene Officer.

3.3 Chemical Hygiene Officer

The Chemical Hygiene Officer is the person responsible for overseeing the implementation of the Chemical Hygiene Plan at Bennington College. The Chemical Hygiene Officer has the following responsibilities:

a. Review the Chemical Hygiene Plan as circumstances warrant, but at least once every 12 months;

b. Recommend changes in the Chemical Hygiene Plan to the Dean of the College;

c. Consult regularly with faculty and staff regarding the use of hazardous substances in labs and for informing and training all personnel who fall under the purview of this Plan;

d. Arranging for periodic inspection of all safety equipment as specified in this Plan;

e. Arranging for regular chemical waste disposal with appropriate outside contractors as described in Appendix B of this Plan;

f. Overseeing annual laboratory safety inspections as specified in this Plan.

g. Provide technical assistance to faculty, staff, and students concerning appropriate storage, handling, and disposal of hazardous chemicals

3.4 Lab Safety Officers

Every laboratory shall have an assigned Lab Safety Officer. They (in concert with the Chemical Hygiene Officer) are responsible for making certain that all College employees, including student employees, who work within the laboratories are aware of the hazards of the materials with which they are working and have received the training required by the Chemical Hygiene Plan, the Hazard Communications Plan and any other applicable Federal or State regulations prior to beginning work in the laboratory. Further, they are required to plan the work to be done in the laboratories under their supervision so that is done in a manner consistent with this Chemical Hygiene Plan. Where such work departs from the usual practices, either because a new procedure is to be used or especially hazardous materials are required to carry out the work, the Lab Safety Officer should consult with the Chemical Hygiene Officer to be certain that the procedures to be followed will ensure the safety of the persons involved.

The Lab Safety Officer will in most cases be the faculty or staff member who is most directly responsible for work performed in a lab or stockroom; current Lab Safety Officers for the various

laboratory spaces in Dickinson Hall, VAPA and B&G are listed in Appendix A. The specific roles of the Lab Safety Officers are listed below (with references to specific sections of this document):

1. SDS procurement (4.3.1).
2. Arranging for routine housekeeping of working spaces (4.4.1).
3. Disposal of hazardous waste (4.4.1, 4.10.1, and Appendix C).
4. Informal lab inspections (4.4.2).
5. Overseeing maintenance of safety equipment (4.4.3).
6. Maintaining an inventory of all chemicals (4.8.2).

3.5 Students, Student Employees and Researchers

All students working in Dickinson Hall and VAPA laboratories are responsible for knowing and abiding by the contents of this Chemical Hygiene Plan; particular attention should be given to the procedures for safe handling of chemicals and for working in areas where chemicals are used (Section 4.1), proper use of personal protective equipment (section 4.7), requirements for operations that require prior approval (sections 4.1 and 4.2) and procedures to be followed in cases of spills, fires, or other emergencies (section 4.9).

4. STANDARD LABORATORY OPERATING PROCEDURES AND REGULATIONS

All employees and students working in laboratories shall abide by the practices and policies set forth in the following sections.

4.1 Basic Rules and Procedures

4.1.1. Definitions. OSHA has defined a "hazardous chemical" as "a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic harm may occur in exposed employees." The term "health hazard" includes "chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skins, eyes, or mucous membranes."

The non-mandatory recommendations for a Chemical Hygiene Plan also include references to "moderately chronic," "highly chronic," and "highly acute" toxicity without defining these terms precisely. This Chemical Hygiene Plan places the burden on the lab supervisor, in consultation with the Chemical Hygiene Officer, to make informed decisions about the relative danger of various substances encountered in labs. Information supplied on SDSs can assist in this process.

4.1.2. Personal Work Practices

a. Inspect personal protective equipment (PPE) prior to use, and wear appropriate protective equipment as procedures dictate and when necessary to avoid chemical exposure.

b. Do not eat, drink, or apply cosmetics in the laboratory (smoking is prohibited anywhere inside Dickinson Hall, VAPA, and B&G). The only place cosmetics can be applied are in spaces designated for use in theater productions.

c. Wash promptly and thoroughly anytime a chemical has contacted the skin.

d. Wash hands well with soap and water before leaving the laboratory.

e. Be aware of long hair or loose-fitting clothing, and confine these close to the body when there is the possibility of their coming into contact with hot surfaces or flames, getting caught in equipment, or coming into contact with hazardous chemicals.

f. Do not sit on lab benches, hood airfoils, or other work surfaces where hazardous materials may have been used; sit only on proper chairs or stools.

g. All employees and students are to be vigilant about unsafe practices and conditions in the laboratory, and shall immediately report such problems to their supervisor or faculty member, or the Chemical Hygiene Officer.

h. Seek information and advice from knowledgeable persons, as well as applicable standards and codes, about the hazards present in the laboratory. Plan operations, equipment choices, and protective measures accordingly.

i. Never operate equipment without functioning safety guards and operational safety controls.

j. Illicit drug use is prohibited. If under the influence, tasks in the laboratories cannot be performed due to the extreme safety hazard being under the influence causes.

4.1.3 General Precautions for Chemical Handling.

4.1.3.1 For each chemical in use, faculty, staff, and students shall make themselves aware of:

a. Chemical hazards and appropriate safety procedures as described in the Safety Data Sheet (SDS), as may be specified by the supervisor, and through other appropriate references, as may be necessary;

b. The appropriate safety eyewear and other personal protective equipment to be used;

c. Symptoms of exposure for the chemicals with which they work and with the precautions necessary to prevent exposure;

d. Location and proper use of emergency equipment, including fire extinguishers, safety showers, and eyewash stations;

e. Proper storage for the chemical when it is no longer in use;

f. Appropriate personal work practices (see above);

g. Proper waste disposal procedures; and

h. Emergency procedures, including spill clean-up methods and evacuation routes.

4.1.3.2. Do not block access to emergency showers, eyewashes, or exits.

4.1.3.3. Skin contact with chemicals is to be avoided, and all personnel are to wash hands before leaving the laboratory.

4.1.3.4. Mouth suction for the purposes of pipetting or starting a siphon is prohibited; use pipette bulbs or other pipetting aids.

4.1.3.5. Do not use refrigerators, glassware or utensils which are also used for laboratory operations for the storage or handling of food or beverages.

4.1.3.6. When working with flammable liquids, be certain that there are no sources of ignition nearby that might cause a fire or explosion.

4.1.3.7. Any chemical mixture should be assumed to be as toxic as its most toxic component, and substances of unknown toxicity should be assumed to be toxic.

4.1.4 Chemical Labeling. To avoid the generation of unidentified waste materials and to prevent unsafe laboratory conditions, it is the policy of Bennington College that all containers of chemicals be labeled as described below.

4.1.4.1. All chemical and waste containers in the laboratory shall be labeled with a proper GHS label. GHS labels can be obtained from the Chemical Hygiene Officer.

4.1.4.2. Chemical containers are to be provided with a durable label that clearly identifies the contents and any relevant hazard. Except for containers holding transferred bulk solvents, the label should also include the date of acquisition and the source (manufacturer or experimental procedure) of the chemical.

4.1.4.3. Chemicals that are known reproductive toxins, select carcinogens, or are otherwise highly toxic should have an additional warning label that describes the nature of the hazard.

4.1.4.4. Hazardous Waste containers must be labeled with the words “Hazardous Waste” in addition to a description of the contents, the generating process, and the user. Waste containers should remain closed except when adding waste. Hazardous waste stickers can be obtained from the Chemical Hygiene Officer.

4.1.4.5. An exemption from labeling requirements is made for transferring a chemical from a labeled container into another container, such as a beaker or Erlenmeyer flask, where the chemical is solely for the *immediate* use of the worker who performed the transfer. It is the responsibility of all laboratory workers, including faculty, staff, and students, to insure that no unlabeled containers of chemicals are on benchtops before leaving the laboratory.

4.1.4.6. Labels should be periodically inspected by the Lab Safety Officer or staff member in charge of the lab to ensure that labels have not been damaged, defaced, or removed.

4.1.5. Avoidance of Routine Exposure. Never taste chemicals. Avoid contact with skin. As a general rule, one should avoid smelling chemicals, particularly as a means of identification. However, since it is prudent to know the odors of some common chemicals as a matter of safety, when smelling any chemical, waft the vapors very cautiously to avoid inhaling high concentrations and minimize the amount smelled.

4.1.6. Equipment and Glassware. Handle and store laboratory glassware with care to avoid damage. Do not use damaged glassware; be especially careful to check for "star cracks" on glassware that is to be either pumped to vacuum, pressurized, or used with a heating mantle or other heat source. Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain chemicals and fragments should implosion occur. Use equipment only for designed purpose.

4.1.7. Procedures for Use of Compressed Gas Cylinders.

4.1.7.1. Gas cylinders must be chained or secured at all times while in use, storage, or transport.

4.1.7.2. Gas cylinders must be transported only while chained to a cylinder cart, and with all protective caps or rings securely in place.

4.1.7.3. When tapping a gas cylinder, use only a pressure regulator which has a CGA fitting designation identical to that of the cylinder in use.

4.1.7.4. Gas containers will be labeled in accordance with Section 4, above (Chemical Labeling). Empty containers should also be clearly indicated with tags marked "EMPTY" or "MT."

4.1.7.5. If the regulator or associated valving shows any evidence of improper performance or operation, including the failure to read zero when disconnected from the supply cylinder, the regulator must immediately be tagged as defective and removed from service.

4.1.7.6. When working with corrosive or toxic gases:

a. All other provisions of this Plan regarding toxic chemicals must be met.

b. The cylinder, regulator, and associated plumbing must be situated inside a fume hood or other appropriate protective enclosure while in use.

c. The regulator *must* have been cleaned and serviced within the past six months, unless it has not been used since either its date of purchase or the date of its prior cleaning and servicing.

d. It is recommended that a cross-purge arrangement be set up using argon or nitrogen to flush the regulator and valves after use of the corrosive or toxic gas, both to prevent

damage to the equipment and to avoid spillage of residual gas when the equipment is removed from the hood.

4.1.8 Work with Reproductive Toxins, Carcinogens and Chemicals with High Toxicity. The use of certain chemicals and operations may pose unusual hazards. This includes work with highly toxic materials, reproductive toxins, and select carcinogens, as such materials are defined in 29 CFR 1910.1200 Appendices A and B, and in 29 CFR 1910.1450, and also would include such operations as high-pressure reactions. The degree of the hazard will depend on the quantities of substances involved as well as the duration for which personnel may be exposed, and determination of the actual level of hazard requires informed judgment on the part of the supervisor as well as the laboratory worker. Work of a particularly hazardous nature may be undertaken only with prior approval from the supervisor. If there is a reasonable possibility that individuals other than the person performing the operation may be exposed or affected, the supervisor must provide written or e-mail notice to the Chemical Hygiene Officer regarding the location and duration of the activity. The following conditions precautions shall be followed for all work with these highly hazardous chemicals.

a. Prior approval from the Lab Safety Officer must be obtained for work with these chemicals. Substitute with less hazardous chemicals where possible.

b. The user will design the experiment such that the smallest amount of chemical that is consistent with the desired outcome is obtained and utilized.

c. The Lab Safety Officer shall ensure that a written protocol is in place that describes in detail the work to be performed, the chemicals to be used, any other hazards that may be involved, and the protective measures that will be taken.

d. All work with toxic chemicals that may expose the user or other individuals to toxic vapors or respirable dusts shall be performed in an operating fume hood, in a vacuum line, or similar device, which shall be equipped as necessary with HEPA or other suitable filters and traps.

e. Determination of appropriate containment devices and personal protective equipment shall be made by the supervisor after consulting appropriate references and the CHO.

f. At a minimum, splash goggles, gloves suitable for the hazard involved, and a long-sleeved lab coat shall be worn. Hands and arms shall be washed immediately after working with such chemicals.

g. Two people must always be present during any work with highly-toxic chemicals.

h. A designated work area, consisting of a hood, portion of a laboratory, or an entire laboratory room as necessary, shall be established for work with these substances.

i. The designated work area shall be posted with signs identifying the hazardous material in use, and the boundaries of the work area shall be clearly marked.

j. Only those persons trained to work with the chemicals may be allowed in the designated area.

k. The work area is to be thoroughly cleaned and/or decontaminated after use.

4.2 Control-Measures and Equipment.

4.2.1. Unattended Operations. Leave lights on, place an appropriate sign on the door, and provide for containment of hazardous chemicals and/or toxic substances in the event of failure of utility service (such as cooling water or electricity) to an unattended operation. No operations involving the use of extremely hazardous materials may be allowed to run unattended without prior approval of the Chemical Hygiene Officer. Such approval will only be granted if the Chemical Hygiene Officer is convinced that precautions have been taken to ensure the safety of others. All unattended operations involving the use of especially hazardous materials will require posting of a sign that such operations are being conducted and that the room may not be entered by persons other than the person(s) conducting the operation. This sign shall also include the name and telephone number of the individual(s) responsible for the laboratory.

4.2.2. Use of Hoods. Use of a laboratory fume hood is recommended for any work with volatile chemicals. A fume hood is to be utilized for all chemical procedures, which might result in release of hazardous chemical vapors, mists, or dusts. As a general rule, the hood shall be used for all chemical procedures involving substances which are appreciably volatile and have a Permissible Exposure Limit (PEL) less than 50 ppm, or where exposure by inhalation is likely to routinely exceed the ACGIH Threshold Limit Value (TLV) or other action level for that chemical; the PEL and TLV values for any hazardous material should be included on its SDS.

Laboratory ventilation should be normally not less than 20 cubic feet per minute air flow through each room. This flow rate is not considered sufficient to prevent accumulation of chemical vapors. Fume hoods should provide 60 to 120 linear feet per minute of air flow. Confirm adequate hood performance before use; keep the hood sash at the indicated level at all times except when adjustments within the hood are being made; keep materials stored in hoods to a minimum and do not allow these materials to block vents of air flow. Leave the hood "on" when it is not in active use if toxic substances are stored in it or if it is uncertain whether adequate general laboratory ventilation will be maintained when it is "off". Be alert to unsafe conditions and see that they are corrected when detected. The adequacy of hood performance shall be tested at least annually. To the extent feasible, each hood should have a continuous monitoring device to allow convenient confirmation of adequate hood performance before use. If this is not possible, work with substances of unknown toxicity should be avoided or other types of local ventilation devices should be provided.

4.3 Chemical Procurement, Distribution, and Storage

4.3.1 Procurement. Chemicals are to be ordered by Lab Safety Officers in Dickinson Science Building and by the VAPA Visual Arts Coordinator. Lab Safety Officers shall insure that SDSs are received for all chemicals ordered for their respective labs. Archived copies shall be maintained for 30 years as medical records. The College, through the Dean and the Chemical Hygiene Officer,

retains the right to require that specific permission be granted before chemicals which will pose significant risks are procured. It also retains the right to limit the quantities of such chemicals or to deny the acquisition of such chemicals if the conditions do not exist for the proper handling and/or disposal of the chemical. (See the Hazardous Waste Management Policy and Procedures in Appendix B).

4.3.1.a Chemicals Purchased By Students. The Faculty or Staff member that the student is working under must approve any chemical purchased by a student for use on an individual project. The Faculty or Staff member must keep an inventory of these chemicals.

4.3.2 Inventory. All chemicals on campus will be logged into the SDS Inventory spreadsheet that is maintained by the Chemical Hygiene Officer and shall include: material name, quantity, SDS links, and expiration date, if applicable. Here is the link to the inventory: Chemical Inventory

4.3.3 Chemical Storeroom. Access to the chemical storeroom (Dickinson 206) will be limited to faculty and staff only. Students and student employees may not enter the storeroom owing to the myriad of potential chemical hazards. Student employees given permission by the CHO may enter the chemical storeroom.

4.3.4 Chemical Storage. Chemicals may be stored in the chemical storeroom and in individual teaching and research laboratories. The following steps are required to insure safe chemical storage regardless of specific location.

Chemicals should be stored, insofar as practical, in their original containers with labels intact. Labels shall not be removed or defaced. Bottles of chemicals should be placed on the storage shelves in such a way as to minimize the danger of bottles falling off the shelves. Chemicals shall be stored in a manner consistent with any particular precautions specified on its SDS; for example, materials that need to be kept cold shall be stored in a suitable refrigerator or freezer, light sensitive chemicals will be stored in suitable containers, etc. Otherwise, except for the specific hazardous materials described below, chemicals may be stored in open shelves provided they are arranged in such a way to minimize the possibility that incompatible materials could come into contact; the Flynn System or similar arrangement scheme should be employed. (The Chemical Hygiene Officer should be consulted anytime uncertainty arises regarding such storage.) Substances that pose a particularly high health risk shall have additional warning labels that clearly indicate the nature of their hazards and should be stored in secured areas, with appropriate ventilation as needed. Research labs are secured areas. Flammable chemicals will be stored separately from other chemicals in special cabinets or rooms. All chemicals should be examined at least annually by the Lab Safety Officer to determine the need for replacement and the integrity of the container and label. Quantities stored will not exceed recommended limits noted in "Prudent Practices in the Laboratory," 2nd edition, Table 4.3.

Amounts stored within a laboratory should be as small as practical. To prevent accumulation of chemicals in laboratories and the associated hazards, chemicals are to be returned to the storeroom as soon as the need for the chemical no longer exists in a given laboratory.

4.3.5 Distribution. Chemicals that need to be transported out of a given laboratory should be labeled as required by the Hazard Communication Program. When chemicals are hand carried between rooms, the container will be placed in an outside container or bucket. When several bottles of chemicals are to be moved at the same time, the use of a laboratory cart is permitted provided that the bottles are properly contained on the cart. When transporting chemicals in a motor vehicle to field sites, all relevant Department of Transportation regulations must be followed.

4.4. Housekeeping, Maintenance, and Inspections.

4.4.1 Cleaning. Floors within the laboratories are normally to be cleaned by the housekeeping staff of Buildings & Grounds. Regular cleaning of bench tops and tables is the responsibility of the Lab Safety Officers or their designees. In the event of spills, the Lab Safety Officer is required to supervise the cleaning and disposal of the spilled material. Disposal of chemical waste is handled by the Lab Safety Officer, in consultation with the Chemical Hygiene Officer when necessary.

4.4.2 Inspections. Formal housekeeping and chemical hygiene inspections will be held at least annually. It is the responsibility of the Chemical Hygiene Officer to schedule and conduct these inspections; Lab Safety Officers will be asked to help review labs other than their own in the course of these inspections. Records of inspection will be kept be kept for at least 3 years.

Informal inspections are to be carried out continually in order to correct any deficiency as quickly as possible. Informal inspections are the responsibility of the Lab Safety Officer and Chemical Hygiene Officer. In addition, inspections may be held from time to time by representatives of various Federal and State regulatory agencies. The Chemical Hygiene Officer, or his/her designee, should accompany these persons on the inspection tour.

4.4.3 Maintenance. The primary responsibility for noting the need for repair of malfunctioning equipment, including fume hoods, eye wash stations, safety showers, and ventilation systems, rests with the Lab Safety Officer. These persons are charged with prompt reporting of any malfunctions in the safety related equipment to Buildings & Grounds or an appropriate external contractor. In addition, a regular program of inspection of safety related equipment will be conducted. Eye wash stations will be tested or inspected annually and regularly flushed monthly for a length of 1 minute by Buildings & Grounds personnel; the Chemical Hygiene Officer shall arrange for these inspections. Buildings & Grounds personnel will flush safety showers twice monthly for a length of 1 minute. Fume hoods will be inspected annually by the designee of the Chemical Hygiene Officer. Out-of-service equipment will be plainly marked so that persons in the area of the equipment will be aware that it is not in service. Out-of-service equipment will be repaired and put back into service as quickly as possible or removed from teaching areas. Appropriate lock out/tag out procedures will be followed.

4.4.4 Passageways. Stairways and hallways will not be used as storage areas for chemicals. Access to exits, emergency equipment, and utility controls will never be blocked by stored materials.

4.5 Access to Laboratories and Studios

4.5.1. Faculty and Staff. Employees covered by this CHP have unrestricted access to the laboratory spaces in Dickinson Hall and VAPA.

4.5.2. Students. Bennington students enrolled in courses have access only to the lab spaces scheduled for the course(s) in which they are enrolled. Faculty may give permission for students to work outside of regularly scheduled hours or in spaces the students do not normally work in during class. During normal business hours (8:00 AM to 5:00 PM) labs are normally left unlocked to facilitate authorized student access. Outside of these hours, labs are normally kept locked but faculty can provide a list of students who have authorization to work in the space to Campus Safety; students need to arrange entry into the lab with a Campus Safety Officer directly.

4.5.3. Visitors and Guests. Access to a given lab space may be granted to visitors, or guests of individuals working in the lab, with the following restrictions. When any work is being performed in a laboratory, visitors or guests may enter the lab only with the direct verbal authorization of the faculty or staff member present; if no faculty or staff member is present, guests or visitors are not permitted to enter the laboratory. When labs are vacant, visitors must be accompanied by a member of the faculty or staff that is covered by this CHP or, in the case of visits by prospective students, a Bennington College admissions counselor. All visitors, regardless of the nature of the visit, must wear proper eye and foot protection as described in the CHP.

4.6 Medical Program

4.6.1 Compliance and Regulation. Regular medical examinations, consultations, and surveillance of personnel will be provided as required by law or regulation. The cost of this surveillance will be borne by the College.

4.6.2 Routine Surveillance. Anyone whose work involves regular and frequent handling of a hazardous chemical, any person showing symptoms which may have been caused by exposure to hazardous materials in the workplace, any person involved in an incident creating the likelihood of a hazardous exposure, any person who is routinely exposed to hazardous chemicals above the action level, or in the absence of an action level, the PEL of an OSHA-regulated substance for which there are exposure monitoring and medical surveillance requirements, or any persons having a medical condition which is known to be aggravated by exposure to hazardous materials within the workplace may consult a licensed physician qualified in the area of occupational exposure to hazardous materials to determine on an individual basis whether a regular schedule of medical surveillance is desirable. The cost of such surveillance will be borne by the College.

4.6.3 First Aid. In any situation requiring first aid attention, Campus Safety should be contacted (at extension 767). When the emergency is such that severe impairment of function or death may result if help is delayed in arriving, the North Bennington Fire Department (at 8-911) should be called prior to Campus Safety. Hard copies of all relevant SDSs should be secured as soon as

possible. "Incident Report Forms" (Appendix A) should be readily available in all labs and completely as thoroughly as possible at the time of the accident.

4.6.4 Information Provided to Physician. In the event of an event or condition requiring the consultation with or examination by a licensed physician, the employer shall provide the following information to the physician:

a. the identity of the hazardous chemical to which the employee may have been exposed,

b. a description of the conditions under which the exposure occurred, including quantitative exposure data, if available, and

c. a description of the signs and symptoms of exposure that the employee is experiencing, if any. The relevant SDS(s) shall also be provided to the physician as quickly as possible.

4.6.5 Information Provided by the Physician. For any examination or consultation provided under this Plan, Bennington College shall obtain a written opinion from the examining physician which shall include the following:

a. any recommendation for further medical follow-up;

b. the results of the medical examination and any associated tests;

c. any medical condition which may be revealed in the course of the examination which may place the employee at increased risk as a result of exposure to a hazardous workplace, and;

d. a statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination of treatment.

4.7 Protective Apparel and Equipment

4.7.1 Safety Equipment. All laboratories in which hazardous chemicals are used must be equipped with fire extinguishers, eye wash stations, and where feasible, drench showers. Employees, including student employees, working in these laboratories must be informed of their locations and trained in the proper use of the equipment at the time they first begin working in the laboratory. Emergency contact information must be posted in each lab.

4.7.2 Personal protective equipment (PPE) shall be provided by Bennington College to students and employees of the laboratories when and where necessary. The Lab Safety Officer has the responsibility to assess if hazards exist that require measures that go beyond eye and hand protection afforded by PPE on hand; if such assessment reveals a need for additional PPE, such as face shields, respirators, aprons, specialty gloves or boots, the College, through the Lab Safety Officer, will communicate selection decisions to each affected worker and select the PPE that properly fits each affected employee or student.

4.7.3 Eye Protection Appropriate eye protection must be worn by all persons, including students and visitors, in all laboratories where hazardous chemicals are used. Glasses must meet ANSI Z87.1-1989 standards. Safety glasses with side shields are the minimum protection; goggles are recommended in situations where splashes or projectiles are probably hazards. In addition to

required eye protection, full-face shields should be worn when conducting particularly hazardous operations. Special glasses are required when working with lasers. Lab Safety Officers, in consultation with the Chemical Hygiene Officer, are responsible for specifying which level of eye protection is appropriate for particular labs.

Employees and students who wear contact lenses in the lab must have a bright red dot in the form of a sticker on the side of their glasses, goggles or other face/eye protection. This can inform co-workers and emergency rescuers that they are wearing contact lenses.

4.7.4 Appropriate gloves will be worn when the potential for contact with toxic materials exists. Inspect gloves before each use. Appendix G gives a list of chemicals and the type of gloves that should be worn when handling said chemical.

4.7.5 Appropriate footwear is always required in all labs; no sandals, open-toed shoes or perforated shoes are permitted in any laboratory.

4.7.6 Blast shields are available from the Chemistry Stockroom and should be employed in operations, including lecture demonstrations, that entail explosion hazards; the shields need to be inspected for damage prior to and after use. Report any damage to the Lab Safety Officer or Chemical Hygiene Officer.

4.7.7 Respirators. Use of respirators is discouraged; typically, any experiment or procedure that necessitates the use of a respirator under 29 CFR 1910.134 should be conducted in a sufficiently well-ventilated environment such that the use of a respirator is not required. If not feasible, lab supervisors should consult with the Chemical Hygiene Officer as necessary whenever respirator use is required. If a respirator is required, the College's Respiratory Protection Plan will be consulted.

4.8 Records

4.8.1 Accident Reports. Records of all accidents will be written and retained for at least ten years following the accident. Reports of all accidents are to be made on the "Incident Report Form." (Appendix B.) The Bennington College Safety Committee, and the offices of Campus Safety and Human Resources will maintain copies of all Incident Report Forms.

4.8.2 Inventory records for all substances will be maintained by the Chemical Hygiene Officer in order to know the identities, locations, and quantities of all chemicals on hand. Laboratory notebooks should be maintained in such a fashion as to record the usage of substances which pose a particularly high health risk and these notebooks are to be retained by the Lab Safety Officers indefinitely.

4.8.3 Medical records will be maintained by Human Resources for thirty years or as otherwise required by state and/or federal regulations in accordance with the requirements of state and federal regulations.

4.8.4 Safety Data Sheets (SDS) are readily available to all employees and can be reviewed for all hazardous chemicals used at this workplace. SDSs are available in all laboratories, housekeeping areas, Buildings & Grounds. All books are yellow with SDS labeled on them. SDSs are updated and managed by the Chemical Hygiene Officer (Abbey Killam, akillam@bennington.edu).

4.9 Spills and Accidents

4.9.1 General Procedures for Spills. All laboratory operations are to be carried out in accordance with accepted laboratory practices to ensure the prevention of accidental spills. Should a spill occur, immediate action is required of the person causing the spill, the nature of which will depend on the nature of the spilled material as described below.

a. If no immediate health or safety risk is involved, the individual involved is responsible for minimizing the spread of the spill and to report the incident to the faculty or lab supervisor or the Lab Safety Officer. Except for minor spills, the Lab Safety Officer will notify the Chemical Hygiene Officer who will arrange for the cleanup of the spilled material according to accepted practices. Outside help will be called in to clean up the spill when the extent of the spill or the material involved in the spill are such that inside help is not capable of handling the situation.

b. If the material spilled presents a serious health risk owing to its toxicity, or presents a physical hazard owing to a combination of the volume of the spill and the material's flammability, volatility, or other hazardous property, no action should be taken except to notify the Lab Safety Officer who will then notify appropriate emergency responders.

4.9.2 Fire Alarms. The fire alarm system is available to signal people to evacuate the building in the event of an emergency requiring that action. This alarm system shall be tested annually by Buildings & Grounds. The North Bennington Fire Department and Campus Safety will be notified of all instances when the fire alarm is activated as well as any corrective actions taken to prevent recurrences of similar incidents.

4.9.3 Incident Reporting. After any accident or incident that results in injury, or that which would be deemed a near miss of injury, an Incident Report Form (Appendix B) will be completed by the Lab Safety Officer and/or Chemical Hygiene Officer. All accidents or near accidents will be analyzed by the Bennington College Safety Committee and any recommendations arising from the analysis will be distributed to all who might benefit from the information. Also, as a follow up to any safety related Incident Reports, a written recommendation will be sent to the Chemical Hygiene Officer and a copy filed with the Incident Report for a permanent record with Human Resources. Campus Safety will be notified if the injury requires medical attention and the person needs to be evaluated by a physician. Human Resources will be notified if the injury results in a workman's comp claim. If corrective action is necessary, the Vice President of Business and Finance will also be copied with the recommendation.

4.10 Waste Disposal Program

The proper disposal of chemical wastes is necessary to protect people, plants, and animals from the harm that could be caused by the improper and careless disposal of these wastes. Appendix D gives a list of general compatibility guidelines. Consult the chemical's SDS for specific guidelines on compatibility.

4.10.1 General Procedures. Disposal of wastes from laboratories shall conform to the regulations outlined in the document "Hazardous Waste Management Policy and Procedures" (Appendix C). All Lab Safety Officers under the purview of this Chemical Hygiene Plan are responsible for the

collection of these wastes from each of the respective laboratories, the identification of the wastes, and the storage of the wastes pending removal of the wastes by the chemical waste disposal company contracted by the College.

4.10.2 Biological Waste is defined as waste that is composed or contaminated with biological materials. Examples of biological wastes include cell cultures, animal tissues, any item containing infectious agents or recombinant DNA; or human tissues, bloods, or fluids.

a. Liquid biological waste is to be decontaminated (bacterial cultures, blood, animal fluids, etc.) by autoclaving, if appropriate. Decontaminated culture media, containing no chemicals or drugs, may be discarded into a sink drain. Biological waste that has been mixed with chemical waste must be managed as hazardous waste. The hazardous waste label must include a list of biological components in addition to the chemical components.

b. Solid biological waste (such as contaminated paper, plastic pipettes, and tips) should be placed in clear autoclave bags and promptly autoclaved. After autoclaving, the waste bags can be collected with non-hazardous solid wastes in the trash.

c. Animal carcasses (non-infectious tissues and associated non-sharps solid waste) are collected in red biohazard bags and sealed.

d. Needles, razors, and other sharps are collected in red puncture-proof sharps containers. Items must never be removed from these bins once they have been placed inside.

4.10.3 Oily Rags must be placed in an *oily rag* can that is properly labeled. The rags are contained in the can until full, then disposed of in accordance with "Hazardous Waste Management Policy and Procedures." The oily rag can is self-closing to prevent ignition of the rags.

4.10.4 Solvents, such as paint thinner, turpentine, toluene, xylene, other organic solvents and alcohols are considered hazardous waste. DO NOT DUMP them down the drain. Follow the instructions for handling hazardous waste.

4.10.5 Paints. Oil-based paints are considered hazardous waste. DO NOT DUMP oil-based paint down the drain or place in regular trash. Oil-based paints may be combined with solvents for disposal. Follow the instructions for handling hazardous waste. Latex paints should be dried out and placed in regular trash. Water-based paints may be disposed via the regular trash.

4.10.6 Ceramic Glaze. Many ceramic glazes contain metals that are considered hazardous waste. Unused portions of the glazes should be disposed as hazardous waste. Glaze preparation and rinsing should be conducted in the sink specified for this purpose.

4.10.7 Photographic Chemicals. Photographic chemicals generally fit into four categories: fixers, developers, rinses, and specialized chemicals. Standard developers and rinses can be rinsed down the drain during processing. Most fixers contain silver in quantities above the amount for sewer disposal. Fixer waste must be collected and poured through the silver recovery unit. Specialized chemicals, such as special acids and bases, are considered hazardous waste and collected according to the instructions for handling hazardous waste.

4.10.8 Acids and Bases. Materials with a pH of less than 2 or more than 12.5 are considered hazardous waste. Do not mix these wastes with the solvent or oil wastes. Use care when handling acids and bases and follow the instructions for handling hazardous waste.

4.10.9 Lubricating Oils. Oils such as pump oil, motor oil and other machine oils are recyclable. These materials should be placed in a plastic container, sealed and labeled as *Used Oil*. Do not label them as hazardous waste or as waste oil.

4.10.10 Broken Glass Sharp Implements. Sharp objects, such as razor blades, knives, and broken glass should be packaged in a puncture-proof jar or box and placed in regular trash. Pre-packaging helps to avoid injury to janitor or others handling the trash.

4.10.11 Empty Chemical Containers should be triple-rinsed and recycled or placed in regular trash.

4.10.12 Outdated chemicals and those which bear no label will be placed, in their bottles, with the laboratory waste to be removed by the commercial waste disposal company.

4.10.13 Disposal. The College shall contract with a reputable waste disposal contractor who will show evidence that the disposal means used by that contractor are means that fall within the legal requirements and provide due consideration of the environmental consequences of waste disposal.

5. SPECIFIC HAZARDS FOR INDIVIDUAL LABORATORIES AND STUDIOS

Specific hazards have been identified for individual laboratories on Bennington College's campus. These hazards include chemical and physical hazards. Refer to Appendix E for hazards associated with Dickinson Science Building. Refer to Appendix F for hazards associated with VAPA. Refer to Appendix G for hazards associated with Buildings and Grounds.

6. TRAINING

Training on the safe use of laboratory chemicals shall include methods of detecting the presence of hazardous chemicals, physical and health hazards of chemicals in the lab, and measures lab personnel can take to protect themselves from these hazards. OSHA Hazardous Communication/SDS, Fire Safety, and Slip, Trip and Fall trainings are required for all employees on an annual basis. All other safety training offered by the college is required for employees whose jobs include the hazards identified by the training.

Employees shall be instructed by Lab Safety Officers on the hazards presented by the specific chemicals in use in the laboratory in which they work. They are to receive training at the time of initial assignment to the laboratory or laboratories and prior to any assignments that involve new exposure situations.

Training for students, in regular courses or research tutorials, shall be conducted by faculty. All students taking a laboratory class will sign a safety contract at the beginning of each term confirming they have been trained on the general hazards of each lab.

Training for employees shall include discussion of:

- The provisions of OSHA Laboratory Standard, 29 CFR 1910.1450;
- The location and availability of the Chemical Hygiene Plan;
- Signs and symptoms associated with exposure to the chemicals present in the laboratory;
- Standard operating procedures from the Chemical Hygiene Plan and other sources that are relevant to the individual's work in the laboratory;

- The permissible exposure limits for OSHA-regulated substances or recommended exposure values for other hazardous chemicals not regulated by OSHA that are present in the lab;
- Location and availability of appropriate reference materials on chemical hygiene and lab safety.

Appendix A

Laboratory Safety Personnel 2021-2022

Chemical Hygiene Officer: Abbey Killam (Dickinson 200, x 4470, akillam@bennington.edu)

Laboratory Safety Officers:

Lab Name/Location	*Lab Safety Officer(s)*	*Contact Information*
Chemistry Lab	Abbey Killam	Dickinson 200, ext. 4470
Dickinson 205		akillam@bennington.edu
Instrument Room	Abbey Killam	Dickinson 200, ext. 4470
Dickinson 218/219		akillam@bennington.edu
Chemistry Research Lab	John Bullock	Dickinson 208, ext. 4463
Dickinson 208		jbullock@bennington.edu
Chemistry Research Lab	John Bullock	Dickinson 203, ext. 4472
Dickinson 203		jbullock@bennington.edu
Physics Lab	Hugh Crowl	Dickinson 104, ext. 4481
Dickinson 238		hcrowl@bennington.edu
Geology Lab	Tim Schroeder	Dickinson 233, ext. 4496
Dickinson 232		tschroeder@bennington.edu
Cell Biology Lab	Amie McClellan	Dickinson 111, ext. 4469
Dickinson 110		amcclellan@bennington.edu
Animal Physiology Lab	Blake Jones	Dickinson 107, ext. 4466
Dickinson 106		blakejones@bennington.edu
Ecology Lab	Kerry Woods	Dickinson 149, ext. 4465
Dickinson 143		kwoods@bennington.edu
Biology Teaching Lab	Abbey Killam	Dickinson 200, ext. 4470
Dickinson 146/147		akillam@bennington.edu

Photography/Digital Lab	Veronica Melendez	VAPA E110, ext. 4736
VAPA E109/E110		veronicamelendez@bennington.edu
Photography/Alternative Process Darkroom	Veronica Melendez	VAPA E110, ext. 4736
VAPA E105		veronicamelendez@bennington.edu
Photography	Dakota Pace	VAPA E204
VAPA E106		dakotapace@bennington.edu
Photography	Veronica Melendez	VAPA E110, ext. 4736
VAPA E107		veronicamelendez@bennington.edu
Photography/B&W Analog Darkroom	Veronica Melendez	VAPA E110, ext. 4736
VAPA D106		veronicamelendez@bennington.edu
Ceramics Studio	Joshua Primmer	VAPA B107
VAPA B102/Outside Building		joshuaprimmer@bennington.edu
Scene Shop	Seancolin Hankins	VAPA E227, ext. 4542
VAPA E117		seancolinhankins@bennington.edu
3D-Printing Studio	Dakota Pace	VAPA E204
VAPA B105		dakotapace@bennington.edu
Print Making Studio	Corinne Rhodes	VAPA D101, ext. 4886
VAPA D102		corinnerhodes@bennington.edu
Print Making Studio	Corinne Rhodes	VAPA D101, ext. 4886
EAC2		corinnerhodes@bennington.edu
Sculpture Studio	John Umphlett	VAPA B112, ext. 4562
VAPA B109		jumphlett@bennington.edu
Costume Shop	Richard MacPike	VAPA D111, ext. 4564/4563
VAPA D108		rmacpike@bennington.edu
CNC Area	John Crowe	VAPA D207
VAPA B109		johncrowe@bennington.edu
Metal Shop	John Umphlett	VAPA B112, ext. 4562

VAPA B109		jumphlett@bennington.edu
Back Crit Room (Painting)	Abbey Killam, Housekeeper: Brenda George	Dickinson 200, ext. 4470
VAPA B206		akillam@bennington.edu
The Feeley Studio (Painting)	Abbey Killam, Housekeeper: Brenda George	Dickinson 200, ext. 4470
VAPA C201		akillam@bennington.edu
Intermediate Painting Studio	Abbey Killam, Housekeeper: Brenda George	Dickinson 200, ext. 4470
VAPA B205		akillam@bennington.edu
Old Carpenter's Shop	Abbey Killam	Dickinson 200, ext. 4470
Orchard		akillam@bennington.edu
Swan Garage	Abbey Killam	Dickinson 200, ext. 4470
Faculty Row		akillam@bennington.edu
Drawing Studio	Abbey Killam	Dickinson, ext. 4470
VAPA B210		akillam@bennington.edu
Carpenter Workshop	Dan Pratt, Sam Griffis, Mark Hunter, Pete Swanson	Buildings and Grounds, ext. 4584
Buildings and Grounds		buildingsandgrounds@bennington.edu
Plumbing Workshop	Neil Kenyon, Page Williams	Buildings and Grounds, ext. 4584
Buildings and Grounds		buildingsandgrounds@bennington.edu
Painting Workshop	Pete Swanson	Buildings and Grounds, ext. 4584
Buildings and Grounds		buildingsandgrounds@bennington.edu
Grounds	Melissa West, Nate Cornwell, Tex Aiken	Buildings and Grounds, ext. 4584
Buildings and Grounds		buildingsandgrounds@bennington.edu
Locksmith	Joe Vadakin	Buildings and Grounds, ext. 4584
Buildings and Grounds		buildingsandgrounds@bennington.edu
Electrician Workshop	Chris Dickinson	Buildings and Grounds, ext. 4584
Buildings and Grounds		buildingsandgrounds@bennington.edu
Purchasing and Shipping/Receiving	Tim Hutton, Mark Mason	Buildings and Grounds, ext. 4584
Buildings and Grounds		buildingsandgrounds@bennington.edu

Boiler Room	Rickey Setzer	Buildings and Grounds, ext. 4584
Buildings and Grounds		buildingsandgrounds@bennington.edu

Appendix B

Incident Report Form

For apparently non-serious injuries or exposures:
Contact the Laboratory Safety Officer

For any injury or exposure which may seem serious or life-threatening,
First: call 8-911 immediately with detailed information on the location of patient(s)
Next: call 767 to notify Campus Safety
Next: locate hard copy of relevant SDS(s)

Describe incident/accident:

If Injuries or Exposures: (one sheet for each patient)

Date: _____ **Time of injury/exposure:** _____

Name of patient: _____ **Age:** _____

Current medications: _____

Medical history: _____

Known allergies: _____

Best Estimate of Exposure:

Substance(s): _____

Duration and route of exposure: _____
(Inhalation, ingestion, injection, absorption)

NOTE: Transfer relevant SDS(s) to emergency room or physician with patient.

Signs and Symptoms

Symptoms reported by patient

Signs of injury and/or exposure as reported by bystanders:

Actions taken on scene:

Emergency Room Personnel: Please make a copy of this form for your records, if necessary, and return the original to:

Human Resources
Bennington College
Bennington, VT 05201.

Appendix C

Hazardous Waste Disposal

Purpose

The purpose of this policy is to 1) prevent haphazard or indiscriminate disposal of College-generated wastes that can pose a hazard to health and the environment, and 2) to provide for the proper and legal disposal of such wastes.

Definitions

Generally, waste is defined as surplus, unneeded, or unwanted material. Lab workers have some latitude in declaring a substance as a waste, although some regulations limit this discretion. Anything that is abandoned or "inherently waste-like" (such as a spilled substance) is a waste.

The following characteristics are associated with hazardous materials (40 CFR 261.21-261.24):

(1) A material is ignitable (flammable) if it has any of the following characteristics:

- it has a flashpoint of less than 60 C (140 F), or some other characteristic that has the potential to cause fire;
- it is capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture, or spontaneous chemical changes and, when ignited, burns vigorously and persistently so as to create a hazard;
- it is a flammable compressed gas, or can form a flammable gas mixture;
- is it an oxidizer that stimulates combustion of organic materials.

(2) A material is corrosive if it is a liquid that has a pH of less than 2 or greater than 12.5 (or corrodes certain grades of steel).

(3) The material is reactive; that is, it is normally unstable, reacts violently with water, is capable of detonation if exposed to some initiating source, or produces toxic gases.

(4) The material 1) has an LD_{50} less than 50 mg/kg (oral, rat), an LC_{50} less than 2 mg/L (rat), or a dermal LD_{50} less than 200 mg/kg (rabbit), or is otherwise capable of causing or significantly contributing to an increase in serious, irreversible, or incapacitating reversible, illness, or 2) is listed in Appendix VIII in 40 CFR 261.

Procedures

The Bennington College hazardous waste management program has four basic components: waste minimization, identification, storage, and disposal.

1. Minimization

a. Only those amounts of chemicals known to be needed should be ordered. "Economy of Scale" purchases should be avoided when the immediate foreseeable use of the chemical is not obvious.

b. Procedures should be designed, where possible, to eliminate or minimize the amount of waste materials generated. This should preferably be included as part of the lab experiment for student laboratories.

c. Whenever possible, spent solvents should be recovered and recycled by distillation or chromatographic purification for reuse.

d. Aqueous solutions of acids and bases should be neutralized before flushing down the drain with large volumes of water.

e. Solutions containing toxic heavy metals such as mercury, lead, chromium, silver, etc. should be disposed of as hazardous waste and labelled appropriately.

f. Fume hoods should not be used as a means of disposal of volatile chemicals.

g. Liquid organic wastes are to be emptied into labelled containers kept in vented metal cabinets in each laboratory. Organic wastes are separated into two categories: halogenated and non-halogenated.

h. Highly reactive wastes, such as acid chlorides, should be converted to a less reactive form before disposing in the waste containers.

2. Identification

a. All wastes are to be clearly labeled with: contents, the name of the person who labeled it, and the date. Labels are to be as specific and thorough as possible. For example: "used degreaser, ARMCO-SD 70 from Geology Lab" tells more than simply "used degreased" or "waste solvent." Labels should include product or chemical name, suspected contaminants, and a note about the process, which produced it.
   - Hazardous waste is labelled with a yellow “Hazardous Waste” sticker (obtained from the CHO) and is labelled with: generator name, generator address, generator phone number, waste contents, EPA ID number, type of hazardous waste, and waste hazard code.
   - Bennington College’s EPA ID: VTD981886765

b. Every effort should be made to avoid an unlabeled waste container. If such a container is discovered, the lab supervisor should attempt to determine the most likely contents of the container by interviewing appropriate people. The substance should be analyzed only if there is a high degree of certainty that this can be done without risk. If this cannot be done, the substance must be disposed of as an "unknown" at considerable cost to the College.

3. Storage

a. Each laboratory is responsible for storing its own waste until it is transferred to a central waste accumulation location prior to being picked up by a disposal firm.
   - The central waste accumulation is located at B&G in the waste disposal shed.

b. Each generator (lab) may accumulate no more than 55 gallons of hazardous waste or 1 quart of acutely hazardous waste.

c. The Code of Federal Regulations states that hazardous waste pick-ups are to occur within 180 days after the waste starts to accumulate (at the collection site) to avoid becoming a storage facility. All laboratories will be notified of the collection date so that wastes can be made available for pick-up.

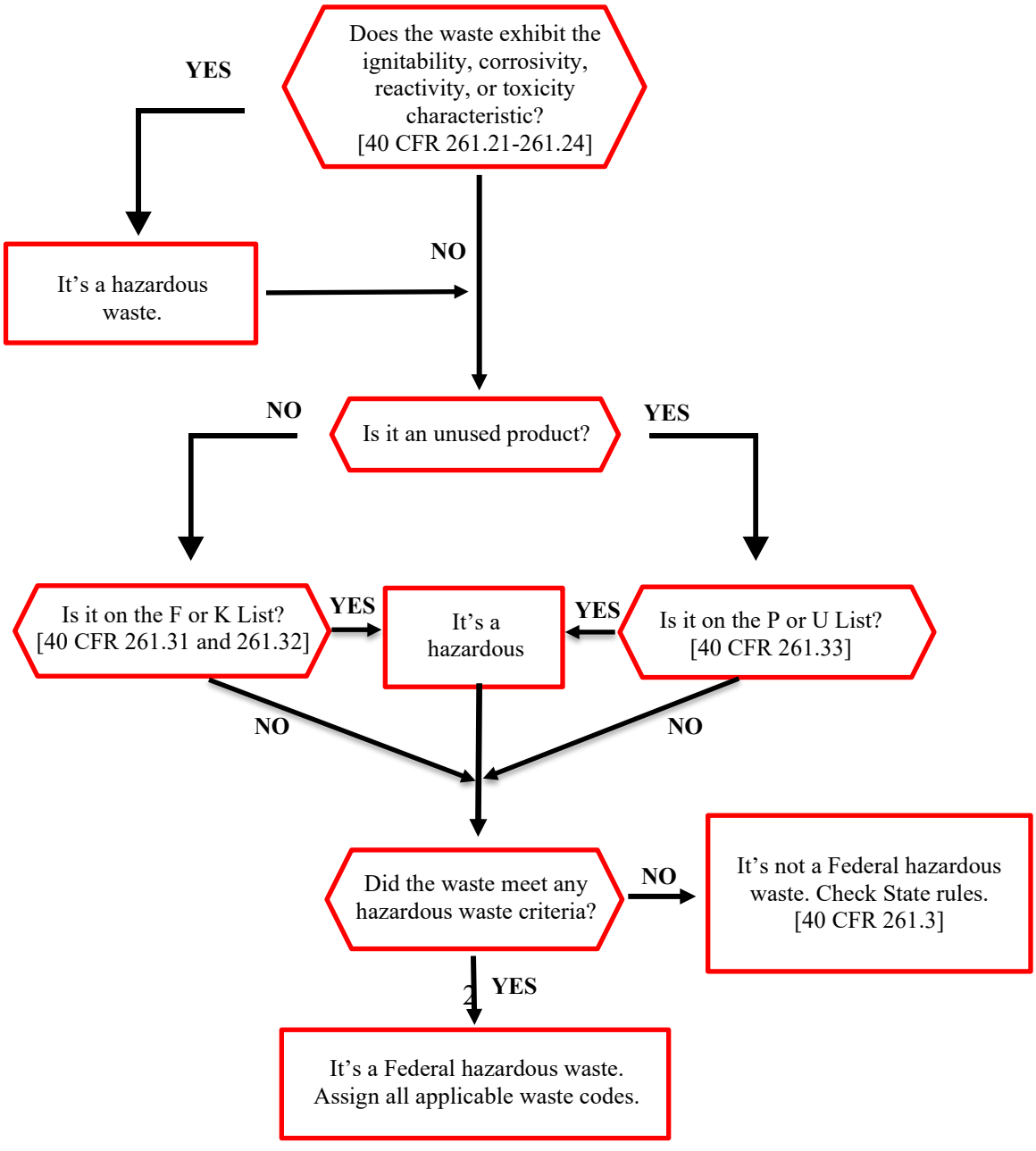
4. Disposal

Certain chemical wastes are not to be treated or disposed of on campus, but are shipped off campus. Wastes sent off campus include those that require special disposal permits, those subject to regulations specifying where and how they may be disposed, and those for which no on-campus disposal system works. As noted above, these wastes can be accumulated for no more than 1 year at the generator/satellite locations. Once at the collection site, off-campus disposal must occur within 90 days

Hazardous Waste Flow Chart

Step 1 – Waste is placed in an acceptable container. A hard thick plastic bottle or rinsed glass bottle are appropriate containers for waste disposal.

Step 2 – Determine if the waste is hazardous or non-hazardous. Ask yourself the following flow of questions to determine the status of your waste. All contents of your waste need to be written out on the label.



Addendum

Samples of Hazardous Waste
MPCA - Toxic and Hazardous Wastes. Toxic and hazardous wastes are waste materials including but not limited to poisons, pesticides, herbicides, acids, caustics, pathological wastes, radioactive materials, flammable or explosive materials, and similar harmful chemicals and wastes which require special handling and must be disposed of in a manner to conserve the environment and protect the public health and safety.

Small Quantity Generator
The college operates as a small quantity generator (SQG). In the even of a fire, explosion, or other release that could threaten human health outside the facility or when the generator has knowledge that a spill has reached surface water, the generator must immediately notify the chemical hygiene officer and campus safety. The chemical hygiene officer will then notify the National Response Center at (800) 424-8802. The notification must provide the following information:

- Generator's name, address, and EPA ID
- Date, time, and type of incident
- Quantity and type of hazardous waste involved in the incident
- Extent of any injuries
- Estimated quantity and disposition of recovered materials

Appendix D

General Chemical Compatibility Guidelines

The following information is to be used only as a guide. Specific incompatibilities will be listed on the Material Safety Data Sheets.

Separate acids from
• Bases (possible violent exothermic reaction)
• Most metals (production of flammable hydrogen gas)
• Cyanides (forms toxic and flammable hydrogen cyanide gas)
• Sulfides (forms toxic and flammable hydrogen sulfide gas)
• Azides (may form explosive hydrazoic acid)
• Phosphides (may form toxic and flammable phosphene gas)
• Oxidizers (may form toxic and/or explosive compounds)

Separate oxidizers from
• Acids (may form toxic and/or explosive compounds) (For example: concentrated sulfuric acid mixed with chlorates or perchlorates forms explosive compounds)
• Organic materials (especially when mixed with flammables, may ignite)
• Metals (may form explosive compounds)
• Reducing agents (for example: boranes, hydrides, sodium hydrosulfite, etc.)
• Ammonia (anhydrous or aqueous)

Separate water-reactive chemicals from
• Aqueous solutions and in many cases just the moisture in the air (for example: metal hydrides, alkali metals and certain metal dusts in moist air will form hydrogen gas and ignite; halosilanes and acid halides will react with water to form toxic acid gases)

Separate Sodium Hypochlorite (bleach) from
• Acids (release of chlorine gas may occur)
• Solution containing ammonia (release of chlorine gas may occur, risk of explosive compounds)
• Organics (release of chlorine gas may occur, risk of explosive compounds)
• Metals (Pressurization may occur)
• Hydrogen Peroxide (violent release of oxygen gas may occur)
• Reducing Agents (heat reaction may occur)

Appendix E

Specific hazards associated with Dickinson Science Building

Chemistry Lab (Rooms 203, 204, 205, 206, 208, 218, and 219)

1. **Corrosives.** A corrosive chemical destroys or damages living tissue by direct contact. Some acids, bases, dehydrating agents, oxidizing agents, and organics are corrosives. To ensure safe handling of corrosives, the following special handling procedures should be used:
    - **a.** Always store corrosives properly. Refer to the SDSs and the Chemical Storage section of this manual for more information.
    - **b.** Always wear gloves and face and eye protection when working with corrosives. Wear other personal protective equipment, as appropriate.
    - **c.** To dilute acids, add the acid to the water, not the water to the acid.
    - **d.** Corrosives, especially inorganic bases (e.g., sodium hydroxide), may be very slippery; handle these chemicals with care and clean any spills, leaks, or dribbles immediately.
    - **e.** Use a chemical fume hood when handling fuming acids or volatile irritants (e.g., ammonium hydroxide).
    - **f.** A continuous flow eye wash station should be in every work area where corrosives are present. An emergency shower should also be within 100 feet of the area.

2. **Flammables.** A flammable chemical is any solid, liquid, vapor, or gas that ignites easily and burns rapidly in air. Consult the appropriate SDSs before beginning work with flammables. Follow these guidelines when working with flammable chemicals:
    - **a.** Handle flammable chemicals in areas free from ignition sources.
    - **b.** Never heat flammable chemicals with an open flame. Use a water bath, oil bath, heating mantle, hot air bath, etc.
    - **c.** Use ground straps when transferring flammable chemicals between metal containers to avoid generating static sparks.
    - **d.** Use a fume hood when there is a possibility of dangerous vapors. (Ventilation will help reduce dangerous vapor concentrations.)
    - **e.** Restrict the amount of stored flammables, and minimize the amount of flammables present in a work area.
    - **f.** Remove from storage only the amount of chemical needed for a particular experiment or task.

3. **Solvents.** Organic solvents are often the most hazardous chemicals in the work place. Solvents such as ether, alcohols, and toluene, for example, are highly volatile or flammable. Chlorinated solvents such as chloroform are nonflammable, but when exposed to heat or flame, may produce carbon monoxide, chlorine, phosgene, or other highly toxic gases. Always use volatile and flammable solvents in an area with good ventilation or in a fume hood. Never use ether or other highly flammable solvents in a room with open flames or other ignition sources present.

4. **Reactives and Explosives.** Reactive chemicals are sensitive to either friction or shock or they react in the presence of air, water, light, or heat. Explosive chemicals decompose or burn very rapidly when subjected to shock or ignition. Reactive and explosive chemicals produce large amounts of heat and gas; they are extremely dangerous. Examples of reactive chemicals that are present in the Chemistry Lab are:

a. Diethyl Ether
b. Sodium Metal
c. Metal and non-metal hydrides (boranes, $LiAlH_4$)

5. Toxic Chemicals. The toxicity of a chemical refers to its ability to damage an organ system (kidneys, liver), disrupt a biochemical process (e.g., the blood-forming process) or disturb an enzyme system at some site remote from the site of contact. Toxicity is a property of each chemical that is determined by molecular structure. Exposure of toxic chemicals can occur by inhalation, absorption, ingestion, or injection.

a. Acute Toxins can cause severe injury or death as a result of short-term, high-level exposure. Do not work alone when handling acute toxins. Use a fume hood to ensure proper ventilation and wear personal protective equipment compatible for the chemical that is being use. Consult the chemical's SDS for exact PPE requirements. Examples of acute toxins present in the Chemistry Lab are:
   i. Arsenic
   ii. Thiophenol
   iii. Potassium cyanide
   iv. Sodium azide
   v. Benzene

b. Chronic Toxins cause severe injury after repeated exposure. Use a fume hood to ensure proper ventilation and where protective personal equipment (PPE) (gloves, goggles, etc.) when using the chemical. Always consult the chemical's SDS to ensure proper PPE is being worn. Examples of chronic toxins present in the Chemistry Lab are:
   i. Lead
   ii. Formaldehyde

c. Carcinogens are materials that can cause cancer in humans or animals. They cause damage after repeated or long-duration exposure and their effects may become evident only after a long latency period. Use a fume hood to ensure proper ventilation and where protective personal equipment (PPE) (gloves, goggles, etc.) when using the chemical. Always consult the chemical's SDS to ensure proper PPE is being worn. Examples of carcinogens present in the Chemistry Lab are:
   i. Methylene chloride (aka dichloromethane)
   ii. Cadmium compounds
   iii. Chromate, hexavalent compounds
   iv. Formaldehyde

d. Reproductive Toxins are chemicals that can produce adverse effects in parents and developing embryos. Chemicals including heavy metals, some aromatic solvents (benzene, toluene, xylenes, etc.), and some therapeutic drugs are capable of causing these effects. Use a fume hood to ensure proper ventilation and where protective personal equipment (PPE) (gloves, goggles, etc.) when using the chemical. Always consult the chemical's SDS to ensure proper PPE is being worn. Examples of reproductive toxins present in the Chemistry Lab are:
   i. Chloroform
   ii. Lead

e. Sensitizers may cause little or no reaction upon first exposure. Repeated exposures may result in severe allergic reactions. Wear proper PPE when working with sensitizers. Examples of sensitizers present in the Chemistry Lab are:
   i. Formaldehyde
   ii. Nickel Salts

f. Irritants cause reversible inflammation or irritation to the eyes, respiratory tract, skin, and mucous membranes. Irritants cause inflammation through long-term exposure or high concentration exposure. Wear proper PPE when working with irritants. Examples of sensitizers present in the Chemistry Lab are:
   i. Ammonia
   ii. Halogens
   iii. Formaldehyde

6. Centrifuges. Centrifuges operate at high speeds and can cause serious injury if not operated properly. Unbalanced centrifuge rotors can result in injury or death. Sample container breakage can release aerosols that are harmful if inhaled. To avoid injury, workers should follow the manufacturer's operating instructions for each make and model of centrifuge that they use. Follow these steps for the safe operation of centrifuges:

- **a.** Ensure that the centrifuge bowls and tubes are dry
- **b.** Ensure that the spindle is clean
- **c.** Use matched sets of tubes, buckets, and other equipment
- **d.** Always use safety centrifuge cups to contain potential spills and prevent aerosols
- **e.** Inspect tubes or containers for cracks or flaws before using them
- **f.** Avoid overfilling tubes or other containers
- **g.** Make sure the tubes or containers are properly balanced in the rotor
- **h.** Do not exceed the rotor's maximum run speed
- **i.** Close the centrifuge lid during operation
- **j.** Make sure that the rotor has come to a complete stop before opening the lid

7. Vacuum pumps used in laboratories pose many hazards. There are mechanical hazards associated with the moving parts. There are chemical hazards of contaminating the pump oil with volatile substances and subsequently releasing them into the lab. There are also fire hazards when pumps malfunction or overheat and ignite nearby flammable or combustible materials. Follow these Guidelines for Safe Pump Operation:

- **a. Physical** (injuries/fires)
  - i. Ensure that electrical cords and switches are free from defects.
  - ii. Do not place pumps in an enclosed, unventilated cabinet allowing heat and exhaust to build up.
  - iii. Do not operate pumps near containers of flammable chemicals, flammable chemical wastes, or combustible materials such as paper or cardboard.
  - iv. Use correct vacuum tubing (thick walls) not thin Tygon-type hose.
  - v. Replace old tubing; crumbly tubing can degrade performance.
  - vi. Use the shortest length of tubing that reaches where needed.
- **b. Chemical**
  - i. Do not use solvents that might damage the pump.
  - ii. Always close the valve between the vacuum vessel and the pump before shutting off the pump to avoid sucking vacuum oil into the system.
  - iii. Place a pan under pumps to catch oil drips.
  - iv. Check oil levels and change oil when necessary. Replace and properly dispose of vacuum pump oil that is contaminated with condensate. Used pump oil must be disposed as hazardous waste.
  - v. With oil rotary pumps many vapors condense in the pump oil. Solvents in the oil degrade its performance (and eventually ruin the pump), create a chemical hazard when the oil is changed, and are emitted in an oil mist vented from the system. Other vapors pass directly into the exhaust stream. To avoid these problems:
    1. Trap evaporated materials with a cold trap before they reach the pump. Depending on the material that is to be trapped, this can be a filtration flask either at room temperature or placed in an ice bath. For more volatile solvents more sophisticated options exist (e.g. dry ice trap).
    2. Vent the pump exhaust properly.
- **c. Personnel**
  - i. Conduct all vacuum operations behind a table shield or in a fume hood and always wear safety glasses, lab coat, and gloves.
  - ii. Keep a record for each pump to record oil change dates and to keep track of the maintenance schedule.

8. Rotary Evaporators (also called "rotavaps") are used to remove solvents from reaction mixtures and can accommodate volumes as large as 3 liters. The following is the general rules for using a rotovap safely.

a. The solvent collection flask of the unit should always be emptied prior use to prevent accidentally mixing of incompatible chemicals.
b. The flask with the solution is placed on the rotary evaporator. The use of a bump trap prevents the solution from accidentally splashing into the condenser (and being contaminated).
c. A clip is used to secure the flask and the bump trap.
d. The aspirator vacuum is turned on. The stopcock at the top of the apparatus should be closed to pull vacuum. Once the solvent is removed, the stopcock is opened to release the vacuum.
e. The water bath is raised to immerse the flask in the warm water. The water bath temperature should not exceed the boiling point of the solvent!! For small amounts of common solvents the bath heater is not needed.
f. The solvent should start collecting on the condenser and drip into the receiving flask. Some solvents (such as diethyl ether or dichloromethane) are so volatile that they will also evaporate from the receiving flask and be discharged down the drain. To prevent this, a cooling bath on the receiver or can be used.
g. Once all the solvent evaporated (or whatever is desired at this point), the vacuum is released. The flask is removed from the water bath and the spinning is discontinued.

9. **Hot Plates/Heating Mantles** can become very hot and need to be handled with extreme caution to avoid possible injury. The following are guidelines to using a hot plate or heating mantle safely.
   a. When heating material, make sure the glassware's heat resistance is high. Also, inspect the glassware for cracks visible to the naked eye to avoid the glassware breaking when heating.
   b. When liquids are being brought to a boil, add boiling stones to help facilitate the process.
   c. Be careful to not let a vessel go completely dry. If there is too little moisture and the vessel remains exposed to heat, it will eventually crack.
   d. Liquids should be heated at the proper temperature. Do not overheat the liquids as that can cause uncontrollable boiling and fast evaporation.
   e. When removing objects from the hot plate or heating mantle use tongs or rubber coated, heat resistant gripping devices.
   f. Do no store volatile or flammable materials in the vicinity of a hot plate.
   g. Check for corrosion of thermostats, which can create a spark hazard.
   h. Turn off the hotplate or heating mantle when not in use.

Physics Lab (Room 238, Stock Room 220)

1. **Lasers** present many safety threats, but the most common threat is damage to the eyes. Other common laser concerns include skin damage, electrical hazards from high-energy power sources, chemical exposure, fire/explosion hazards, and exposure to cryogenic materials such as hydrogen and oxygen. Many lasers emit invisible ultraviolet or infrared radiation. Class 3a and Class 3b lasers are used in the Physics Lab. The following are guidelines when using the lasers.
   a. **Class 3a** lasers are intermediate power lasers that would not normally cause injury to the eye unless viewed with collection optics. This laser is a red laser.
      i. A Class 3a laser is low powered. It normally would not harm eyes during a momentary exposure of less than ¼ second. This is within the aversion response, where a person turns away and/or blinks to avoid bright light.
      ii. Do not deliberately look or stare into the laser beam. Laser protective eyewear is normally not necessary. A Class 3a laser is not a skin or materials burn hazard.
   b. **Class 3b** lasers are medium powered lasers that pose moderate risk and can cause injury. The physics lab contains a blue 3b laser and a green 3b laser.
      i. Never aim a laser at a person.
      ii. Wear protective clothing such as eyewear and skin protection as appropriate.
      iii. Post warning signs at entrances where lasers are present.
      iv. When working with power supplies, remove jewelry, stand on a dry surface, and work with only one hand at a time.

v. Control access to areas where lasers are used.

2. **Masonry Saws** are used to cut tiles, bricks, and blocks of stone, concrete, and other materials. The one present in the Physics' stock room is mounted to a stand. Working with saws can expose workers to hazards such as cutting blades, kick-back, push-back, and pull-ins. Follow these guidelines when working with the masonry saw.
   - **a.** Cutting blades should be the correct size, installed properly, guarded at all times, and speed should not exceed the manufacturer's suggested RPM.
   - **b.** The correct blade for the job should be used and inspected for defects before each use.
   - **c.** Never apply excessive pressure and let the blade do most of the work.
   - **d.** Use water for lubrication during the cut. Without lubrication, the saw blades can become damaged.
   - **e.** Saws should be maintained and kept clean from dust build-up.

Student Biology Lab (Room 147)

1. **Water Baths** may become contaminated by organisms incubated in them or through amplification of water or airborne organisms. It should be cleaned monthly to ensure no bacterial growth is occurring. The water in the water bath can become very hot and care should be taken when removing containers that have been incubating in the water bath.
2. **Deep Freeze.** The freezer located in the "alleyway" of room 147 is set to -80°C. When removing anything stored in the deep freeze, insulated gloves are to be worn to prevent frostbite on hands. Make sure the freezer is shut properly to prevent the freezer from working improperly causing it to heat up.

Biology Lab (Room 106)

1. **Animals** are used for student and faculty research. Bennington College is licensed to care for fish, amphibians, and other reptiles. The animals are placed in proper living conditions and are the responsibility of the researcher using the animals. If a student, faculty, or staff member has a known allergy to a specific animal, that animal will not be used for research. If a death occurs, the animal is disposed of in compliance with OHSA regulations. Always wash hands after handling animals.
2. **Scalpels and Sharp Devices.** Please observe the following safety practices when using sharp devices such as needles, scalpels, Pasteur pipettes, slides and capillary tubes while performing lab procedures.
   - **a.** Eliminate the use of devices sharp enough to puncture your skin (including glass) whenever possible.
   - **b.** Use a sharp with an engineered safety feature when such a device is available and feasible for your procedure.
   - **c.** Use scalpels/blades in the appropriate and safe manner.
     i. Before using a disposable blade, stage a sharps container within arm's reach so that it can be immediately disposed of after use.
     ii. Use disposable safety scalpels with fixed blades whenever possible. These devices eliminate the need to remove a blade, which requires significant skill to perform safely.
     iii. Do not use blades without a handle. The handle serves as a means to control the blade and puts a barrier between your hand and the sharp edge.
     iv. Do not "saw" with a scalpel or put excessive force on it. These actions can cause the blade to snap creating an aerosol and flying debris hazard as well as a sharps exposure hazard. Use knives for tasks that require greater cutting action.
     v. Do not leave blades out in the lab environment after use (i.e., left on the lab counter), regardless of what they have been used for.
   - **d.** Do not leave sharp devices out in the environment any longer than necessary.
   - **e.** Do not put excessive force on a sharps device.
   - **f.** Use an appropriate sharps container for disposal of sharps waste.
   - **g.** Do not overfill sharps containers.

Cell Biology Lab (Room 110)

1. **Autoclaves** use high pressure and high temperature steam to kill microorganisms and render biohazardous material inactive. For effective sterilization, the materials/load must be saturated with steam. Potential risks of using an autoclave are heat and steam burns, hot fluid scalds, injuries to hands and arms from the door, and bodily injury in the event of an explosion. To prevent injuries from the autoclave consult the following steps:
   - **a.** Wear appropriate Personal Protective Equipment (PPE) including a lab coat, heat resistant gloves, and eye protection, especially when unloading the autoclave.
   - **b.** Never seal containers; under pressure they pose an explosion risk.
   - **c.** Never open the door to the autoclave if there is water running out the bottom. Clogged steam lines, equipment malfunction, or plugged drains may cause a buildup of scalding water.
   - **d.** Wait for the pressure to reach zero and the temperature is at or below 121°C before opening the door at the end of a cycle to avoid steam burns and shattered glassware. Do not stand directly in front of the door.
   - **e.** Never autoclave the following:
     i. Sharps
     ii. Hazardous chemicals
     iii. Dried bleach and bleach-associated materials
     iv. Radioactive materials
     v. Pathological waste
2. **Centrifuges.** Centrifuges operate at high speeds and can cause serious injury if not operated properly. Unbalanced centrifuge rotors can result in injury or death. Sample container breakage can release aerosols that are harmful if inhaled. To avoid injury, workers should follow the manufacturer's operating instructions for each make and model of centrifuge that they use. Follow these steps for the safe operation of centrifuges:
   - **a.** Ensure that the centrifuge bowls and tubes are dry
   - **b.** Ensure that the spindle is clean
   - **c.** Use matched sets of tubes, buckets, and other equipment
   - **d.** Always use safety centrifuge cups to contain potential spills and prevent aerosols
   - **e.** Inspect tubes or containers for cracks or flaws before using them
   - **f.** Avoid overfilling tubes or other containers
   - **g.** Make sure the tubes or containers are properly balanced in the rotor
   - **h.** Do not exceed the rotor's maximum run speed
   - **i.** Close the centrifuge lid during operation
   - **j.** Make sure that the rotor has come to a complete stop before opening the lid
3. **Water Baths** may become contaminated by organisms incubated in them or through amplification of water or airborne organisms. It should be cleaned monthly to ensure no bacterial growth is occurring. The water in the water bath can become very hot and care should be taken when removing containers that have been incubating in the water bath.
4. **Hot Plates/Heating Mantles** can become very hot and need to be handled with extreme caution to avoid possible injury. The following are guidelines to using a hot plate or heating mantle safely.
   - **a.** When heating material, make sure the glassware's heat resistance is high. Also, inspect the glassware for cracks visible to the naked eye to avoid the glassware breaking when heating.
   - **b.** When liquids are being brought to a boil, add boiling stones to help facilitate the process.
   - **c.** Be careful to not let a vessel go completely dry. If there is too little moisture and the vessel remains exposed to heat, it will eventually crack.
   - **d.** Liquids should be heated at the proper temperature. Do not overheat the liquids as that can cause uncontrollable boiling and fast evaporation.
   - **e.** When removing objects from the hot plate or heating mantle use tongs or rubber coated, heat resistant gripping devices.
   - **f.** Do no store volatile or flammable materials in the vicinity of a hot plate.

g. Check for corrosion of thermostats, which can create a spark hazard.
h. Turn off the hotplate or heating mantle when not in use.

5. **Electrophoresis Equipment.** When using electrophoresis equipment, there is always the potential for injury. To avoid receiving a shock that can lead to injuries or even death, you should inspect the equipment before use and follow the general guidelines outlined below.
   a. Turn the power off before connecting the electrical leads.
   b. Connect one lead at a time, using one hand only.
   c. Ensure that hands are dry while connecting leads.
   d. Keep the apparatus away from sinks or other water sources.
   e. Turn off power before opening lid or reaching inside chamber.
   f. Do not override safety devices.
   g. Do not run electrophoresis equipment unattended.
   h. Mix all stock solutions in a chemical fume hood.
   i. Provide spill containment by mixing gels on a plastic tray.
   j. Decontaminate surfaces with ethanol. Dispose of all cleanup materials as hazardous waste.

Machine Shop (Room 140)

1. **General Machinery and Equipment Hazards.** Several general types of hazards exist on many types of machinery.
   a. Rules for all Machines. The owner or operator's manual must be in the shop area with the machine. The area of operation must be free and clear of obstructions. Space must be provided between each machine and other objects, including other machine operating areas, as needed, to allow safe operation of the machine. Students are not permitted to work alone in the shop and must be supervised by a qualified individual. Before using a machine, proper training will be administered to lessen the probability of injury.
   b. Point of Operation refers to the area where work (e.g. cutting, shearing, shaping, boring) is performed on a stock material. Some machinery, such as table saws and band saw have point of operation guarding that must be in place during operation.
   c. Nip or Pinch Point refers to an area other than a point of operation where a belt contacts a pulley or one or more rotating parts come together where it is possible for a part of the body to get nipped or pinched by the moving parts. Machinery with rollers are a prime example of nip/pinch points.
   d. Power Transmission refers to areas where power is transferred from one part to another such as a drive shaft, belt, or chain. Belts, pulleys, flywheels, rotating parts etc. must be guarded to prevent entanglement and amputations.

Appendix F

Specific hazards associated with the Visual and Performing Arts Building (VAPA)

(Information sourced from Princeton University Environmental Health and Safety)

Photography/Alternative Process Darkroom (Rooms E105, E106)

Black-and-White Photographic Processing A wide variety of chemicals are used in black and white photographic processing. Film developing is usually done in closed canisters. Print processing uses tray processing, with successive developing baths, stop baths, fixing baths, and rinse steps. Other treatments include use of hardeners, intensifiers, reducers, toners, and hypo eliminators.

1. **Mixing Photochemicals** They can be bought in liquid form, which only need diluting, or powder form, which need dissolving and diluting. The following is the hazards and precautions to take when mixing photochemicals.
   - **a.** Developer solutions and powders are often highly alkaline, and glacial acetic acid, used in making the stop bath, is also corrosive by skin contact, inhalation and ingestion.
   - **b.** Developer powders are highly toxic by inhalation, and moderately toxic by skin contact, due to the alkali and developers themselves.
   - **c.** Use liquid chemistry whenever possible, rather than mixing developing powders. Pregnant women should not be exposed to powdered developer.
   - **d.** When mixing powdered developers, use a glove box (a cardboard box with glass top, and two holes in the sides for hands and arms), local exhaust ventilation, or wear a NIOSH-approved toxic dust respirator.
   - **e.** Wear gloves, goggles and protective apron when mixing concentrated photochemicals. Always add any acid to water, never the reverse.
   - **f.** In case of skin contact, rinse with lots of water. In case of eye contact, rinse for at least 15-20 minutes, preferably using an eyewash station, seek medical attention.
   - **g.** Store concentrated acids and other corrosive chemicals on low shelves so as to reduce the chance of face or eye damage in case of breakage and splashing.
   - **h.** Do not store photographic solutions in glass containers.

2. **Developing Baths** The most commonly used developers are hydroquinone, monomethyl para-amino phenol sulfate, and phenidone. Several other developers are used for special purposes. Other common components of developing baths include an accelerator, often sodium carbonate or borax, sodium sulfite as a preservative, and potassium bromide as a restrainer or antifogging agent. Hazards and precautions to take are below:
   - **a.** Developers are skin and eye irritants, and in many cases strong sensitizers. Monomethyl-p-aminophenol sulfate creates many skin problems, and allergies to it are frequent (although this is thought to be due to the presence of para-phenylene diamine as a contaminant). Hydroquinone can cause depigmentation and eye injury after five or more years of repeated exposure, and is a mutagen. Some developers also can be absorbed through the skin to cause severe poisoning (e.g., catechol, pyrogallic acid). Phenidone is only slightly toxic by skin contact.
   - **b.** Most developers are moderately to highly toxic by ingestion, with ingestion of less than one tablespoon of compounds such as monomethyl-p-aminophenol sulfate, hydroquinone, or pyrocatechol being possibly fatal for adults. Symptoms include ringing in the ears (tinnitus), nausea, dizziness, muscular twitching, increased respiration, headache, cyanosis (turning blue from lack of oxygen) due to methemoglobinemia, delirium, and coma. With some developers, convulsions also can occur.
   - **c.** Para-phenylene diamine and some of its derivatives are highly toxic by skin contact, inhalation, and ingestion. They cause very severe skin allergies and can be absorbed through the skin.
   - **d.** Sodium hydroxide, sodium carbonate, and other alkalis used as accelerators are highly corrosive by skin contact or ingestion. This is a particular problem with the pure alkali or with concentrated stock solutions.

e. Potassium bromide is moderately toxic by inhalation or ingestion and slightly toxic by skin contact. Symptoms of systemic poisoning include somnolence, depression, lack of coordination, mental confusion, hallucinations, and skin rashes.

f. Sodium sulfite is moderately toxic by ingestion or inhalation, causing gastric upset, colic, diarrhea, circulatory problems, and central nervous system depression. It is not appreciably toxic by skin contact. If heated or allowed to stand for a long time in water or acid, it decomposes to produce sulfur dioxide, which is highly irritating by inhalation.

Precautions

a. See the section on Mixing Photochemicals for mixing precautions.

b. Do not put your bare hands in developer baths. Use tongs instead. If developer solution splashes on your skin or eyes immediately rinse with lots of water. For eye splashes, continue rinsing for 15-20 minutes and seek medical attention.

c. Do not use para-phenylene diamine or its derivatives if at all possible.

3. **Stop Baths and Fixer** Stop baths are usually weak solutions of acetic acid. Acetic acid is commonly available as pure glacial acetic acid or 28% acetic acid. Some stop baths contain potassium chrome alum as a hardener. Fixing baths contain sodium thiosulfate ("hypo") as the fixing agent, and sodium sulfite and sodium bisulfite as a preservative. Fixing baths also may also contain alum (potassium aluminum sulfate) as a hardener and boric acid as a buffer.

   Hazards

   a. Acetic acid, in concentrated solutions, is highly toxic by inhalation, skin contact, and ingestion. It can cause dermatitis and ulcers and can strongly irritate the mucous membranes. The final stop bath is only slightly hazardous by skin contact. Continual inhalation of acetic acid vapors, even from the stop bath, may cause chronic bronchitis.

   b. Potassium chrome alum or chrome alum (potassium chromium sulfate) is moderately toxic by skin contact and inhalation, causing dermatitis and allergies.

   c. In powder form, sodium thiosulfate is not significantly toxic by skin contact. By ingestion it has a purging effect on the bowels. Upon heating or long standing in solution, it can decompose to form highly toxic sulfur dioxide, which can cause chronic lung problems. Many

   d. asthmatics are particularly sensitive to sulfur dioxide.

   e. Sodium bisulfite decomposes to form sulfur dioxide if the fixing bath contains boric acid, or if acetic acid is transferred to the fixing bath on the surface of the print.

   f. Alum (potassium aluminum sulfate) is only slightly toxic. It may cause skin allergies or irritation.

   g. Boric acid is moderately toxic by ingestion or inhalation and slightly toxic by skin contact (unless the skin is abraded or burned, in which case it can be highly toxic).

   Precautions

   a. All darkrooms require good ventilation to control the level of acetic acid vapors and sulfur dioxide gas produced in photography.

   b. Wear gloves and goggles.

   c. Cover all baths when not in use to prevent evaporation or release of toxic vapors and gases.

4. **Intensifiers and Reducers** A common after-treatment of negatives (and occasionally prints) is either intensification or reduction. Common intensifiers include hydrochloric acid and potassium dichromate, or potassium chlorochromate. Mercuric chloride followed by ammonia or sodium sulfite, Monckhoven's intensifier consisting of a mercuric salt bleach followed by a silver nitrate/potassium cyanide solution, mercuric iodide/sodium sulfite, and uranium nitrate are older, now discarded, intensifiers. Reduction of negatives is usually done with Farmer's reducer, consisting of potassium ferricyanide and hypo. Reduction has also be done historically with iodine/potassium cyanide, ammonium persulfate, and potassium permanganate/sulfuric acid.

   Hazards

   a. Potassium dichromate and potassium chlorochromate are probable human carcinogens and can cause skin allergies and ulceration. Potassium chlorochromate can release highly toxic chlorine gas if heated or if acid is added.

b. Concentrated hydrochloric acid is corrosive; the diluted acid is a skin and eye irritant.

c. Mercury compounds are moderately toxic by skin contact and may be absorbed through the skin. They are also highly toxic by inhalation and extremely toxic by ingestion. Uranium intensifiers are radioactive and are especially hazardous to the kidneys.

d. Sodium or potassium cyanide is extremely toxic by inhalation and ingestion, and moderately toxic by skin contact. Adding acid to cyanide forms extremely toxic hydrogen cyanide gas which can be rapidly fatal.

e. Potassium ferricyanide, although only slightly toxic by itself, will release hydrogen cyanide gas if heated, if hot acid is added, or if exposed to strong ultraviolet light (e.g., carbon arcs). Cases of cyanide poisoning have occurred through treating Farmer's reducer with acid.

f. Potassium permanganate and ammonium persulfate are strong oxidizers and may cause fires or explosions in contact with solvents and other organic materials.

Precautions

a. Chromium intensifiers are probably the least toxic intensifiers, even though they are probable human carcinogens. Gloves and goggles should be worn when preparing and using these intensifiers. Mix the powders in a glove box or wear a NIOSH-approved toxic dust respirator. Do not expose potassium chlorochromate to acid or heat.

b. Do not use mercury, cyanide or uranium intensifiers, or cyanide reducers because of their high or extreme toxicity.

c. The safest reducer to use is Farmer's reducer. Do not expose Farmer's reducer to acid, ultraviolet light, or heat.

5. **Toners** Toning a print usually involves replacement of silver by another metal, for example, gold, selenium, uranium, platinum, or iron. In some cases, the toning involves replacement of silver metal by brown silver sulfide, for example, in the various types of sulfide toners. A variety of other chemicals are also used in the toning solutions.

   Hazards

   a. Sulfides release highly toxic hydrogen sulfide gas during toning, or when treated with acid.

   b. Selenium is a skin and eye irritant and can cause kidney damage. Treatment of selenium salts with acid may release highly toxic hydrogen selenide gas. Selenium toners also give off large amounts of sulfur dioxide gas.

   c. Gold and platinum salts are strong sensitizers and can produce allergic skin reactions and asthma, particularly in fair-haired people.

   d. Thiourea is a probable human carcinogen since it causes cancer in animals.

   Precautions

   a. Carry out normal precautions for handling toxic chemicals as described in previous sections. Wear gloves and goggles. See also the section on mixing photochemicals.

   b. Toning solutions must be used with local exhaust ventilation.

   c. Take precautions to make sure that sulfide or selenium toners are not contaminated with acids. For example, with two bath sulfide toners, make sure you rinse the print well after bleaching in acid solution before dipping it in the sulfide developer.

   d. Avoid thiourea whenever possible because of its probable cancer status.

6. **Other Hazards** Many other chemicals are also used in black and white processing, including formaldehyde as a pre-hardener, a variety of oxidizing agents as hypo eliminators (e.g., hydrogen peroxide and ammonia, potassium permanganate, bleaches, and potassium persulfate), sodium sulfide to test for residual silver, silver nitrate to test for residual hypo, solvents such as methyl chloroform and freons for film and print cleaning, and concentrated acids to clean trays .Electrical outlets and equipment can present electrical hazards in darkrooms due to the risk of splashing water.

   Hazards

   a. Concentrated sulfuric acid, mixed with potassium permanganate or potassium dichromate, produces highly corrosive permanganic and chromic acids.

   b. Hypochlorite bleaches can release highly toxic chlorine gas when acid is added, or if heated.

c. Potassium persulfate and other oxidizing agents used as hypo eliminators may cause fires when in contact with easily oxidizable materials, such as many solvents and other combustible materials. Most are also skin and eye irritants.

Precautions

a. See previous sections for precautions in handling photographic chemicals.

b. Cleaning acids should be handled with great care. Wear gloves, goggles and acid-proof, protective apron. Always add acid to the water when diluting.

c. Do not add acid to, or heat, hypochlorite bleaches.

d. Keep potassium persulfate and other strong oxidizing agents separate from flammable and easily oxidizable substances.

e. Install ground fault interrupters (GFCIs) whenever electrical outlets or electrical equipment (e.g. enlargers) are within six feet of the risk of water splashes.

Color Processing Color processing is much more complicated than black and white processing, and there is a wide variation in processes used by different companies. Color processing can be either done in trays or in automatic processors.

1. **Color Developing Baths** The first developer of color transparency processing usually contains monomethyl-p-aminophenol sulfate, hydroquinone, and other normal black and white developer components. Color developers contain a wide variety of chemicals including color coupling agents, penetrating solvents (such as benzyl alcohol, ethylene glycol, and ethoxydiglycol), amines, and others.

   Hazards

   a. See the developing section of black and white processing for the hazards of standard black and white developers.

   b. In general, color developers are more hazardous than black and white developers. Para-phenylene diamine, and its dimethyl and diethyl derivatives, are known to be highly toxic by skin contact and absorption, inhalation, and ingestion. They can cause very severe skin irritation, allergies and poisoning. Color developers have also been linked to lichen planus, an inflammatory skin disease characterized by reddish pimples which can spread to form rough scaly patches. Recent color developing agents such as 4-amino-N-ethyl-N-[P-methane- sulfonamidoethyl]-m-toluidine sesquisulfate monohydrate and 4-amino-3-methyl-N-ethyl-N-[,3-hydroxyethyl]-aniline sulfate are supposedly less hazardous, but still can cause skin irritation and allergies.

   c. Most amines, including ethylene diamine, tertiary-butylamine borane, the various ethanolamines, etc. are strong sensitizers, as well as skin and respiratory irritants.

   d. Although many of the solvents are not very volatile at room temperature, the elevated temperatures used in color processing can increase the amount of solvent vapors in the air. The solvents are usually skin and eye irritants.

   Precautions

   a. Wear gloves and goggles when handling color developers.

   b. Mix powders in a glove box or wear a NIOSH-approved toxic dust respirator.

   c. Color processing needs more ventilation than black and white processing due to the use of solvents and other toxic components at elevated temperatures.

2. **Color Processing: Bleaching, Fixing, and Other Steps** Many of the chemicals used in other steps of color processing are essentially the same as those used for black and white processing. Examples include the stop bath and fixing bath. Bleaching uses a number of chemicals, including potassium ferricyanide, potassium bromide, ammonium thiocyanate, and acids. Chemicals found in prehardeners and stabilizers include succinaldehyde and formaldehyde; neutralizers can contain hydroxylamine sulfate, acetic acid, and other acids.

   Hazards

   a. Formaldehyde is moderately toxic by skin contact, and highly toxic by inhalation and ingestion. It is an skin, eye and respiratory irritant, and strong sensitizer, and is a probable human carcinogen. Formaldehyde solutions contain some methanol, which is highly toxic by ingestion.

   b. Succinaldehyde is similar in toxicity to formaldehyde but is not a strong sensitizer or carcinogen.

c. Hydroxylamine sulfate is a suspected teratogen in humans since it is a teratogen (causes birth defects) in animals. It is also a skin and eye irritant.

d. Concentrated acids, such as glacial acetic acid, hydrobromic acid, sulfamic acid and p-toluenesulfonic acids are corrosive by skin contact, inhalation and ingestion.

e. Acid solutions, if they contain sulfites or bisulfites (e.g., neutralizing solutions), can release sulfur dioxide upon standing. If acid is carried over on the negative or transparency from one step to another step containing sulfites or bisulfites, then sulfur dioxide can be formed.

f. Potassium ferricyanide will release hydrogen cyanide gas if heated, if hot acid is added, or if exposed to strong ultraviolet radiation.

Precautions

a. Local exhaust ventilation is required for mixing of chemicals and color processing.

b. Use premixed solutions whenever possible.

c. Avoid color processes using formaldehyde, if possible.

d. Wear gloves, goggles and protective apron when mixing and handling color processing chemicals. When diluting solutions containing concentrated acids, always add the acid to the water. An eyewash should be available.

e. A water rinse step is recommended between acid bleach steps and fixing steps to reduce the production of sulfur dioxide gas.

f. Do not add acid to solutions containing potassium ferricyanide or thiocyanate salts.

g. Control the temperature carefully according to manufacturer's recommendations to reduce emissions of toxic gases and vapors.

Ceramics Studio (VAPA B102/Outside Building)

1. Flammables. A flammable chemical is any solid, liquid, vapor, or gas that ignites easily and burns rapidly in air. Consult the appropriate SDSs before beginning work with flammables. Follow these guidelines when working with flammable chemicals:

a. Handle flammable chemicals in areas free from ignition sources.

b. Never heat flammable chemicals with an open flame. Use a water bath, oil bath, heating mantle, hot air bath, etc.

c. Use ground straps when transferring flammable chemicals between metal containers to avoid generating static sparks.

d. Use a fume hood when there is a possibility of dangerous vapors. (Ventilation will help reduce dangerous vapor concentrations.)

e. Restrict the amount of stored flammables, and minimize the amount of flammables present in a work area.

f. Remove from storage only the amount of chemical needed for a particular experiment or task.

2. Toxic Chemicals. The toxicity of a chemical refers to its ability to damage an organ system (kidneys, liver), disrupt a biochemical process (e.g., the blood-forming process) or disturb an enzyme system at some site remote from the site of contact. Toxicity is a property of each chemical that is determined by molecular structure. Exposure of toxic chemicals can occur by inhalation, absorption, ingestion, or injection.

a. Carcinogens are materials that can cause cancer in humans or animals. They cause damage after repeated or long-duration exposure and their effects may become evident only after a long latency period. Use a fume hood to ensure proper ventilation and where protective personal equipment (PPE) (gloves, goggles, etc.) when using the chemical. Always consult the chemical's SDS to ensure proper PPE is being worn. Examples of carcinogens present in the Ceramics Studio are:

i. Cadmium compounds

ii. Chromate, hexavalent compounds

3. Kilns. The most used type of kiln in the Ceramics Studio is a fuel-fired kiln. In fuel-fired kilns, the kiln is heated by burning gas (natural or propane), oil, wood, coke, charcoal or other materials. Firing temperatures can vary from as low as 1382°F for raku and bisque wares, to as high as 2372 °F for stoneware, and 2642 °F for certain porcelains. Below are the hazards associated with the fuel-fired kilns and the precautions to take when using a kiln.

a. Hazards

i. Chlorine, fluorine, sulfur dioxide, nitrogen dioxide, and ozone are highly toxic by inhalation. Bisque firings of high-sulfur clay have caused the production of great amounts of choking sulfur dioxide. Other large acute exposures to gases are not common. Inhalation of large amounts of these gases can result in severe acute or chronic lung problems. Long-term inhalation of low levels of these gases can cause chronic bronchitis and emphysema. Fluorine gas can also cause bone and teeth problems.

ii. Many metal fumes generated at high temperatures are highly toxic by inhalation. Since lead vaporizes at a relatively low temperature, it is especially hazardous.

iii. Carbon monoxide from fuel-fired kilns or the combustion of organic matter in clays is highly toxic by inhalation and can cause oxygen starvation. One symptom of carbon monoxide poisoning is an intense frontal headache, unrelievable by analgesics.

iv. Hot kilns produce infrared radiation, which is hazardous to the eyes. There have been reports of cataracts, from years of looking inside the hot kilns.

v. Heat generated by the kiln can cause thermal burns. The Edward Orton Jr. Ceramic Foundation reported that when a kiln was operated at 2370 °F, the surface temperature, was at and above 595 °F, and the temperature one foot away from the peephole was 156 °F.

vi. Heat produced by even small electric kilns can cause fires in the presence of combustible materials or flammable liquids.

vii. If an electric kiln fails to shut off, the heating elements melt which can cause fires. Gas kilns also generate a lot of heat, and room temperatures often exceed 100 °F.

b. Precautions

1. Infrared goggles approved by the American National Standards Institute (ANSI) or hand-held welding shields should be worn when looking into the operating kiln. Shade number from 1.7 to 3.0 is recommended, but a darker shade may be required if spots appear in front of one's eyes after looking away from the kiln.
2. Do not use lead compounds at stoneware temperatures since the lead will vaporize.
3. Lumber, paper, solvents, or other combustible and flammable materials should not be stored in kiln areas.
4. Always check that the kiln has shut off.
5. If gas leaks are suspected (e.g. gas odor): shut off gas at the source; shut off power to the kiln room at the circuit breaker; and call the gas company. Test for leaks with nonfat, soapy water or use approved leak-detection solutions.

4. Special Process Firing. Salt firing and raku firing are two special types of firing that occur in the ceramics studio. Along with the general hazards of kilns, these two processes bring new hazards and precautions when using the kiln.

a. Salt Firing. This process involves throwing wet salt (sodium chloride) into the heated kiln while the bisque ware is being fired. Wet salt at high temperatures decomposed to sodium and chlorine. The sodium reacts with the bisque ware to form a glaze. Large amounts of hydrogen chloride gas and possibly chlorine are also formed.

1. Hazards

1. Hydrogen chloride gas is highly toxic by inhalation. Health effects are both similar and more irritating compared with most other kiln gases. Often, local environmental protection laws ban salt kilns.
2. Hydrogen chloride and water vapor form hydrochloric acid, which can corrode metal fittings in the area.

ii. **Precautions**

1. Sodium chloride salt glazing should only be done outdoors. Kilns should be equipped with canopy hoods and chimneystacks that are tall enough to disperse the hydrogen chloride safely.
2. All gas piping, and metal fixtures should be routinely checked for corrosion.

b. Raku Firing. The process involves first firing ware at a low temperature in a regular gas kiln, and then removing the still hot pieces and placing in them in sawdust, leaves or other organic materials for a reduction phase.

i. **Hazards**
   i. See above for the hazards and safety precautions used with gas kilns.
   ii. The reduction step produces large amounts of smoke and carbon monoxide.
   iii. Treated wood or other materials can yield an exposure to highly toxic preservatives or pesticides, such as arsenic and chromium compounds.

ii. **Precautions**
   i. Raku should only be done outdoors because of smoke. Be careful to not locate raku near air intakes or open windows of buildings.
   ii. Do not use materials that have been treated with preservatives or pesticides for the reduction phase.

5. Clay. Clays are minerals composed of hydrated aluminum silicates, often containing large amounts of crystalline silica. The following are hazards and precautions involved when handling clay.

a. Hazards

i. Asbestos is extremely toxic by inhalation and possibly by ingestion. Asbestos inhalation may cause asbestosis, lung cancer, mesothelioma, stomach cancer, and intestinal cancer.
ii. Sand, perlite, grog, and vermiculite contain free silica and are, therefore, highly toxic by inhalation. Vermiculite is also frequently contaminated with asbestos.
iii. There is a danger of accidents if clay or water can be added while the mixer is in operation.
iv. Bags of clay and glaze materials can be very heavy, and lifting can cause back problems.
v. Hand contact with wet clay can result in abrasion and dryness of fingertips and hands. Moving parts of kick wheels can cause cuts and abrasions.
vi. Clay scraps on the floor, bench and other surfaces can dry and pulverize, producing an inhalation hazard due to the presence of free silica. Similarly, reconditioning clay by pulverization and sanding finished green ware, can create very high concentrations of hazardous silica dust.

b. Precautions

i. Clay storage and mixing should take place in a separate room. Bags of clay (and other pottery materials) should be stacked on palettes or grids off the floor for easier clean-up.
ii. All clay mixers should be equipped with local exhaust ventilation to remove fine silica dust particles from the air.
iii. Clay mixers should be equipped with proper machine guards so that they cannot be opened to add clay or water while the mixer blades are turning.
iv. Wear separate work clothes while in the studio. Choose clothes of material and design that don't trap dust. Wash these clothes weekly, and separately from other laundry.
v. Avoid contact of clay with broken skin. Use a skin moisturizer.
vi. To prevent back problems, always lift with knees bent.
vii. Be careful of the moving parts on kick wheels.
viii. Recondition clay by cutting still-wet clay into small pieces, letting them air-dry, and soak in water.
ix. Finish green ware while still wet or damp with a fine sponge instead of sanding when dry. Do not sand green ware containing fibrous talc.
x. Wet mop floors and work surfaces daily to minimize dust levels and prevent dry scraps from becoming pulverized.

6. Glazes. Glazes used to color or finish clay pieces are a mixture of silica, fluxes and colorants. Common fluxes include lead, barium, lithium, calcium and sodium, and are used to lower the melting point of silica. The following are hazards and precautions involved when using glazes.

a. Hazards

i. Lead compounds are highly toxic by inhalation or ingestion.

ii. Lead-glazed food ware can leach lead if not fired properly, or if the glaze composition is not correctly adjusted.
iii. A glaze label marked "lead-safe" means that the finished ware, if fired properly, will not release lead into food or drink. The actual glaze is still hazardous to handle and fire and may contain lead.
iv. Other fluxes such as barium and lithium are also highly toxic by inhalation, but less so than lead.
v. Certain colorant compounds of particular metals are known or probable human carcinogens, including: arsenic, beryllium, cadmium, chromium (VI), nickel, and uranium.
vi. Antimony, barium, cobalt, lead, lithium, manganese, and vanadium colorant compounds are highly toxic by inhalation.
vii. Antimony, arsenic, chromium, vanadium, and nickel compounds are moderately toxic by skin contact.
viii. Free silica occurs in many of the clays, plant ash, flint, quartz feldspars, talcs, etc. used in glazes.
ix. Soda ash, potassium carbonate, alkaline feldspars, and fluorspar used in glazes are skin irritants.
x. Spray application of glazes is very hazardous because of the potential inhalation of glaze mists.
xi. Dipping, pouring, and brushing certain glazes may cause skin irritation and accidental ingestion due to careless personal hygiene habits.
xii. Glazes containing solvents are both flammable and hazardous.

b. Precautions

i. Use lead-free glazes. If the glaze does not state "lead-free" or "leadless" on the label, assume it contains lead until proven otherwise.
ii. Lead glazes should only be used on non-food ware items. Design lead-glazed pieces so that they won't be used for food or drink. Lead-glazed pottery should be labeled as lead containing.
iii. If possible, don't use colorants that are known human carcinogens and avoid probable human carcinogens. There is no known safe level of exposure to carcinogens.
iv. Consider wearing a respiratory when weighing and mixing powdered. Wet glazes are not an inhalation hazard. Good housekeeping procedures and cleanup of spills reduce the risk of inhalation or ingestion of toxic dusts. Wet mop spilled powders.
v. Gloves should be worn while handling wet or dry glazes.
vi. Good dilution ventilation or local exhaust ventilation should be available when applying solvent-containing glazes.
vii. Basic personal hygiene rules should be followed including restricting eating, drinking, or smoking in the studio, and wearing personal protective equipment such as gloves, and separate work clothes or coveralls. Wash hands after work. Leftover glazes and glaze scrapings can be homogenized, combined, tested, and used as a glaze.

Scene Shop (Room E117)

1. **General Machinery and Equipment Hazards.** Several general types of hazards exist on many types of machinery.
    a. **Rules for all Machines.** The owner or operator's manual must be in the shop area with the machine. The area of operation must be free and clear of obstructions. Space must be provided between each machine and other objects, including other machine operating areas, as needed, to allow safe operation of the machine. Students are not permitted to work alone in the shop and must be supervised by a qualified individual. Before using a machine, proper training will be administered to lessen the probability of injury.

b. **Point of Operation** refers to the area where work (e.g. cutting, shearing, shaping, boring) is performed on a stock material. Some machinery, such as table saws and band saw have point of operation guarding that must be in place during operation.
c. **Nip or Pinch Point** refers to an area other than a point of operation where a belt contacts a pulley or one or more rotating parts come together where it is possible for a part of the body to get nipped or pinched by the moving parts. Machinery with rollers are a prime example of nip/pinch points.
d. **Power Transmission** refers to areas where power is transferred from one part to another such as a drive shaft, belt, or chain. Belts, pulleys, flywheels, rotating parts etc. must be guarded to prevent entanglement and amputations.

2. **Lifting and Material Handling.** Moving and transporting set pieces can be some of the most significant hazards during set construction. The following tips are recommended to avoid injury while moving and lifting objects:
   a. Ensure you have adequate help to lift heavy or awkward items
   b. Plan your route before lifting. Ensure pieces will fit through doorways, openings on vehicles before attempting any lifting.
   c. Use hand trucks or carts whenever possible to reduce lifting
   d. Strap or secure items that may fall during transport. "If it can fall down, lay it down."

3. **Formaldehyde from MDF and hardwood pressed boards (ex. Masonite).** MDF, or Medium Density Fiberboard, is a type of composite wood product. It is produced from both hardwoods and softwoods broken down into fibers and combined with wax and a resin (glue). It is formed into panels using heat and pressure.
   a. If feasible, use a safer product such as solid wood, composite panels with no added formaldehyde, or products with low formaldehyde emissions.
   b. Use proper ventilation. The best ventilation, known as local exhaust ventilation, extracts dust and gases at the point of generation. If local exhaust is not available, then use good room ventilation.
   c. Keep dust levels down with good housekeeping. Keep the work area clean so you do not suspend dust into the air while working.
   d. Use a respirator with cartridges approved for dust and formaldehyde. Respirators should not be used without a full respirator program, which includes training on proper use and fit testing.
   e. Good hygiene includes washing whenever you get dirty, and shower and launder clothes at the end of the day.
   f. The below table shows the amount of formaldehyde in the air when certain tasks are performed.

Formaldehyde Levels (ppm)	Description
0.1	Level expected to cause symptoms in sensitive individuals
0.75	OSHA worker exposure limit
0.01 - 0.14	Sawing and sanding MDF in ventilated dust chamber
0.19 - 0.78	Sanding particleboard under laboratory conditions

4. **Softwood/Hardwood Dust.**
   a. Work in a well ventilated space to ensure dust particles are being removed from the air by the ventilation system.
   b. If the ventilation system in a particular room is inadequate, respirators or dust masks should be worn for protection.

Print Making Studio (Room D102)

1. **Printing Ink, Water-Based and Oil-Based** (Speedball Silkscreen Inks, Gamblin Etching Inks, Hanco Lithography Inks, Speedball Professional Relief Inks) Intaglio, lithography and relief inks consist of pigments suspended in either linseed oil or water as a vehicle. There can be additional hazardous binders or preservatives, etc.

a. **Hazards**
   i. Oil-based inks contain treated linseed oils. While linseed oil is not considered a hazard by skin contact or inhalation, ingestion of large amounts of some treated linseed oils might be hazardous due to presence of small amounts of toxic heavy metals. Oil vehicles are flammable when heated, and rags soaked in these may ignite by spontaneous combustion.

a. **Precautions**
   i. Know what materials are used. Obtain the material safety data sheets (MSDSs) on all products used. Use the least toxic inks possible.
   ii. Do not use an open flame to heat linseed oil, linseed oil, varnishes, or burnt plate oil. Take normal fire prevention measures (e.g. no smoking or open flames in work area).
   iii. Place oil-soaked rags in self-closing disposal cans and remove from the studio each day. An alternative is to place the oil-soaked rags in a pail of water.

2. **Pigments** are the colorants used in lithography, intaglio, and relief printing inks. There are two types of pigments: inorganic pigments, and organic pigments.
   a. **Hazards**
      i. Pigment poisoning can occur if pigments are inhaled or ingested. For normal printing with prepared inks, the main hazard is accidental ingestion of pigments due to eating, drinking or smoking while working, or inadvertent hand to mouth contact.
      ii. The classic example of a toxic inorganic pigment in printmaking is lead chromate (chrome yellow). Lead pigments can cause anemia, gastrointestinal problems, peripheral nerve damage (and brain damage in children), kidney damage and reproductive system damage. Other inorganic pigments may be hazardous also, including pigments based on cobalt, cadmium, and manganese.
      iii. Some of the inorganic pigments, in particular cadmium pigments, chrome yellow and zinc yellow (zinc chromate) may cause lung cancer if inhaled. In addition, lamp black and carbon black may contain impurities that can cause skin cancer.
      iv. Chromate pigments (chrome yellow and zinc yellow) may cause skin ulceration and allergic skin reactions.
      v. The long-term hazards of the modern synthetic organic pigments have not been well studied.
   b. **Precautions**
      i. Obtain MSDSs on all pigments. This is especially important because the name that appears on label of the color may or may not truly represent the pigments present.
      ii. Use the safest pigments possible. Avoid lead pigments.
      iii. Avoid mixing dry pigments whenever possible. If dry pigments are mixed, wear a NIOSH-approved toxic dust respirator.

3. **Solvents** (mineral spirits, lacquer thinner, denatured alcohol, acetone, Citra-Solv, Naphtha) In general, organic solvents are one of the most underrated hazards in art materials. Organic solvents are used in printmaking to dissolve and mix with oils, resins, varnishes, and inks, and to clean plates, rollers, tools, and even hands.
   a. **Hazards**
      i. Repeated or prolonged skin contact with solvents can cause defatting of the skin and resultant dermatitis. Many solvents can also be harmful through skin absorption.
      ii. Inhalation of solvent vapors is the major way in which solvents are harmful. High concentrations of most solvents can cause dizziness, nausea, fatigue, loss of coordination, or coma. This can also increase the chances for mistakes and accidents.
      iii. Many solvents are toxic if ingested. Swallowing an ounce of turpentine can be fatal.
      iv. Most solvents, except chlorinated hydrocarbons, are also either flammable or combustible.
   b. **Precautions**
      i. Obtain the MSDS on all solvent products used. Use the least toxic solvent possible. For example, replace the more toxic methyl alcohol with denatured alcohol or isopropyl alcohol.
      ii. Use adequate ventilation.

iii. Keep minimum amounts of solvents on hand and purchase in smallest practical container size. Large amounts of solvents or solvent-containing materials should be stored in a flammable storage cabinet.
iv. Never store solvents or solvent-containing materials in food or drink containers. Always label containers.
v. Do not allow smoking, open flames or other sources of ignition near solvents.
vi. Have a class B fire extinguisher in the area. If ordinary combustible materials are present, you may need a Class ABC fire extinguisher.
vii. Wear gloves when handling solvents to avoid skin contact. In particular do not use solvents to clean ink off hands. Baby oil is a good substitute.

4. **Corrosives** (Ferric Chloride, Nitric Acid, Hydrochloric Acid, Tannic Plate Etch) Acids are used in intaglio (acid etching) and in lithography. Strong acids commonly used include nitric acid, hydrochloric acid, and phosphoric acid, and less commonly carbolic acid (phenol), chromic acid, hydrofluoric and sulfuric acids.
   a. **Hazards**
      i. Concentrated acids are corrosive to the skin, eyes, respiratory system and gastrointestinal system. Dilute acids can cause skin irritation on repeated or prolonged contact.
      ii. Chromic acid is a skin sensitizer, suspect carcinogen, and oxidizer.
      iii. Phenol is highly toxic by skin absorption and ingestion. It may cause severe kidney damage, central nervous system effects and even death if absorbed in large amounts.
      iv. Hydrofluoric acid is highly toxic and can cause severe, deep burns which require medical attention. There is no immediate pain warning from contact with hydrofluoric acid.
      v. Concentrated nitric acid is a strong oxidizing agent and can react explosively with other concentrated acids, solvents, etc. Nitric acid gives off various nitrogen oxide gases, including nitrogen dioxide which is a strong lung irritant and can cause emphysema.
   b. **Precautions**
      i. Know what is used. Obtain the MSDS for all acids.
      ii. Whenever possible avoid concentrated acids.
      iii. Doing acid etching requires working in a enclosed hood, or in front of a slot exhaust hood or window exhaust fan at work level.
      iv. Store concentrated nitric and chromic acids away from organic materials. Concentrated nitric acid should always be stored separately even from other acids.
      v. An important safety rule when diluting concentrated acids is to add the acid to the water, never the reverse.
      vi. Wear appropriate gloves, goggles and protective apron or lab coat when handling acids.
      vii. If adequate ventilation is not available, wear a NIOSH-approved respirator with acid gas cartridges.
      viii. If acid is spilled on your skin, wash with lots of water. In case of eye contact, rinse the eyes with water for at least 15-20 minutes and seek medical attention.

5. **Lithography** (Takach Lithography Press, Charles Brand Lithography Press) uses either zinc and aluminum metal plates or stones for printing. It involves use of a variety of chemicals to make the image ink-receptive and non-image areas receptive to water and ink-repellent.
   - **Plate and Stone Preparation** A variety of drawing materials with high wax and fatty acid content are used to make the image, including tusche and lithographic crayons. Airbrushing liquid drawing materials or using spray enamel or lacquer is also common. Other materials used in stone or plate processing include etch solution containing acids and gum arabic, counteretch solutions containing acids and sometimes dichromate salts, and fountain solutions containing dichromate salts. Phenol (carbolic acid) has been used for removing grease from stones, and a variety of solvents including lithotine, gasoline, kerosene, and mineral spirits, which are used for diluting drawing materials, washing out images and correction of images. Talc and rosin mixtures are also used. Metal plates are prepared with solvent-based vinyl lacquers.

a. **Hazards**
   i. Acids used include phosphoric, nitric, acetic, hydrochloric, hydrofluoric and tannic acids. The concentrated acids are corrosive, and even dilute acid solutions can cause skin irritation from prolonged or repeated contact. Hydrofluoric acid and phenol are the most dangerous to use.
   ii. Lithotine, kerosene, and mineral spirits are skin and eye irritants and inhalation can cause intoxication and respiratory irritation.
   iii. The solvents contained in vinyl lacquers can include highly toxic isophorone and cyclohexanone. Methyl ethyl ketone (MEK), which is moderately toxic, is often used as a thinner.
   iv. Dichromate salts may cause skin and nasal ulceration and allergic reactions, and are suspect cancer-causing agents.
   v. Rosin dust may cause asthma and allergic dermatitis. There is the hazard of explosion from the buildup of rosin dust, in enclosed rosin boxes, around an ignition source.
   vi. Talcs may be contaminated with asbestos and silica.
   vii. Airbrushing drawing materials or using spray enamel paints is more hazardous than drawing with a brush because the inhalation hazard is higher.

b. **Precautions**
   i. Obtain the MSDS for all materials used.
   ii. See Acids and Solvents sections for the precautions with acids and solvents.
   iii. Use the least toxic solvents. Gasoline should never be used. Lithotine and mineral spirits are less toxic than the more irritating kerosene.
   iv. Use asbestos-free talcs such as baby powders.
   v. Avoid dichromate-containing counteretches and fountain solutions if possible. Do not use hydrofluoric acid or phenol.
   vi. Appropriate gloves, goggles and a protective apron should be worn when mixing or using concentrated acids.

- **Printing and Cleanup** For all types of lithographic inks, solvents are used to make image corrections on the press, to remove images, and to clean the press bed and rollers.

a. **Hazards**
   i. Some roller cleaners and glaze cleaners can contain chlorinated hydrocarbons such as perchloroethylene and methylene chloride. Most chlorinated solvents (except 1,1,1-trichloroethane) have been shown to cause liver cancer in animals and are therefore suspect human carcinogens. In addition, perchloroethylene can cause liver damage, and methylene chloride heart attacks.

b. **Precautions**
   i. Know materials used. Obtain the MSDS for all solvents. See Solvents section for the precautions with solvents.
   ii. Choose products that do not contain chlorinated solvents whenever possible.
   iii. For small scale solvent use in correcting images or cleaning the press bed using lithotine or mineral spirits, dilution ventilation (e.g. window exhaust fan) is sufficient.

6. **Intaglio** is a printmaking process in which ink is pressed into depressed areas of the plate and then transferred to paper. These depressed areas can be produced by a variety of techniques, including acid etching, drypoint, engraving and mezzotint.

- **Etching** involves use of dilute nitric acid, Dutch mordant (hydrochloric acid plus potassium chlorate) or ferric chloride to etch the zinc or copper (respectively) metal plate. Unetched parts the plate are protected with resists such as stopout varnishes containing ethyl alcohol, grounds containing asphaltum or gilsonite and mineral spirits, rubber cement, and rosin or spray paints for aquatinting. Sometimes, soft grounds contain more toxic solvents.

a. **Hazards**
   i. See Solvents section for the hazards of solvents. 1,1,1- trichloroethane found in some soft grounds is moderately toxic by inhalation under normal conditions but may cause fatalities at very high concentrations.

ii. See Acids section for the hazards of acids. In particular nitric acid etching releases the respiratory irritant nitrogen dioxide which has poor odor warning properties. During the etching process, flammable hydrogen gas is also produced.
iii. Concentrated nitric acid is a strong oxidizing agent and can react with many other chemicals, especially solvents or other organic compounds, to cause a fire.
iv. Mixing hydrochloric acid with potassium chlorate to make Dutch mordant produces highly toxic chlorine gas. Potassium chlorate is a key ingredient in many pyrotechnics and is a potent oxidizing agent. It can react explosively with organic compounds, sulfur compounds, sulfuric acid or even dirt or clothing. On heating it can violently decompose to oxygen and potassium chloride. Storage and use are very dangerous require special precautions especially when mixing.
v. Rosin dust (and asphaltum dust which is also sometimes used) is combustible. Sparks or static electricity have caused explosions in enclosed rosin and aquatint boxes. Rosin dust may also cause asthma and dermatitis in some individuals.
vi. Inhalation of solvents and pigments can result from use of aerosol spray paints.

b. Precautions

i. Obtain the MSDS for all materials used.
ii. See Solvents and Acids sections for specific precautions.
iii. Use Dutch mordant with extreme caution. A safer substitute for etching copper plates is ferric chloride (iron perchloride). This forms acidic solutions so should be handled accordingly but does not have the dangers of handling concentrated acids. Ferric chloride solution might cause minor skin irritation from prolonged contact.
iv. Application of grounds or stopouts should be done with local exhaust ventilation, (e.g. slot or enclosed hood).
v. Acid etching should be done with local exhaust ventilation. See section on precautions for Acids for more information. Rosin (or asphaltum) boxes should be explosion-proof. Use sparkproof metal cranks, explosion-proof motors, or compressed air. Do not use hair dryers to stir up rosin dust.

- **Other Techniques** Drypoint, mezzotint and engraving use sharp tools to incise lines in metal plates.

a. Hazards

i. One major hazard associated with these types of processes involves accidents with sharp tools.
ii. Long-term use of these tools can cause carpel tunnel syndrome, which can cause numbness and pain in the first three fingers. Severe cases can be incapacitating.

b. Precautions

i. Keep tools sharp, store them safely and always cut away from yourself.
ii. When possible, clamp down plates to avoid slippage.
iii. Minimize the chance of carpel tunnel syndrome by choosing tools with wide handles, avoiding tight grips, and doing hand flexing exercises during regular rest periods. Set work table height so wrist flexing motions are minimal.

- **Printing and Cleanup** Intaglio inks contain pigments, treated linseed oil and modifiers. Printing involves placing the ink on the inking slab, inking the plate by hand, and then printing. Cleanup of inking slab, press bed, and cleaning the plate is done with a variety of solvents including mineral spirits, alcohol, lithotine, turpentine, etc.

a. Hazards

i. Preparing your own inks from dry pigments can involve inhalation of toxic pigments. See Pigments section for the hazards of pigments.
ii. See Solvents section for the hazards of solvents. Plate cleaning is more hazardous than cleaning inking slabs or press beds because larger amounts of solvents are used.
iii. Lithotine, turpentine, or oil-soaked rags can be a spontaneous combustion hazard if improperly stored.

b. Precautions

i. See Pigments and Solvents sections for the specific precautions for pigments and solvents.
ii. NIOSH-approved respirators with organic vapor cartridges can be used if ventilation is not adequate.

7. **Relief and Other Printing Processes** Other printing processes include relief printing, collagraphs, monoprints, and plastic prints.
   - **Relief Printing** techniques include woodcuts, linoleum cuts and acrylic plates for plaster relief. These techniques involve the cutting away of plate areas that are not to be printed. Relief inks can be oil-based or water-based.
     a. **Hazards**
        i. Some woods used for woodcuts can cause skin irritation and/or allergies. This is particularly true of tropical hardwoods.
        ii. Accidents involving sharp tools can result in cuts.
        iii. Wood carving and cutting tools can cause carpel tunnel syndrome. This was discussed earlier in the section that included drypoint and mezzotint.
        iv. Caustic soda (sodium hydroxide) is sometimes used for etching linoleum. It can cause skin burns and severe eye damage if splashed in the eyes.
        v. Eating, drinking or smoking while printing can result in accidental ingestion of pigments.
        vi. Hazardous solvents are used in stopouts and resists in linoleum etching, and for cleaning up after printing with oil-based inks. See Solvents section for more information on the hazards of solvents.
     b. **Precautions**
        i. Obtain the MSDS for all materials used.
        ii. See Acids and Solvents sections for precautions with acids and solvents.
        iii. Water-based inks are preferable to oil-based inks since solvents are not needed.
        iv. Wear appropriate gloves, goggles and protective apron when handling caustic soda.
        v. If the chemical is spilled on your skin, wash with lots of water. In case of eye contact, rinse the eyes with water for at least l5-20 minutes and contact a physician.
        vi. Always cut in a direction away from you, with your free hand on the side or behind the hand with the tool.
        vii. Carpel tunnel syndrome can be minimized or avoided by using tools with wide handles, avoiding tight grips, and rest periods with hand flexing exercises. Linoleum cutting is softer to work, and thus can reduce musculoskeletal injury.

   - **Collagraphs** are prints produced by using a collage of different materials glued onto a rigid support. A wide variety of materials and adhesives can be used in making collagraphs.
     a. **Hazards**
        i. Rubber cement, a common adhesive used with collagraphs, is extremely flammable and most rubber cements and their thinners contain the solvent n-hexane which can cause damage to the peripheral nervous system (hands, arms, legs, feet) from chronic inhalation.
        ii. Epoxy glues can cause skin and eye irritation and allergies.
        iii. Spraying fixatives on the back of collagraph plates to seal them can involve risk of inhalation of the solvent-containing spray mist.
        iv. Sanding collagraph plates which have been treated with acrylic modeling compounds or similar materials can involve inhalation of irritating dusts.
     b. **Precautions**
        i. Know the hazards of materials used. Obtain the MSDSs from the manufacturer.
        ii. Use the least toxic materials available. In particular use water-based glues and mediums (e.g. acrylic medium) whenever possible. Some rubber cements are made with the solvent heptane, which is less toxic than n-hexane, primarily because peripheral neuropathy is not associated with its use.
        iii. Wear gloves when using epoxy glues.
        iv. Wear a NIOSH-approved toxic dust respirator when sanding collagraph plates.

- **Plastic Prints** can involve making prints from a wide variety of plastic materials and resins.
  - **a. Hazards**
    - **i.** Plastic prints can involve hazards from inhalation of plastic resin vapors (e.g. epoxy resins) and also from inhalation of decomposition fumes from drilling, machining, sawing, etc. of finished plastics.
  - **b. Precautions**
    - **i.** Obtain the MSDS for all materials used.
    - **ii.** See solvents section for the precautions with solvents.
    - **iii.** Use the least toxic material available.

- **Monoprints** involve standard intaglio, lithographic and other printmaking techniques, but only one print is made. Monoprints have the same hazards involved in plate preparation and printing as the parent techniques.

- **Photoprintmaking** involves exposing a light-sensitive emulsion or film to ultraviolet light through a transparent support containing an opaque image to transfer the image to a plate. The transparency through which the photoemulsions are developed can include drawings on a transparent support such as Mylar or acetate, or photographic images processed on graphic arts film to yield a positive image. Several photoprintmaking methods will be discussed.

- **Photolithography** involves transferring graphic images to stones or metal plates that are coated with a light-sensitive emulsion. One can coat the stone or metal plate, or use presensitized metal plates. Light-sensitive emulsions used on stone consist of a mixture of powdered albumin, ammonium dichromate, water, and ammonia; commercial emulsions are usually based on diazo compounds. Developing solutions for these mixtures often contain highly toxic solvents. Diazo-sensitizing solutions, developers with highly toxic solvents, plate conditioners containing strong alkali, and other brand name mixtures are used for metal plates.
  - **a. Hazards**
    - **i.** Diazo photoemulsions are the least hazardous although they can cause eye irritation.
    - **ii.** Ammonium dichromate used for stone is a probable human carcinogen, is moderately toxic by skin contact, and may cause allergies, irritation, and external ulcers; it is highly flammable and a strong oxidizer.
    - **iii.** Ammonia is a skin irritant and highly toxic by inhalation. Ammonia is highly corrosive to the eyes. It has good odor-warning properties.
    - **iv.** Light exposure sources include photoflood lamps, vacuum Poly- Lite units, and carbon arcs. Carbon arcs produce large amounts of ultraviolet radiation which can cause skin and eye damage and possible skin cancer. Carbon arcs also produce hazardous metal fumes, and ozone and nitrogen dioxide (which can cause emphysema), and toxic carbon monoxide.
    - **v.** Screen cleaning solutions include strong caustic solutions, enzyme detergents which can cause asthma, and chlorine bleach. These are skin and respiratory irritants.
    - **vi.** Many solvents used in developing solutions are highly toxic both by inhalation and skin absorption.
  - **b. Precautions**
    - **i.** Obtain a MSDS for all materials used.
    - **ii.** See Solvents section for more precautions with solvents.
    - **iii.** Avoid ammonium dichromate and use presensitized plates if possible. If you cannot substitute, wear gloves and goggles. Store it away from heat, solvents and other organic materials.
    - **iv.** Use ammonia solutions or solvent-containing photolithographic solutions inside a laboratory hood, or in front of a slot exhaust hood. Wear gloves, goggles, and if ventilation is inadequate, a respirator.
    - **v.** Do not use carbon arcs unless they are equipped with local exhaust ventilation exhausted to the outside. Quartz mercury or metal halide lamps are safer.
    - **vi.** Wear gloves, goggles and plastic apron or laboratory coat when mixing hazardous chemicals.

- **Photoetching** is usually done using the KPR products. Photoresist dyes often contain a variety of highly toxic solvents, including ethylene glycol monomethyl ether acetate (2-ethoxyethyl acetate, cellosolve acetate), ethylene glycol monoethyl ether, and xylene, and benzaldehyde. The developers contain xylene and ethylene glycol monomethyl ether acetate (2-methoxyethyl acetate or methyl cellosolve acetate). Developers used for safer presensitized plates also contain solvents. Exposure of the plate is done with ultraviolet sources such as carbon arcs, mercury lamps, or metal halide lamps.
    a. **Hazards**
        i. See the Solvents section for the hazards of various solvents. In particular methyl and ethyl ether acetates of ethylene glycol is highly toxic by skin absorption and inhalation and can cause anemia, kidney damage, testicular atrophy and sterility in men, and miscarriages and birth defects in pregnant women.
        ii. Xylene is moderately toxic by skin absorption, and highly toxic by inhalation and ingestion. It is a strong narcotic.
        iii. The Photolithography section discusses carbon arc hazards.
    b. **Precautions**
        i. See Solvents section for precautions with solvents.
        ii. Pregnant or nursing women, children, and men trying to conceive should not work with these materials.
        iii. Use photofloods or other light sources instead of carbon arcs. Precautions with carbon arcs is discussed in the Photolithography section.
        iv. Use presensitized plates if possible.
        v. Use photoresist solutions with local exhaust ventilation or wear an organic vapor respirator. Wear butyl rubber gloves when handling KPR solutions.

8. **General Machinery and Equipment Hazards.** Several general types of hazards exist on many types of machinery.
    a. **Rules for all Machines.** The owner or operator's manual must be in the shop area with the machine. The area of operation must be free and clear of obstructions. Space must be provided between each machine and other objects, including other machine operating areas, as needed, to allow safe operation of the machine. Students are not permitted to work alone in the shop and must be supervised by a qualified individual. Before using a machine, proper training will be administered to lessen the probability of injury.
    b. **Point of Operation** refers to the area where work (e.g. cutting, shearing, shaping, boring) is performed on a stock material. Some machinery, such as table saws and band saw have point of operation guarding that must be in place during operation.
    c. **Nip or Pinch Point** refers to an area other than a point of operation where a belt contacts a pulley or one or more rotating parts come together where it is possible for a part of the body to get nipped or pinched by the moving parts. Machinery with rollers are a prime example of nip/pinch points.
    d. **Power Transmission** refers to areas where power is transferred from one part to another such as a drive shaft, belt, or chain. Belts, pulleys, flywheels, rotating parts etc. must be guarded to prevent entanglement and amputations.

9. **Hot Plates/Heating Mantles** can become very hot and need to be handled with extreme caution to avoid possible injury. The following are guidelines to using a hot plate or heating mantle safely.
    a. When heating material, make sure the glassware's heat resistance is high. Also, inspect the glassware for cracks visible to the naked eye to avoid the glassware breaking when heating.
    b. When liquids are being brought to a boil, add boiling stones to help facilitate the process.
    c. Be careful to not let a vessel go completely dry. If there is too little moisture and the vessel remains exposed to heat, it will eventually crack.
    d. Liquids should be heated at the proper temperature. Do not overheat the liquids as that can cause uncontrollable boiling and fast evaporation.
    e. When removing objects from the hot plate or heating mantle use tongs or rubber coated, heat resistant gripping devices.

f. Do no store volatile or flammable materials in the vicinity of a hot plate.
g. Check for corrosion of thermostats, which can create a spark hazard.
h. Turn off the hotplate or heating mantle when not in use.

10. **Lifting and Material Handling.** Moving and transporting set pieces can be some of the most significant hazards during set construction. The following tips are recommended to avoid injury while moving and lifting objects:
    a. Ensure you have adequate help to lift heavy or awkward items
    b. Plan your route before lifting. Ensure pieces will fit through doorways, openings on vehicles before attempting any lifting.
    c. Use hand trucks or carts whenever possible to reduce lifting
    d. Strap or secure items that may fall during transport. "If it can fall down, lay it down."

Print Making Studio (WIL)

1. **Printing Ink, Oil-Based** (Hanco Lithography Inks, Speedball Professional Relief Inks) Intaglio, lithography and relief inks consist of pigments suspended in either linseed oil or water as a vehicle. There can be additional hazardous binders or preservatives, etc.
    a. Hazards
        i. Oil-based inks contain treated linseed oils. While linseed oil is not considered a hazard by skin contact or inhalation, ingestion of large amounts of some treated linseed oils might be hazardous due to presence of small amounts of toxic heavy metals. Oil vehicles are flammable when heated, and rags soaked in these may ignite by spontaneous combustion.
    b. Precautions
        i. Know what materials are used. Obtain the material safety data sheets (MSDSs) on all products used. Use the least toxic inks possible.
        ii. Do not use an open flame to heat linseed oil, linseed oil, varnishes, or burnt plate oil. Take normal fire prevention measures (e.g. no smoking or open flames in work area).
        iii. Place oil-soaked rags in self-closing disposal cans and remove from the studio each day. An alternative is to place the oil-soaked rags in a pail of water.

2. **Pigments** are the colorants used in lithography, intaglio, and relief printing inks. There are two types of pigments: inorganic pigments, and organic pigments.
    a. Hazards
        i. Pigment poisoning can occur if pigments are inhaled or ingested. For normal printing with prepared inks, the main hazard is accidental ingestion of pigments due to eating, drinking or smoking while working, or inadvertent hand to mouth contact.
        ii. The classic example of a toxic inorganic pigment in printmaking is lead chromate (chrome yellow). Lead pigments can cause anemia, gastrointestinal problems, peripheral nerve damage (and brain damage in children), kidney damage and reproductive system damage. Other inorganic pigments may be hazardous also, including pigments based on cobalt, cadmium, and manganese.
        iii. Some of the inorganic pigments, in particular cadmium pigments, chrome yellow and zinc yellow (zinc chromate) may cause lung cancer if inhaled. In addition, lamp black and carbon black may contain impurities that can cause skin cancer.
        iv. Chromate pigments (chrome yellow and zinc yellow) may cause skin ulceration and allergic skin reactions.
        v. The long-term hazards of the modern synthetic organic pigments have not been well studied.
    b. Precautions
        i. Obtain MSDSs on all pigments. This is especially important because the name that appears on label of the color may or may not truly represent the pigments present.
        ii. Use the safest pigments possible. Avoid lead pigments.
        iii. Avoid mixing dry pigments whenever possible. If dry pigments are mixed, wear a NIOSH-approved toxic dust respirator.

3. **Solvents** (mineral spirits, denatured alcohol, NTT Wash, Roller Wash) In general, organic solvents are one of the most underrated hazards in art materials. Organic solvents are used in printmaking to dissolve and mix with oils, resins, varnishes, and inks, and to clean plates, rollers, tools, and even hands.
    a. **Hazards**
        i. Repeated or prolonged skin contact with solvents can cause defatting of the skin and resultant dermatitis. Many solvents can also be harmful through skin absorption.
        ii. Inhalation of solvent vapors is the major way in which solvents are harmful. High concentrations of most solvents can cause dizziness, nausea, fatigue, loss of coordination, or coma. This can also increase the chances for mistakes and accidents.
        iii. Many solvents are toxic if ingested. Swallowing an ounce of turpentine can be fatal.
        iv. Most solvents, except chlorinated hydrocarbons, are also either flammable or combustible.
    b. **Precautions**
        i. Obtain the MSDS on all solvent products used. Use the least toxic solvent possible. For example, replace the more toxic methyl alcohol with denatured alcohol or isopropyl alcohol.
        ii. Use adequate ventilation.
        iii. Keep minimum amounts of solvents on hand and purchase in smallest practical container size. Large amounts of solvents or solvent-containing materials should be stored in a flammable storage cabinet.
        iv. Never store solvents or solvent-containing materials in food or drink containers. Always label containers.
        v. Do not allow smoking, open flames or other sources of ignition near solvents.
        vi. Have a class B fire extinguisher in the area. If ordinary combustible materials are present, you may need a Class ABC fire extinguisher.
        vii. Wear gloves when handling solvents to avoid skin contact. In particular do not use solvents to clean ink off hands. Baby oil is a good substitute.

4. **Sharp Tools** Drypoint, mezzotint and engraving use sharp tools to incise lines in metal plates.
    a. **Hazards**
        i. One major hazard associated with these types of processes involves accidents with sharp tools.
        ii. Long-term use of these tools can cause carpel tunnel syndrome, which can cause numbness and pain in the first three fingers. Severe cases can be incapacitating.
    b. **Precautions**
        i. Keep tools sharp, store them safely and always cut away from yourself.
        ii. When possible, clamp down plates to avoid slippage.
        iii. Minimize the chance of carpel tunnel syndrome by choosing tools with wide handles, avoiding tight grips, and doing hand flexing exercises during regular rest periods. Set work table height so wrist flexing motions are minimal.

5. **General Machinery and Equipment Hazards.** Several general types of hazards exist on many types of machinery.

    a. **Rules for all Machines.** The owner or operator's manual must be in the shop area with the machine. The area of operation must be free and clear of obstructions. Space must be provided between each machine and other objects, including other machine operating areas, as needed, to allow safe operation of the machine. Students are not permitted to work alone in the shop and must be supervised by a qualified individual. Before using a machine, proper training will be administered to lessen the probability of injury.

    b. **Point of Operation** refers to the area where work (e.g. cutting, shearing, shaping, boring) is performed on a stock material. Some machinery, such as table saws and band saw have point of operation guarding that must be in place during operation.

c. **Nip or Pinch Point** refers to an area other than a point of operation where a belt contacts a pulley or one or more rotating parts come together where it is possible for a part of the body to get nipped or pinched by the moving parts. Machinery with rollers are a prime example of nip/pinch points.

d. **Power Transmission** refers to areas where power is transferred from one part to another such as a drive shaft, belt, or chain. Belts, pulleys, flywheels, rotating parts etc. must be guarded to prevent entanglement and amputations.

6. **Lifting and Material Handling.** Moving and transporting set pieces can be some of the most significant hazards during set construction. The following tips are recommended to avoid injury while moving and lifting objects:
   a. Ensure you have adequate help to lift heavy or awkward items
   b. Plan your route before lifting. Ensure pieces will fit through doorways, openings on vehicles before attempting any lifting.
   c. Use hand trucks or carts whenever possible to reduce lifting
   d. Strap or secure items that may fall during transport. "If it can fall down, lay it down."

7. **Lead Type** oxidizes when exposed to air, producing a thin layer of lead oxide dust which can collect in the type drawers and come off onto hands. In addition, type abrasion can produce lead dust. The type drawers should be of plastic or some surface easy to wash and should have a lid to minimize exposure to air.
   a. **Hazards**
      i. Harmful if swallowed or inhaled. Lead is an acute toxic chemical.
      ii. May damage fertility or an unborn child
      iii. May cause damage to organs with prolonged or repeated exposure
      iv. Very toxic to aquatic life with long lasting effects
   b. **Precautions**
      i. Read label and SDS before using.
      ii. Use only in a well ventilated space. If a well ventilated space cannot be obtained, a respirator must be used when handling the lead type.
      iii. Only trained employees/students should use this chemical
      iv. Hands must be thoroughly washed after handling

8. **Vandercook Proofing Press** uses lead type and oil-based relief inks. There are a number of hazards associated with these mechanized presses that are not found with normal printmaking presses, including getting caught in the moving rollers and the potential lead hazard from the type.
   a. **Hazards**
      i. Moving rollers pose a potential risk of getting stuck in the rollers when cleaning
      ii. Exposure to the lead type can lead to an overexposure of lead, which can cause serious health problems, see “Lead Type” for hazards and precautions
      iii. If rollers cannot be turned manual, cleaning becomes more difficult and poses a risk
   b. **Precautions**
      i. The press must be in a lock out/tag out position to clean it
      ii. Wear a respirator when cleaning the press due to lead exposure
      iii. The type and type drawer should be vacuumed with a HEPA vacuum filter and washed on a regular basis
      iv. The water should be filtered to remove the lead dust
      v. Hands should be thoroughly washed after handling lead type

9. **Printing Ink, Rubber Based** (Van Son Holland Inks)
   a. **Hazards**
      i. May cause an allergic skin reaction
      ii. If inhaled, may cause asthma or allergy symptoms
   b. **Precautions**
      i. Avoid breathing dust or fumes by working in a well ventilated space

ii. Wear appropriate PPE (gloves, eye protection) when handling the inks
iii. Dispose of waste ink in appropriate way regulated by the state
iv. Wash skin with soap and water after handling

10. **Printing Ink, Soy-Based** (Risograph Inks)
    a. **Hazards**
        i. May cause an allergic skin reaction
        ii. If inhaled, may cause asthma or allergy symptoms
    b. **Precautions**
        i. Avoid breathing dust or fumes by working in a well ventilated space
        ii. Wear appropriate PPE (gloves, eye protection) when handling the inks
        iii. Dispose of waste ink in appropriate way regulated by the state
        iv. Wash skin with soap and water after handling

Sculpture Studio (Room B109)

1. **Spray Chamber Safety**
    a. Wear proper personal protective equipment while in the chamber. Eye protection and respiratory protection are a must when working with aerosol paints.
    b. Before working in the chamber, always notify someone that you are in the chamber. Never use the chamber if you are working alone in the Sculpture Studio.
    c. Store all aerosol paints in the flammable cabinet inside the spray chamber.
    d. Make sure the chamber is properly ventilated before painting

2. **General Machinery and Equipment Hazards.** Several general types of hazards exist on many types of machinery.
    a. **Rules for all Machines.** The owner or operator's manual must be in the shop area with the machine. The area of operation must be free and clear of obstructions. Space must be provided between each machine and other objects, including other machine operating areas, as needed, to allow safe operation of the machine. Students are not permitted to work alone in the shop and must be supervised by a qualified individual. Before using a machine, proper training will be administered to lessen the probability of injury.
    b. **Point of Operation** refers to the area where work (e.g. cutting, shearing, shaping, boring) is performed on a stock material. Some machinery, such as table saws and band saw have point of operation guarding that must be in place during operation.
    c. **Nip or Pinch Point** refers to an area other than a point of operation where a belt contacts a pulley or one or more rotating parts come together where it is possible for a part of the body to get nipped or pinched by the moving parts. Machinery with rollers are a prime example of nip/pinch points.
    d. **Power Transmission** refers to areas where power is transferred from one part to another such as a drive shaft, belt, or chain. Belts, pulleys, flywheels, rotating parts etc. must be guarded to prevent entanglement and amputations.

3. **Formaldehyde from MDF and hardwood pressed boards (ex. Masonite).** MDF, or Medium Density Fiberboard, is a type of composite wood product. It is produced from both hardwoods and softwoods broken down into fibers and combined with wax and a resin (glue). It is formed into panels using heat and pressure.
    a. If feasible, use a safer product such as solid wood, composite panels with no added formaldehyde, or products with low formaldehyde emissions.
    b. Use proper ventilation. The best ventilation, known as local exhaust ventilation, extracts dust and gases at the point of generation. If local exhaust is not available, then use good room ventilation.
    c. Keep dust levels down with good housekeeping. Keep the work area clean so you do not suspend dust into the air while working.
    d. Use a respirator with cartridges approved for dust and formaldehyde. Respirators should not be used without a full respirator program, which includes training on proper use and fit testing.

e. Good hygiene includes washing whenever you get dirty, and shower and launder clothes at the end of the day.

f. The below table shows the amount of formaldehyde in the air when certain tasks are performed.

Formaldehyde Levels (ppm)	Description
0.1	Level expected to cause symptoms in sensitive individuals
0.75	OSHA worker exposure limit
0.01 - 0.14	Sawing and sanding MDF in ventilated dust chamber
0.19 - 0.78	Sanding particleboard under laboratory conditions

4. Softwood/Hardwood Dust.

a. Work in a well ventilated space to ensure dust particles are being removed from the air by the ventilation system.

b. If the ventilation system in a particular room is inadequate, respirators or dust masks should be worn for protection.

5. CNC (Computer Numeric Control) Tool

a. Operators Should Have Proper Training: CNC machining is a technical process of controlling the motion of parts and tools through a computer software that uses numeric data. Whether a CNC shop has mills or lathes, the operators must be adequately trained to inspect, maintain, and use the machine, brand, and controller type.

b. The Area Around the Machine Must Be Free of Obstacles: Before a machining or tooling process is initiated, the machinist must inspect the machine to remove any obstacles that may fly off and hit someone. The user must check the path of the router to ensure that there are no screws that can stay embedded in the project. The floor should be clear of sawdust and scraps to prevent any possible accidents.

c. Conducting a Dry Run Is Important: Before beginning the actual CNC machining process, the operator must conduct a trial run to ensure that all moving parts are set and configured correctly. Most machines have a lock feature that allows users to scan the program for mistakes. During this process, the spindle will run, the control will execute the program, and the turret will index. However, only the axes (X, Y and Z) will stay still.

d. Operators Must Dress Accordingly: Users should never wear gloves while operating the machine. Jewelry should be avoided as some can conduct electrical charges as well as getting caught in machinery. Wearing loose clothing is also prohibited since the operator risks getting pulled into the machinery, and this can be quite fatal.

e. In any workplace, safety comes first. Operators must understand all the safety features on the machine such as curtain guards, contact mats, guard fencing, soundproof casing, and emergency stop button operation to ensure a safe CNC machining operation.

Costume Shop (Room D108)

1. Sewing Machines.

a. Needles are sharp. Keep fingers away from needle while the machine is operating.

b. Avoid distractions and stay focused when using the machine.

c. When the machine is not in use, it should be turned off to avoid an accidental push of the pedal causing the needle to move up and down.

d. The machine should be serviced at least once a year to make sure it is working properly.

e. Avoid sewing through thick or tough material, which can lead to damage to the machine or inflict injury on the operator.

2. Hot Plates/Heating Mantles can become very hot and need to be handled with extreme caution to avoid possible injury. The following are guidelines to using a hot plate or heating mantle safely.

a. When heating material, make sure the glassware's heat resistance is high. Also, inspect the glassware for cracks visible to the naked eye to avoid the glassware breaking when heating.

b. When liquids are being brought to a boil, add boiling stones to help facilitate the process.
c. Be careful to not let a vessel go completely dry. If there is too little moisture and the vessel remains exposed to heat, it will eventually crack.
d. Liquids should be heated at the proper temperature. Do not overheat the liquids as that can cause uncontrollable boiling and fast evaporation.
e. When removing objects from the hot plate or heating mantle use tongs or rubber coated, heat resistant gripping devices.
f. Do no store volatile or flammable materials in the vicinity of a hot plate.
g. Check for corrosion of thermostats, which can create a spark hazard.
h. Turn off the hotplate or heating mantle when not in use.

Metal Shop

1. **MIG Welding**
    a. Welding space should be clean and organized.
    b. Check the gas lines for leaks from the torch all the way to the gas cylinder.
    c. Use proper welding gear that includes eye protection and protective clothing.
        i. **Welding Mask.** As a general guideline, a welding helmet with a lens rated number 6 is for work up to 30 amps. Number 14 should be used when using more than 400 amps. As a rule of thumb, close your eyes immediately after welding. If you still see the arc, then you need to go to a darker lens shade.
        ii. **Protective Clothing.** At a minimum, closed toed shoes are to be worn while welding, with steel capped boots highly recommended. Make sure long hair is covered and pulled back. Leather gloves and a long sleeve dark color shirt are to be worn for skin protection.
    d. Make sure lighting is adequate so that your work can be seen. Beware of arc rays and spatter. Arc rays and spatter can injure eyes and burn skin. Wear eye, ear, and body protection. Electric arc radiation can burn eyes and skin the same way as strong sunlight. Electric arcs emit both ultraviolet and infrared rays. Use the correct filter.
    e. Keep any degreasing away from welding area.
    f. Compressed Gas Safety (4.1.7 CHP)

2. **TIG Welding**
    a. Be aware of electrical shock. Only trained and qualified individuals are to be using the welding device. Make sure the equipment is operating correctly before use.
    b. Compressed Gas Safety (4.1.7 CHP)
    c. Arc welding produces electromagnetic radiation over a wide range of wavelengths. This can cause burns to the skin and eyes. Wear protective clothing and ensure no skin areas are left exposed.
    d. Maintain a tidy work area, especially free from trip hazards.
    e. Keep walkways clear and free from welding cables, spare materials, and consumables.
    f. Flame-retardant boiler suits, gloves or gauntlets, safety shoes, leather aprons, etc, should be in good condition and as free from oil, grease and moisture as is physically possible as these can reduce the effectiveness of the safety equipment.
    g. Simple routine maintenance will be performed on the equipment to ensure proper function.

3. **General Machinery and Equipment Hazards.** Several general types of hazards exist on many types of machinery.
    a. **Rules for all Machines.** The owner or operator's manual must be in the shop area with the machine. The area of operation must be free and clear of obstructions. Space must be provided between each machine and other objects, including other machine operating areas, as needed, to allow safe operation of the machine. Students are not permitted to work alone in the shop and must be supervised by a qualified individual. Before using a machine, proper training will be administered to lessen the probability of injury.

b. **Point of Operation** refers to the area where work (e.g. cutting, shearing, shaping, boring) is performed on a stock material. Some machinery, such as table saws and band saw have point of operation guarding that must be in place during operation.
c. **Nip or Pinch Point** refers to an area other than a point of operation where a belt contacts a pulley or one or more rotating parts come together where it is possible for a part of the body to get nipped or pinched by the moving parts. Machinery with rollers are a prime example of nip/pinch points.
d. **Power Transmission** refers to areas where power is transferred from one part to another such as a drive shaft, belt, or chain. Belts, pulleys, flywheels, rotating parts etc. must be guarded to prevent entanglement and amputations.

Digital Arts

1. **Lasers** present many safety threats, but the most common threat is damage to the eyes. Other common laser concerns include skin damage, electrical hazards from high-energy power sources, chemical exposure, fire/explosion hazards, and exposure to cryogenic materials such as hydrogen and oxygen. Many lasers emit invisible ultraviolet or infrared radiation. Since the lasers in the laser cutter are fully enclosed and are interlocked systems, laser cutters are normally a low-risk, Class 1 lasers in accordance with ANSI Z136.1 Safe Use of Lasers. These devices are safe when used as designed, without manipulating the safety features, and are exempt from UW laser registration and other control measures. However, the lasers embedded inside the enclosed system are often Class 3B lasers. The following are guidelines when using the lasers.
    a. **Class 3b** lasers are medium powered lasers that pose moderate risk and can cause injury. The physics lab contains a blue 3b laser and a green 3b laser.
        i. Never aim a laser at a person.
        ii. Wear protective clothing such as eyewear and skin protection as appropriate.
        iii. Post warning signs at entrances where lasers are present.
        iv. When working with power supplies, remove jewelry, stand on a dry surface, and work with only one hand at a time.
        v. Control access to areas where lasers are used.

Painting

1. **Pigments** are used in oil paints, acrylics, watercolor paints, gouache, encaustic, poster paints, casein paints and tempera. Sometimes commercial paints such as oil, enamel, epoxy paints and automobile paints are used. Paints are pigments mixed with a vehicle or binder. Both inorganic and organic pigments are used as colorants. Dry pigments are especially hazardous because they are easily inhaled and ingested. They are used in encaustic, paper-marbleizing and in the fabrication of paint products, and will be discussed more thoroughly in the section below on pastels.
    a. **Precautions**
        i. Obtain SDSs on your paints to find out what pigments you are using. This is especially important because the name that appears on the tube of color may or may not truly represent the pigments present. Manufacturers may keep the name of a color while reformulating the ingredients.
        ii. Use the least toxic pigments possible. Do not use lead or carcinogenic pigments.
        iii. Avoid mixing dry pigments whenever possible. If dry pigments are mixed, do it inside a glove box (a box with a glass or plexiglass top and holes in the sides for arms) or inside a laboratory-type fume hood.
        iv. Wet mop and wipe all surfaces when using dry pigments.
        v. Avoid using dishes, containers or utensils from the kitchen to mix and store paints and pigments.

2. **Water-Based Paints** include water color, acrylic, gouache, tempera and casein. Water is used for thinning and cleanup.
    a. **Precautions**
        i. See section above for precautions when mixing dry pigments.
        ii. If you add your own preservative, avoid using sodium fluoride, phenol or mercury compounds. For tempera, a small amount of pine oil works for short periods of time.

iii. If you experience eye, nose or throat irritation while using acrylics, opening a window is usually sufficient; if not try a window exhaust fan.
iv. If you mix casein paints using ammonium hydroxide, you will need a window exhaust fan to provide ventilation.
v. Wear gloves, goggles and protective apron when handling ammonia. An eyewash fountain should be available when handling ammonia.

3. **Non Water-Based Paints** are any paints or solvents with an organic backbone. Oil paints, encaustic and egg tempera use linseed oil, wax and egg respectively as vehicles, although solvents are often used as a thinner and for cleanup. Turpentine and mineral spirits (paint thinner), for example, are used in oil painting mediums, for thinning, and for cleaning brushes. Alkyd paints use solvents as their vehicle. In addition many commercial paints used by artists also contain solvents.
    a. **Precautions**
        i. Whenever possible replace turpentine or ordinary mineral spirits with the less toxic odorless mineral spirits. Mineral spirits is also less flammable than turpentine, since its flashpoint is over 100 F (38 C), while turpentine has a flashpoint of 95 F, (35 C).
        ii. Apply the same health and safety considerations for the use of "citrus" or "pine" solvents. These have been found to be quite irritating to the skin and eyes.
        iii. If possible, artists should set up their easel about 3 feet from a window that has a fan exhausting at work level and pulling the solvent vapors away from your face.
        iv. Techniques such as turpentine washes will require a lot of ventilation because they result in the evaporation of large amounts of solvents in a short period of time. Acrylic paint can be substituted for underpainting.
        v. Ventilation only needs to be provided while the solvent is evaporating from the canvas, not during the time while the oil paint film is drying (oxidizing).
        vi. Wear neoprene gloves while cleaning brushes with mineral spirits or turpentine.
        vii. Used solvent can be reclaimed by allowing the paint to settle and then pouring off the clear solvent.
        viii. Paint can be removed from your hands with baby oil, and then soap and water.
        ix. Wax should be only heated to the minimum temperature needed for proper flow of the paint. Do not heat with open flame or hot plate with exposed element. During pregnancy and nursing, switch to water-based paints to avoid exposure to solvents.

4. **Airbrush, Spray Cans, and Spray Guns**
    a. **Precautions**
        i. See section above for precautions with pigments.
        ii. Try to brush items rather than spraying if possible.
        iii. Use water-based airbrushing paints and inks rather than solvent-based paints.
        iv. Use spray cans or an airbrush in a spray booth if possible.
        v. If ventilation is not adequate, then respiratory protection is necessary while air brushing or spraying. Contact EHS for selection and fit-testing.
        vi. Never try to spray paint by blowing air from your mouth through a tube. This can lead to accidental ingestion of the paint.

Drawing

1. **Lead Pencils, Charcoal, and Greasy Charcoal Pencils**
    a. **Precautions**
        i. Avoid inhaling excessive dust
        ii. Work in a well ventilated area
        iii. May contain carbon black. See section above for precautions with pigments.

2. **India Ink**
    a. **Precautions**

i. May contain carbon black. See section above for precautions with pigments.

3. **Permanent Felt Tip Markers/Drawing Inks**
    a. **Precautions**
        i. Contains aromatic hydrocarbons and other highly toxic organic solvents.
        ii. Always work in a well-ventilated area.
        iii. Wear appropriate personal protective equipment to avoid exposing yourself to hazards.
4. **Pastels**
    a. **Precautions**
        i. Work in well ventilated area due to the amount of dust produced when using pastels.
        ii. Highly toxic pigments such as cadmiums, cobalts, nickels, etc. can be released into the air. See section above for precautions with pigments.
        iii. If ventilation is inadequate, an approved dust respirator must be worn.
        iv. Wet mopping or vacuuming cleans pastel dust most adequately.
        v. Do not sweep dust causing toxic particles to be released into the air.

5. **Organic Solvents.** The main organic solvents used in drawing are carbon tetrachloride, methanol, and ketones.
    a. **Precautions**
        i. Organic solvents are often the most hazardous chemicals in the work place. Solvents such as ether, alcohols, and toluene, for example, are highly volatile or flammable. Chlorinated solvents such as chloroform are nonflammable, but when exposed to heat or flame, may produce carbon monoxide, chlorine, phosgene, or other highly toxic gases. Always use volatile and flammable solvents in an area with good ventilation or in a fume hood. Never use ether or other highly flammable solvents in a room with open flames or other ignition sources present.

Theater Spaces (Lester Martin Theatre, Margot Tenney Theatre, Newman Court, Martha Hill Theatre, Greenwall Auditorium and D207)

1. **Set Design/Construction**
    a. **Props and Decoration**
        i. Decorative materials such as curtains, draperies, streamers, fabrics, cotton batting, straw, hay, vines, leaves, stalks, tress and moss must be noncombustible or flame resistant or be rendered so with commercially available products.
    b. **Rigging**
        i. Anything attached to a fly bar must have a safety cable attached as well.
        ii. Check that everything attached to a light, including barn doors, gel cases and safety cables, are secure before it is raised.
        iii. Make sure the rope or cord is strong enough for what you are lifting and that the rope or cord is not frayed or damaged in any way.
        iv. Warn people on the stage or grid before moving any rigged scenery or other objects.
        v. Always maintain visual contact with a moving piece.
        vi. Rigging should be inspected by the production crew before each use
    c. **Personal Protective Equipment (PPE)**
        i. Personal protective equipment includes all types of equipment used to increase individual safety while performing potentially hazardous tasks. This may include eye and face protection, head protection, foot protection, hand protection, respiratory protection, or any equipment used to protect against injury or illness.
    d. **Power Tools**
        i. Only trained crewmembers are permitted to use power tools such as mitre saws, table saws and drill presses.
    e. **Ladders** Under the General Requirements OSHA addresses proper ladder climbing technique. It requires that when ascending or descending a ladder, employees must maintain three points of

contact at all times by: Facing the ladder, using at least one hand to firmly grasp the ladder, and not carrying any object or load that could cause them to lose balance and fall

i. Employers are required to ensure that every employee follows this climbing technique.

ii. The General Requirements also cover the design specifications for rungs and steps used on ladders and stepstools. With the exception of ladders used in elevator shafts and communication towers, the design for rungs and steps must meet the following:

- Ladder rungs, steps, and cleats are parallel, level, and uniformly spaced when the ladder is in position for use
- Ladder rungs, steps, and cleats are spaced not less than 10 inches [25 centimeters (cm)] and not more than 14 inches (36 cm) apart, as measured between the centerlines of the rungs, cleats, and steps
- Ladder rungs, steps, and cleats have a minimum clear width of 11.5 inches (29 cm) on portable ladders and 16 inches (41 cm) (measured before installation of ladder safety systems) for fixed ladders (the minimum clear width does not apply to ladders with narrow rungs that are not designed to be stepped on, such as those located on the tapered end of orchard ladders and similar ladders)
- Rungs and steps of manhole entry ladders that are supported by the manhole opening must have a minimum clear width of nine inches (23 cm)
- Rungs and steps on rolling ladders used in telecommunication centers must have a minimum clear width of eight inches (20 cm)
- Stepstools have a minimum clear width of 10.5 inches (26.7 cm)

iii. In addition, the General Requirements mandate the following:

- Wooden ladders are not coated with any material that may obscure structural defects,
- Metal ladders are made with corrosion-resistant material or protected against corrosion,
- Ladder surfaces are free of puncture and laceration hazards,
- Ladders are used only for the purpose for which they were designed,
- Ladders are inspected before initial use in each work shift, and more frequently as necessary, to identify any visible defects that could cause employee injury, and
- Any ladder with structural or other defects is immediately tagged "Dangerous: Do Not Use" or with similar language in accordance with 29 CFR1910.145 and removed from service until repaired in accordance with 29 CFR1910.22(d), or replaced.

f. Chemical Hazards

i. Most chemical use in theater is limited to paints and stains. In the event of a chemical spill, determine if you need to contact the chemical hygiene officer or campus safety or if you will be able to clean it up yourself.

g. Housekeeping Work areas can become congested while constructing the set and while rehearsals take place. Clutter makes it difficult to move around and can be a fire hazard. To prevent accumulation of materials, trash should be removed daily.

i. Place trash in proper receptacles, preferable in metal containers.

ii. Clean up after each work session

iii. Avoid accumulating scrap lumber and materials

iv. Purchase materials as needed to avoid the need for additional storage

v. Store tools in the proper areas when not in use

h. Storage of Materials The proper storage of materials in theater spaces is extremely important to the efficiency of the production and the safety of the cast, crew and audience.

i. Flammable and combustible liquids must be stored in approved flammable storage cabinets.

ii. If the building has sprinklers, materials must be a minimum of 18 inches below sprinkler heads

iii. Materials in any building must be a minimum of 24 inches below the ceiling

iv. Materials must never obstruct an exit from the building

v. Stored materials must be a minimum of three feet in all directions from unit heaters, duct furnaces and flues
vi. Smoking is prohibited in all places of assembly and in spaces where combustible materials are stored or handled.

i. **Lifting and Material Handling** Moving and transporting set pieces can be some of the most significant hazards during set construction. The following tips are recommended to avoid injury while moving and lifting objects:
   i. Ensure you have adequate help to lift heavy or awkward items
   ii. Plan your route before lifting. Ensure pieces will fit through doorways, openings on vehicles before attempting any lifting.
   iii. Use hand trucks or carts whenever possible to reduce lifting
   iv. Strap or secure items that may fall during transport. "If it can fall down, lay it down."

2. **Electrical Hazards** Many students have never worked with electricity directly before working on stage.
   a. **Repairs**
      3. Students should not attempt electrical repairs without proper training.
      4. Equipment that malfunctions or causes shocks should be removed from service and repaired by a qualified individual.
   b. **Extension cords**
      i. Extension cords are only designed for temporary use.
      ii. Use of thin, light duty extension cords can increase the risk of fire and shock.
      iii. Make sure extension cords have adequate current capacity for the equipment being used.
      iv. Do not pull an electrical cord out of a socket by the cord. This breaks interior wires and can cause a short and, possibly, a fire.
      v. Inspect for frayed or split cords or plugs before use.
   c. **Electrical Cords**
      i. Electrical cords can also be a tripping hazard. It is a good practice to route cords away from traffic areas to prevent trips and falls.
      ii. Avoid stretching or pinching cords between objects. This can break interior wires, causing overheating which can result in a fire.
      iii. Do not cover electrical cords with rugs; this can also result in a fire.
   d. **Circuit Protection Devices**
      i. Circuit protection devices are designed to automatically limit or shut off the flow of electricity in the event of a ground-fault, overload, or short circuit in the wiring system.
      ii. A ground-fault circuit interrupter, or GFCI, should be used in high-risk areas such as wet locations or outdoor sites. Portable GFCIs are available from any hardware store or safety supply catalog.
   e. **Training**
      i. Training is essential in working with lighting circuitry, dimmers and instruments. Students should be trained before being authorized to work the control areas.
      ii. Keep food and beverages out of the light control areas to prevent possible shocks and damage to the circuitry.
3. **Overhead Lighting**
   a. **Lighting dimmers** have limits to the lamp loads they can handle.
      i. Overloading dimmers can cause a fire hazard. There are standard size 1.2 kilowatt (1200W maximum) and 2.4 kilowatt (2400W maximum) dimmers used in the student-run theater spaces. NOTE: The wattage of the bulbs MAY NOT exceed that of the dimmers they are plugged into.
4. **Cast and Crew**
   a. **Cosmetics**
      i. Products approved for makeup use have been tested extensively for toxic hazards. Only these products should be used for stage productions.
      ii. Old containers of makeup could contain bacteria and should be thrown away

iii. Wash your face and hands before applying cosmetics
iv. If you are using makeup from a "communal" make-up kit, use a clean brush or your clean hands to apply. Shared makeup should not be applied directly to your face.
    1. **Crème Sticks**
        a. Slice these out with dental spatulas on to individual papers such as butter trays. Label and reuse them individually for touch-ups.
    2. **Lipsticks**
        a. These too can be sliced and labeled. For a long running show, provide individual lipsticks
    3. **Pancakes and Powders**
        a. Powdered products provide a less viable environment for infection, but try to individualize usage. Supply powders in the smallest containers available
    4. **Mascara**
        a. Use individual applicators/containers if possible
    5. **Eyeliners and Eye Makeup**
        a. Use individual products if possible
    6. **Brushes**
        a. Use disposable brushes
    7. **Sponges**
        a. Use disposable sponges whenever possible. Reusable ones can be disinfected. Give out individual sponges at the beginning of a show and maintain separate use
    8. **Miscellaneous**
        a. Any type of facial hair, skullcaps, sequins, or other face product should be disinfected before used by a new performer. Use an approved bactericide for disinfection.
        b. Carefully store these types of products in labeled individual plastic bags between performances.
v. Makeup artists should make a practice of washing their hands between actors
vi. Sponges and brushes should be washed after use on each individual
vii. When removing spirit gum or latex, avoid prolonged skin contact with solvents. Use moisturizers to replace lost skin oils and to guard against dermatitis

b. **Fatigue** is a serious safety concern that should be considered during all stage productions. With performance dates approaching, most crewmembers can become severely overworked
    i. Get proper rest.
    ii. Limit drugs that might contribute to fatigue
    iii. Reduce caffeine, nicotine, and alcohol which can also contribute to fatigue
    iv. Take frequent breaks while working. Repetitive or long work sessions can reduce one's ability to concentrate on the work at hand.
    v. Know when to quit

c. **Heat Stress**
    i. Theater spaces are often without air-conditioning and, even if they are air-conditioned, stage lighting can produce an incredibly hot glow. Add that to the stress and/or excitement of performing, and cast members are prime candidates for heat stress. Working in hot conditions may pose special hazards to safety and health.
    ii. Drink plenty of liquids during a performance to replace the fluids lost from sweating – as much as one quart per hour may be necessary. Water and/or sports drinks are recommended. Avoid caffeinated beverages such as cola, iced tea and coffee.

Appendix G

Specific hazards associated with the Buildings & Grounds Building (B&G)

General Hazards

1. **Ladders.** Under the General Requirements OSHA addresses proper ladder climbing technique. It requires that when ascending or descending a ladder, employees must maintain three points of contact at all times by:
    - Facing the ladder
    - Using at least one hand to firmly grasp the ladder
    - Not carrying any object or load that could cause them to lose balance and fall

    ii. Employers are required to ensure that every employee follows this climbing technique.

    iii. The General Requirements also cover the design specifications for rungs and steps used on ladders and stepstools. With the exception of ladders used in elevator shafts and communication towers, the design for rungs and steps must meet the following:
    - Ladder rungs, steps, and cleats are parallel, level, and uniformly spaced when the ladder is in position for use
    - Ladder rungs, steps, and cleats are spaced not less than 10 inches [25 centimeters (cm)] and not more than 14 inches (36 cm) apart, as measured between the centerlines of the rungs, cleats, and steps
    - Ladder rungs, steps, and cleats have a minimum clear width of 11.5 inches (29 cm) on portable ladders and 16 inches (41 cm) (measured before installation of ladder safety systems) for fixed ladders (the minimum clear width does not apply to ladders with narrow rungs that are not designed to be stepped on, such as those located on the tapered end of orchard ladders and similar ladders)
    - Rungs and steps of manhole entry ladders that are supported by the manhole opening must have a minimum clear width of nine inches (23 cm)
    - Rungs and steps on rolling ladders used in telecommunication centers must have a minimum clear width of eight inches (20 cm)
    - Stepstools have a minimum clear width of 10.5 inches (26.7 cm)

    iv. In addition, the General Requirements mandate the following:
    - Wooden ladders are not coated with any material that may obscure structural defects,
    - Metal ladders are made with corrosion-resistant material or protected against corrosion,
    - Ladder surfaces are free of puncture and laceration hazards,
    - Ladders are used only for the purpose for which they were designed,
    - Ladders are inspected before initial use in each work shift, and more frequently as necessary, to identify any visible defects that could cause employee injury, and
    - Any ladder with structural or other defects is immediately tagged "Dangerous: Do Not Use" or with similar language in accordance with 29 CFR1910.145 and removed from service until repaired in accordance with 29 CFR1910.22(d), or replaced.

2. **Chainsaws.** Operating a chain saw is inherently hazardous. Potential injuries can be minimized by using proper personal protective equipment and safe operating procedures.

    a. Before Starting a Chain Saw
    - Check controls, chain tension, and all bolts and handles to ensure that they are functioning properly and that they are adjusted according to the manufacturer's instructions.
    - Make sure that the chain is always sharp and the lubrication reservoir is full.
    - Start the saw on the ground or on another firm support. Drop starting is never allowed.
    - Start the saw at least 10 feet from the fueling area, with the chain's brake engaged.

    b. Fueling a Chain Saw
    - Use approved containers for transporting fuel to the saw.

- Dispense fuel at least 10 feet away from any sources of ignition when performing construction activities. No smoking during fueling.
- Use a funnel or a flexible hose when pouring fuel into the saw.
- Never attempt to fuel a running or HOT saw.

c. Chain Saw Safety

- Clear away dirt, debris, small tree limbs and rocks from the saw's chain path. Look for nails, spikes or other metal in the tree before cutting.
- Shut off the saw or engage its chain brake when carrying the saw on rough or uneven terrain.
- Keep your hands on the saw's handles, and maintain secure footing while operating the saw.
- Proper personal protective equipment must be worn when operating the saw, which includes hand, foot, leg, eye, face, hearing and head protection.
- Do not wear loose-fitting clothing.
- Be careful that the trunk or tree limbs will not bind against the saw.
- Watch for branches under tension, they may spring out when cut.
- Gasoline-powered chain saws must be equipped with a protective device that minimizes chain saw kickback.
- Be cautious of saw kick-back. To avoid kick-back, do not saw with the tip. If equipped, keep tip guard in place.

3. MIG Welding

a. Welding space should be clean and organized.

b. Check the gas lines for leaks from the torch all the way to the gas cylinder.

c. Use proper welding gear that includes eye protection and protective clothing.

i. **Welding Mask.** As a general guideline, a welding helmet with a lens rated number 6 is for work up to 30 amps. Number 14 should be used when using more than 400 amps. As a rule of thumb, close your eyes immediately after welding. If you still see the arc, then you need to go to a darker lens shade.

ii. **Protective Clothing.** At a minimum, closed toed shoes are to be worn while welding, with steel capped boots highly recommended. Make sure long hair is covered and pulled back. Leather gloves and a long sleeve dark color shirt are to be worn for skin protection.

d. Make sure lighting is adequate so that your work can be seen. Beware of arc rays and spatter. Arc rays and spatter can injure eyes and burn skin. Wear eye, ear, and body protection. Electric arc radiation can burn eyes and skin the same way as strong sunlight. Electric arcs emit both ultraviolet and infrared rays. Use the correct filter.

e. Keep any degreasing away from welding area.

f. Compressed Gas Safety (4.1.7 CHP)

4. TIG Welding

a. Be aware of electrical shock. Only trained and qualified individuals are to be using the welding device. Make sure the equipment is operating correctly before use.

b. Compressed Gas Safety (4.1.7 CHP)

c. Arc welding produces electromagnetic radiation over a wide range of wavelengths. This can cause burns to the skin and eyes. Wear protective clothing and ensure no skin areas are left exposed.

d. Maintain a tidy work area, especially free from trip hazards.

e. Keep walkways clear and free from welding cables, spare materials, and consumables.

f. Flame-retardant boiler suits, gloves or gauntlets, safety shoes, leather aprons, etc, should be in good condition and as free from oil, grease and moisture as is physically possible as these can reduce the effectiveness of the safety equipment.

g. Simple routine maintenance will be performed on the equipment to ensure proper function.

5. General Machinery and Equipment Hazards. Several general types of hazards exist on many types of machinery.

a. **Rules for all Machines.** The owner or operator's manual must be in the shop area with the machine. The area of operation must be free and clear of obstructions. Space must be provided between each machine and other objects, including other machine operating areas, as needed, to allow safe operation of the machine. Students are not permitted to work alone in the shop and must be supervised by a qualified individual. Before using a machine, proper training will be administered to lessen the probability of injury.
b. **Point of Operation** refers to the area where work (e.g. cutting, shearing, shaping, boring) is performed on a stock material. Some machinery, such as table saws and band saw have point of operation guarding that must be in place during operation.
c. **Nip or Pinch Point** refers to an area other than a point of operation where a belt contacts a pulley or one or more rotating parts come together where it is possible for a part of the body to get nipped or pinched by the moving parts. Machinery with rollers are a prime example of nip/pinch points.
d. **Power Transmission** refers to areas where power is transferred from one part to another such as a drive shaft, belt, or chain. Belts, pulleys, flywheels, rotating parts etc. must be guarded to prevent entanglement and amputations.

6. Lifting and Material Handling. Moving and transporting set pieces can be some of the most significant hazards during set construction. The following tips are recommended to avoid injury while moving and lifting objects:

a. Ensure you have adequate help to lift heavy or awkward items
b. Plan your route before lifting. Ensure pieces will fit through doorways, openings on vehicles before attempting any lifting.
c. Use hand trucks or carts whenever possible to reduce lifting
d. Strap or secure items that may fall during transport. "If it can fall down, lay it down."

7. **Torches**

a. Employees will be properly and thoroughly trained before attempting to do any work with or on any Cutting Torch.
b. Before igniting the flame of a torch:
- Open the oxygen valve on the torch.
- Wait until all air has been discharged from the oxygen hose and torch.
- Close the valve.
- Open the fuel gas valve on the torch handle.
- Wait until all air has been discharged from the fuel gas hose and torch
- Then light the fuel gas and open the oxygen valve on the torch handle. Adjust the oxygen to produce the required flame for the job.

c. Light torches with friction lighters or other suitable lighters and not matches. Point the tip away from people.
d. Never put down a torch until the gases have been completely shut off.
e. Never open or turn the pressure adjusting screws on the regulators all the way out. Always adjust flames at torch valves, not with regulator adjusting screws.
f. ALWAYS use fuel gases at safe pressures. Many gauges permit higher, unsafe pressures. If you find a gauge that permits unsafe pressures, take it out of service immediately.
g. Oxygen is not a fuel and will not burn, but contact with it can cause combustible materials such as oil and grease to burn rapidly at room temperature. Therefore, keep oxygen away from grease or oil on surfaces such as gloves, clothes, cylinders, valves, couplings, regulators, and hoses. Do not use oxygen instead of compressed air in pneumatic tools, in oil preheating burners, to start internal combustion, to blow out pipelines, to dust clothing or work, or to create pressure for ventilation.
h. Oxygen and fuel gas hoses must be different in color (green for oxygen and red for fuel gas) or otherwise identified.
i. Inspect hoses and connections every day for leaks. Look for holes, cracks, and loose cylinder fittings or track connectors. To check for leaks: close the oxygen and fuel gas torch valves, then turn the regulator pressure adjusting screws clockwise to give normal working pressure on oxygen

valves and about 10 PSIG on fuel gas valves. Use non-fat soapy water or approved leak test solution to test for leaks. At the same time, check regulators for creeping.

j. If a torch backfires frequently, inspect it and clean the tip. If it continues to backfire or you find other problems, remove it from service immediately. Take it to a qualified technician for repair.

k. Do not use steel wire or similar materials to clean tip orifices.

l. "Flashback" occurs when a flame burns back inside a torch, tip, hose, or regulator and can cause a fire or explosion if it reaches the cylinder. Flashbacks usually make high-pitched squealing or hissing sounds. Flashback arrestors at torch handles and check valves at gas sources help prevent flashbacks. In case of flashback: • Close the oxygen valve at once. • Close the fuel valve. • Let the torch cool off. • Have the torch repaired or replaced.

m. Wear PERSONAL PROTECTIVE EQUIPMENT as required to include tinted eye protection, gloves, etc.

Painting

1. Flammables. A flammable chemical is any solid, liquid, vapor, or gas that ignites easily and burns rapidly in air. Consult the appropriate SDSs before beginning work with flammables. Follow these guidelines when working with flammable chemicals:

a. Handle flammable chemicals in areas free from ignition sources.

b. Never heat flammable chemicals with an open flame. Use a water bath, oil bath, heating mantle, hot air bath, etc.

c. Use ground straps when transferring flammable chemicals between metal containers to avoid generating static sparks.

d. Use a fume hood when there is a possibility of dangerous vapors. (Ventilation will help reduce dangerous vapor concentrations.)

e. Restrict the amount of stored flammables, and minimize the amount of flammables present in a work area.

f. Remove from storage only the amount of chemical needed for a particular experiment or task.

2. Corrosives. A corrosive chemical destroys or damages living tissue by direct contact. Some acids, bases, dehydrating agents, oxidizing agents, and organics are corrosives. To ensure safe handling of corrosives, the following special handling procedures should be used:

a. Always store corrosives properly. Refer to the SDSs and the Chemical Storage section of this manual for more information.

b. Always wear gloves and face and eye protection when working with corrosives. Wear other personal protective equipment, as appropriate.

c. To dilute acids, add the acid to the water, not the water to the acid.

d. Corrosives, especially inorganic bases (e.g., sodium hydroxide), may be very slippery; handle these chemicals with care and clean any spills, leaks, or dribbles immediately.

e. Use a chemical fume hood when handling fuming acids or volatile irritants (e.g., ammonium hydroxide).

f. A continuous flow eye wash station should be in every work area where corrosives are present. An emergency shower should also be within 100 feet of the area.

3. Oil Based Paints. Solvent-based (or "oil based") paints, enamels, varnishes, sealants, etc. meet the definition of hazardous waste and unused portions must be disposed.

a. Paint cans that once contained oil-based paints must meet the EPA's definition of empty before they can be placed in the trash. This is achieved by scraping the container to ensure that all pourable materials have been removed. The pourable material must be collected for disposal.

b. Waste mixtures of solvent based paint and paint thinners/solvent must be collected in a closed, labeled container.

c. Each container of solvent based paint/paint thinner waste must be closed after additions and the funnels should be cleaned out regularly. No air drying of solvent-based paint or paint waste is allowed.

d. Waste containers must be stored with secondary containment and protected from the weather. Secondary containment must be kept clear of spills and debris.
e. Solvent Based Paints should be labeled as a Hazardous Waste.

4. Paint Brushes, Paint Rollers, and Rags

a. Brushes and rags that have been contaminated with hazardous waste (non-latex paints, cleaners, thinners, strippers, etc.) and/or waste solvents cannot be placed in the trash, and must be disposed of as hazardous waste.
b. Rollers, brushes, rags, and trays which are used for latex paints only may be disposed of as regular trash and placed in a dumpster or garbage can once the paint has been allowed to dry completely.
c. Paper towels, wipes, rags or absorbents that have been contaminated with paint/paint thinner waste or solvent waste must be collected as hazardous waste in a steel safety container and disposed.
d. Any excess liquid which separates and pools in a solid waste container (such as a waste paint roller container) must be poured off into a liquid waste container; EH&S will not collect solid waste which is mixed with large amounts of liquid paint, solvent, or oil.

Vehicle Maintenance

1. Used Oil, Oily Wastes, and Oil Filters

a. Used Oil Accumulation Requirements
- Used oil, oil filters, and oily wastes must be clearly and appropriately labeled
- All containers must be closed unless you are actively adding oil to them
- Containers must be kept in good condition and not leaking
- All containers need to be protected from the weather and stored on an impermeable surface
- You are required to have adequate secondary containment, which must be able to contain 110% of the volume of the largest container stored in the area
- Containment area must be kept free of spill residue and debris; clean up all spills or leaks promptly
- Do not add anything but Used Oil to your Used Oil containers
- Disposal records must be kept for a minimum of 3 years from the pickup date
- Designate a Used Oil Manager for each accumulation area who will be responsible for the area

b. Oily Waste Description

Oily wastes are defined as "those materials which are mixed with used oil and have become separated from that used oil." This includes absorbent clay "kitty litter" or other absorbent material used in the process of routine maintenance or in cleaning up a spill. Per F.A.C. 62-710 oily wastes may be packaged and disposed of as non-regulated solid waste (regular trash). OILY WASTES MUST NOT CONTAIN FREE LIQUIDS. Free liquids must never be disposed of in regular solid waste.

c. Used Oil Filters

Commercially generated oil filters are banned from landfill disposal. The filters must be processed by a registered used oil filter processor. Used oil filters must be stored in above ground containers which are clearly labeled **"Used Oil Filters"** and which are in good condition. The storage containers must be protected from weather and stored on an oil impermeable surface. Do not mix fuel or air filters into the oil filter container.

Dust Particles

1. **Formaldehyde from MDF and hardwood pressed boards (ex. Masonite).** MDF, or Medium Density Fiberboard, is a type of composite wood product. It is produced from both hardwoods and softwoods broken down into fibers and combined with wax and a resin (glue). It is formed into panels using heat and pressure.
   a. If feasible, use a safer product such as solid wood, composite panels with no added formaldehyde, or products with low formaldehyde emissions.
   b. Use proper ventilation. The best ventilation, known as local exhaust ventilation, extracts dust and gases at the point of generation. If local exhaust is not available, then use good room ventilation.

c. Keep dust levels down with good housekeeping. Keep the work area clean so you do not suspend dust into the air while working.
d. Use a respirator with cartridges approved for dust and formaldehyde. Respirators should not be used without a full respirator program, which includes training on proper use and fit testing.
e. Good hygiene includes washing whenever you get dirty, and shower and launder clothes at the end of the day.
f. The below table shows the amount of formaldehyde in the air when certain tasks are performed.

Formaldehyde Levels (ppm)	Description
0.1	Level expected to cause symptoms in sensitive individuals
0.75	OSHA worker exposure limit
0.01 - 0.14	Sawing and sanding MDF in ventilated dust chamber
0.19 - 0.78	Sanding particleboard under laboratory conditions

2. Softwood/Hardwood Dust.
a. Work in a well ventilated space to ensure dust particles are being removed from the air by the ventilation system.
b. If the ventilation system in a particular room is inadequate, respirators or dust masks should be worn for protection.

Loading Dock
1. Forklift
a. General Precautions and Rules
- Avoid operating a vehicle that requires maintenance or repair (which should be provided by the respective qualified experts).
- Inform the shift supervisor of any identified issues, problems, questions, or concerns.
- **Forklifts operate uniquely;** since they steer from the rear, the back of the vehicle needs a wide sweep to turn.
- **Never leave an operating forklift unattended.** In fact, leaving keys in an unattended forklift (or, thus, leaving on the ignition of this vehicle) is illegal, and has dire consequences as a safety hazard, even without the actual occurrence of an accident.
- **Know and never exceed the lifting capacity** of the forklift.
- **Forklifts must follow designated roadways** at the work site.
- **Work-site rules and regulations** must be adhered to.
- **Keep hands and feet away from the cross members of the mast—** should the mast be lowered and catch your hand, you'll suffer from serious injury.
- **Forklifts need to be refuelled—** after, of course, they've been turned off—at designated and well-ventilated locations.
- **Forklifts which are not in use** should be carefully parked, with the parking brake applied.

b. Safe and Smooth Operating
- **As the operator of a forklift,** you must receive thorough forklift safety training and certification before being entrusted with the heavy machinery.
- **Be alert and attentive** to your surrounding environment at all times with these forklift safety tips:
  - Avoid hazards on the floor; slippery or unstable surfaces, bumps, holes, etc.
    - Driving over small, scattered hazards (like shards of wood) may make the load shift and topple, or knock you out of place (and out of control)
  - Direct your forklift forward when driving up ramps, but go downhill in reverse.
    - Don't load/unload on the ramp.
  - Alert others of your coming with a horn or your voice.
  - Keep a safe distance from people and from other trucks

    - Stop only when you have enough space to pause safely.
    - Note any changes to your operating environment.
  - **Ensure that you are in complete control** of the vehicle.
  - **Stay in the operator's seat** and keep your body within the frame of the vehicle at all times.
  - **Wear your seat belt** for protection case the vehicle topples; if that's the case, the frame will offer sufficient protection (along with the seatbelt!).
  - **Never allow unauthorized people to drive** or otherwise operate the forklift.
  - **Stick to the appropriate dress code:**
    - Mandatory safety gear (hi-visibility jacket, sturdy footgear, hard-hats)
    - Tight clothing that can't be caught in gears or controls
  - **Never operate with wet or greasy hands or shoes.** You could easily slide or slip and cause an accident.

c. Eliminate Dangers to the Surrounding People

- **If you are driving,** always keep an eye out for other people around you, especially those on foot.
- **Avoid fast moves.** Always drive, stop, turn, and lift or lower the forks slowly and as smoothly as possible.
  - Sudden turns can toss off a load or even the entire forklift off balance, which make it a much greater hazard for the operator and especially the surrounding people.
  - Be especially careful when navigating ramps, inclines, and grades.
- **Always check carefully before turning or backing up the vehicle.** Keep in mind that people may be walking or standing on one of your blind sides (i.e. behind the vehicle) or obstructed by other obstacles;
- **No one should be allowed to stand or walk beneath or upon the forks,** whether they're emptied or loaded.

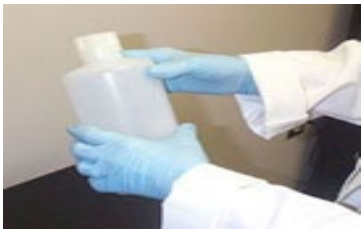
d. When Loads Become Hazardous

- **Most accidents** with forklifts occur by plummeting loads which crush the person below.
- **Place loads back** by the mast, where they'll balance most stably; never place loads at the front of the forks.
- **Never load trucks beyond approved capacity.**
- **Always travel with the forks positioned as low as possible** for increased stability and protection. Never travel with forks that are elevated and/or tilted forward.
- **Ensure that the load** is stable or strapped in place before moving the vehicle.
  - The load must be balanced on both forks.
- **Avoid decaying, warped, or otherwise damaged** skids and pallets.
- **When stocking, be vigilant** for slipping, unstable, or toppling loads.
  - Have a good view of and easy access to the rack or location where you must position your load.
- **If your load obstructs your view,** operate the forklift in reverse to improve visibility and operation control.
  - If visibility remains obstructed, enlist the help of a lookout or helper to guide you between obstacles and people.

Appendix H

Glove Comparison Chart

The glove comparison chart gives an overview of commonly used glove types for laboratory use and their general advantages and disadvantages. The photos provided are examples of the types of gloves that can be purchased. Glove color and appearance may vary. For a more detailed chart with specific chemicals and the gloves used for said chemical, visit AnsellPro.com.

Glove Material	Intended Use	Advantages and Disadvantages	Example Photos
Latex (natural rubber)	Incidental contact	• Good for biological and water-based materials. • Poor for organic solvents. • Little chemical protection. • Hard to detect puncture holes. • Can cause or trigger latex allergies	
Nitrile	Incidental contact (disposable exam glove) Extended contact (thicker reusable glove)	• Excellent general use glove. Good for solvents, oils, greases, and some acids and bases. Clear indication of tears and breaks. Good alternative for those with latex allergies.	
Butyl rubber	Extended contact	• Good for ketones and esters. Poor for gasoline and aliphatic, aromatic, and halogenated hydrocarbons.	

Neoprene	Extended contact	• Good for acids, bases, alcohols, fuels, peroxides, hydrocarbons, and phenols. • Poor for halogenated and aromatic hydrocarbons. • Good for most hazardous chemicals.	
Norfoil	Extended contact	• Good for most hazardous chemicals. • Poor fit (Note: Dexterity can be partially regained by using a heavier weight Nitrile glove over the Norfoil/Silver Shield glove.	
Viton	Extended contact	• Good for chlorinated and aromatic solvents. • Good resistance to cuts and abrasions. • Poor for ketones. • Expensive.	
Polyvinyl chloride (PVC)	Specific use	• Good for acids, bases, oils, fats, peroxides, and amines. • Good resistance to abrasions. • Poor for most organic solvents.	

Polyvinyl alcohol (PVA)	Specific use	• Good for aromatic and chlorinated solvents. • Poor for water-based solutions.	
Stainless steel **Kevlar** **Leather**	Specific use	**Cut-resistant gloves.** Sleeves are also available to provide protection to wrists and forearms. (If potential for biological or chemical contamination: wear appropriate disposable gloves on top of your cut-resistant gloves and discard after use).	 
Cryogenic Resistant Material **Leather**	Specific use	For use with cryogenic materials. Designed to prevent frostbite. Note: Never dip gloves directly into liquid nitrogen.