GENESEO | DEPARTMENT OF Environmental Health & Safety

Chemical Hygiene Plan

April 2023
Version 1.07

Note: The official and current version of this document is hosted at the SUNY Geneseo EHS website. All other electronic or paper copies of this document may be outdated.

Acknowledgements

SUNY Geneseo would like to acknowledge and thank the following Universities whose websites, documentation and assistance provide the resources and information referenced to inform this Chemical Hygiene Plan:

- University at Binghamton, SUNY
- University at Buffalo, SUNY
- Stony Brook University, SUNY
- Central Michigan University
- Hamilton College
- Midwestern State University
- Sonoma State University
- University of Alberta
- University of Mary Washington
- University of Nevada, Reno
- University of Wisconsin-Superior

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Telephone Numbers

Emergencies:

From an on-campus phone **dial x5222** for **Campus Emergency**.

Any other phone, **dial 911**

When making an emergency call:

- Give your name, the building and room number
- The nature of the emergency
- The phone number you are calling from
- Do not hang up until asked to do so

Other Numbers:

Poison Control Center: **1-800-333-0542**

Building Facilities and Utilities Emergencies **x5661** (From on-campus phone)
(585) 245-5661 (from off-campus phone)

SUNY Geneseo Environmental Health and Safety (EHS)
x5663 (From on-campus phone)
(585) 245-5663 (from off-campus phone)

Section One

Introduction

1.1 Purpose

1.1.1 The objective of this Chemical Hygiene Plan (CHP) is to provide specific recommendations to individuals who work at or attend SUNY Geneseo for the control of potentially hazardous occupational exposures to chemical and physical agents in the laboratory environment. This CHP is a "living" document which will need to be updated from time to time to best reflect specific, current conditions and practices. Environmental Health and Safety (EHS) will work with the Campus Laboratory Safety Committee to keep this document current so that the specific guidance provided herein is operationally accurate and useful.

1.2 Policy

1.2.1 It is SUNY Geneseo's policy to provide its employees and students with a safe and healthful work environment and to comply with all pertinent SUNY, federal, state, and local regulatory requirements. Further, SUNY Geneseo is committed to the protection of campus property from damage or loss caused by accidents/emergencies, and to the prevention of harm to the general public or the environment resulting from activities in the laboratory setting.

1.2.2 SUNY Geneseo recognizes unique chemical and physical hazards may be found in laboratories. The CHP is designed to address those hazards by stating laboratory-specific requirements and guidelines. It is a requirement that all instructors, students, laboratory workers, contractors, and visitors who work in SUNY Geneseo laboratories be familiar with and follow the requirements of this document.

1.3 Background

1.3.1 In 1970, the Occupational Safety and Health Act established the Occupational Safety and Health Administration (OSHA) within the US Department of Labor. The original Act decreed that employees should be informed of all hazards to which they are exposed on the job. In the early 1980's, OSHA implemented this instruction by enacting the Hazard Communication Standard (HCS) as 29 CFR 1910.1200, and was adopted by the New York State Department of Labor (NYSDOL). The HCS became effective in 1986. A fundamental premise of the HCS is that employees who may be exposed to hazardous chemicals in the workplace have a right to know about the hazards and how to protect themselves. The HCS is therefore sometimes referred to as the "Worker Right-to-Know Legislation", or more often just as the "Right-to-Know" law. The New York State Right-to-Know Law (12 NYCRR Part 820) also applies, guaranteeing employees in New York State access to information regarding hazardous and toxic substances. Although the original HCS applied only to the manufacturing industry, subsequent court challenges have expanded the scope of the law so that today the HCS applies to nearly all sectors of the work force. In New York State, the Right-to-Know Law is enforced by the Attorney General's Office.

1.4 Scope & Application

1.4.1 SUNY Geneseo’s Chemical Hygiene Plan applies to all campus laboratory operations. While the focus of this CHP is on "Laboratory Scale"[1] operations, many of the control recommendations, administrative procedures, and required uses of personal protective equipment (PPE) apply to other SUNY Geneseo operations, e.g. facilities maintenance activities. Therefore, all SUNY Geneseo operations that find this document (or portions thereof) pertinent may use it for reference and guidance. This CHP does not apply to work with or storage of radioactive materials or biological agents. Those areas have specific requirements which are addressed elsewhere. For additional information, please contact EHS at x5663.

[1] "Laboratory scale" is defined as; "work with substances in which containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person." "Laboratory scale" excludes those work places whose function is to produce commercial quantities of materials.

Section Two

Responsibilities

2.1 Professional Responsibility

2.2.1 Consistent with SUNY Geneseo policy, responsibility for chemical hygiene and safety in the laboratory is shared by administrators, managers, faculty, laboratory workers, and any other persons directly or indirectly involved with laboratory operations. Specific responsibilities are described below.

2.2 Laboratory Safety Committee

2.2.1 The Laboratory Safety Committee (LSC), a committee extension of the Department of Environmental Health and Safety (EHS), and EHS itself, are both responsible for the overall management and administration of the CHP. The LSC and EHS are also responsible for providing leadership and direction to SUNY Geneseo regarding chemical hygiene and safety within the laboratory. Members of the LSC serve as Safety Representatives for respective departments at the College.

2.3 Faculty/Principle Investigator/Laboratory Supervisor

2.3.1 The supervising Faculty member, Principle Investigator (PI), or Laboratory Supervisor are responsible for:

1. Implementing the pertinent requirements of this document in their respective areas.
2. Providing specialized training or ensuring that students working under their direction in their laboratory area or with their laboratory equipment are trained specifically on the chemical and physical hazards associated with that work. This training must take place at the on-set of use of new equipment, new lab assignment, or changed lab assignment.
3. Ensuring that Safe Work Practices are developed for all "high hazard" operations. The guidelines for the development of Safe Work Practices are provided in Section 5.2 of this document. A current listing and copies of all Safe Work Practices should be maintained by the department.
4. Suggesting solutions to improve the safety of the process, equipment, production materials, and training.
5. Knowing safety and emergency equipment locations and operating procedures.
6. Regularly communicating safety information to students as necessary.
7. Ensuring that students are aware of, and familiar with, emergency procedures and the proper use of emergency equipment.
8. Ensuring that all safety training of students is documented and maintained in Department files.
9. Reinforcing training by monitoring the activities of students for unsafe acts and implementing corrective action as necessary.

10. Requesting facility work orders directly or through the Department designated contact (if applicable) to initiate safety corrective actions.
11. Placing defective or unsafe equipment out of service and contacting the Department designated contact to arrange for servicing of equipment that is in need of maintenance and/or repair.
12. Managing hazardous materials operations within their areas by making Material Safety Data Sheets (MSDS) and/or Safety Data Sheets (SDS) available to workers and ensuring that hazardous materials are handled, stored, transported, and disposed of in the correct manner.
13. Maintaining personal work areas in accordance with housekeeping standards.

2.4 Department Chair

2.4.1 Department Chairs provide the leadership and necessary resources for the maintenance of safe working conditions within the department by working with EHS and the LSC to implement and maintain the safety program. Chairs are responsible for:

1. Communicating to Faculty/PI/Laboratory Supervisors and/or Laboratory Staff that they are required by federal and state law to attend all applicable training sessions
2. Motivating and assisting faculty and staff with CHP compliance.

2.5 Environmental Health and Safety

2.5.1 Environmental Health and Safety (EHS) is responsible for certain elements of the CHP. These elements include:

1. Overseeing the education and training of faculty and staff before using hazardous materials.
2. Coordinating the required training classes as requested by the Chair of the Department or the Department Safety Representative.
3. Reviewing and monitoring the safe disposal of hazardous materials according to the appropriate federal and state regulations.
4. Ensuring that medical consultative services are available to those employees requesting or needing such services.
5. Maintaining knowledge of the current legal requirements concerning regulated substances.
6. Responsible for resolution of appropriate chemical hygiene management issues.
7. Testing the performance of laboratory exhaust hoods annually.
8. Maintaining, checking and servicing fire extinguishers.
9. Maintaining the Hazardous Waste Contingency Plan.

2.6 Facilities Department

2.6.1 The Facilities Department is responsible for:

1. Reviewing and approving laboratory equipment installations for compliance with pertinent building codes and regulations.
2. Maintaining and servicing facilities-related equipment which services laboratories including local exhaust ventilation systems and emergency/life safety equipment (e.g. building fire alarms and sprinklers).

3. Providing guidance to Laboratory management, faculty researchers, and the Laboratory Safety Committee regarding appropriate engineering control installations for chemical and physical hazards.
4. Maintaining Safety Shower and Eye Wash stations inspections and performing regular water line flushing maintenance.

2.7 Personnel/Employees

2.7.1 It is the responsibility of all personnel and employees to follow the established CHP, Standard Operating Procedures (SOPs), and safety rules. In order to meet these goals, employees must:

1. Use appropriate PPE
2. Report safety hazards to supervisor(s).
3. Report symptoms and signs of possible and known exposure to hazardous chemicals.
4. Report accidents.
5. Attend all required safety training sessions.
6. Facilitate and assist student employees in meeting these goals.

2.8 Chemical Hygiene Plan Requirements

2.8.1 Training

2.8.1.1 The Faculty member, PI, Laboratory Supervisor and/or Laboratory Manager must make available to all laboratory personnel all pertinent Right-to-Know information concerning the hazards of chemicals found in the laboratory supervised. Training shall consist of:

1. Awareness and contents of the Chemical Hygiene Plan (CHP)
2. Potential hazards of the chemicals commonly found in the laboratory
3. Proper ways to protect and reduce the risk of the chemical hazards in the lab, including Safe Work Practices, established standard operating procedures (SOPs), proper PPE, and emergency procedures
4. How to find, read, and understand Safety Data Sheets (SDS)

2.8.2 Availability of Plan and Review Frequency

2.8.2.1 This CHP will be made available by the college through the SUNY Geneseo EHS website and presented upon request to anyone in any laboratory space at the college where chemicals are in use. This CHP should be reviewed by the LSC when new conditions merit or bi-annually, whichever comes first.

2.8.3 Lab Inspections

2.8.3.1 The LSC will perform periodic health and safety assessments of chemical laboratories and chemical storerooms. Lab inspections are an important part of a holistic laboratory safety program. The goal of these assessments is to identify and inform the Faculty member, PI, Laboratory Manager and/or Laboratory Supervisor of potential safety and health issues and where laboratory safety can be improved. Laboratory inspections are most effective when the Faculty member, laboratory PI, lab supervisor, lab manager and laboratory workers participate with EHS and the LSC. Written recommendations resulting from these inspections will be given to the Faculty member, PI, lab supervisor/manager (leading agency) and the Department Chair.

2.8.3.2 It is recommended that each individual laboratory perform self-assessments of their laboratory at least twice a year, spaced evenly throughout the year. A Laboratory Inspection Checklist is available from EHS to assist in the laboratory self-assessment. The purpose of these assessments it to allow each laboratory to self-identify and correct safety and health issues quickly. A record of self-inspections should be kept so reoccurring problems or concerns may be identified for correction.

Section Three

Preplanning and Approval of Proposed Laboratory Operations

3.1 Approval Process

3.1.1 All proposed new or modified laboratory equipment/operations which use chemical substances or equipment that pose the potential for unique physical hazards (e.g. ionizing radiation, high voltage) require review and approval of EHS prior to use and/or installation. New laboratory equipment which may present significant and/or unusual hazards to personnel or students shall be reviewed by EHS prior to purchase and installation. This requirement does not include newer replacement equipment or equipment with Underwriters Laboratory (UL) or other safety inspected and certified equipment.

3.2 Laboratory Safety Support Equipment and Personal Protective Equipment

3.2.1 EHS and Facilities will ensure Laboratory areas are both properly equipped with the following and properly inspected regularly[2], as determined necessary:

1. Fire sprinkler system
2. Fire extinguisher(s)
3. Eyewash and Safety shower (where corrosive chemicals are used)
4. Eye wash (where hazardous materials are used)
5. Fume hood(s)
6. Specific Hazard Alarm Systems
7. Other equipment as may be deemed necessary by the Laboratory Safety Committee and/or EHS.

3.2.2 The PI and/or Laboratory Manager will ensure Laboratory areas shall additionally be equipped with the following Personal Protective Equipment (PPE) and appropriate signage, as determined necessary by EHS, Facilities, LSC Safety Representatives, and PI or Laboratory Manager:

1. Respirators (if required by EHS)
2. Safety glasses or chemically splash-resistant goggles
3. Face shields (if required by EHS)
4. Lab protective clothing (including but not limited to: lab-appropriate street clothes, lab goggles/lab glasses, lab coats, and gloves)
5. Lab entry postings/signage
6. Safety signage

[2] If facilities-governed equipment is found to be expired, if applicable inspections are expired, or if there are any other concerns or questions, contact Facilities Services at x5661 to report.

Section Four

Chemical Procurement

4.1 Specific Requirements

4.1.1 SUNY Geneseo personnel responsible for ordering chemicals must be cognizant of the following requirements:

1. Chemical purchases shall be kept to the volume required to sustain laboratory operations without incurring significant operational interruption to avoid high waste disposal costs at a later date.
2. Containers shall not be accepted without an adequate identifying label (e.g., chemical identity, hazard warnings, manufacturers name and address). Unsolicited samples of hazardous materials must not be accepted by SUNY Geneseo personnel.
3. Procedures for chemical ordering and SDS Procurement (refer to Section 7.5 Hazard Communication for more information about MSDS/SDS):
    - A. Personnel orders chemical from vendor
    - B. Chemical sent to requester directly from vendor
    - C. Personnel makes at least one copy of SDS delivered with chemical **OR** procures a copy of the appropriate SDS from online sources
    - D. Personnel places a copy SDS at appropriate location. A second copy of the SDS **must** be sent to EHS through campus mail or by email
    - E. Faculty and Staff must review MSDS/SDS prior to working with a material

Section Five

Safe Laboratory Work Practices and Procedures

5.1 General Principles

5.1.1 The number of hazardous chemicals and the number of reactions among them is so large that previous knowledge and/or anticipated recognition of all potential hazards cannot be assumed. Therefore, when the chemical properties of a material are not fully known, the chemical should be assumed hazardous and used in the smallest quantity possible. This will minimize exposure potential, and reduce the probable magnitude of unexpected chemical events.

5.1.2 The following general safety principles should be observed by all personnel when working with chemicals:

1. Substitute less toxic materials whenever possible (e.g., toluene may be substituted for benzene).
2. Minimize all chemical exposures through the use of engineering (e.g., lab-hoods), administrative (e.g. Safe Work Practices), and personal equipment protective (e.g. gloves and/or blast shields).
3. Obtain and read the SDS and other hazard information on solids, liquids, and gases used to support laboratory operations.
4. Confine long hair, loose clothing and jewelry in the laboratory.
5. Be knowledgeable in the use of laboratory emergency equipment such as eyewashes, showers, and fire extinguishers, and know where information is posted about how to obtain additional help in an emergency.
6. Provide a means of containing the materials if equipment or containers should break or spill their contents (secondary containment). A pre-determined spill abatement procedure should be part of the Safe Operating Procedure which covers the use of the chemical.
7. Carefully label or cross-reference every secondary container with the identity of its contents. Appropriate hazard warnings will be required if more than one person will be using the secondary container or if the container is to be left unattended for more than half an hour.
8. Utilize equipment only for its designed purpose.
9. Keep the work area clean and orderly.
10. Determine compatibility of chemicals and store incompatibles separately (refer to Appendix Two – Chemical Storage/Incompatible Reactions).
11. When using volatile or flammable materials, limit the volume set out for active use to the minimum needed. Refer to Section 11.4.1 for a specific discussion on flammable and combustible liquids.
12. Position and clamp reaction apparatus thoughtfully in order to permit manipulation without the need to move the apparatus until the entire reaction is complete. Combine reagents in appropriate order, and avoid adding solids to hot liquids.

13. Seismically brace all chemical storage cabinets, racks, and laboratory equipment containing hazardous materials in accordance with best structural engineering practices.
14. **A**lways **A**dd **A**cids to water to avoid reactions and splattering.
15. Consider the appropriateness of engineering design controls and setup for systems which can generate or operate at high or low pressure.

5.2 Safe Work Practices

5.2.1 The most important administrative controls for hazardous operations are the safe work practices that are developed and used in the Laboratory. Safe Work Practices are those practices used in a laboratory operation, which have been communicated via on-the-job training, through reading of equipment and process specifications, and through reading of general safety information.

5.2.2 Research the chemical hazards of anticipated chemicals to be used before working with them! Consult the Safety Data Sheet (SDS) or other appropriate references prior to using a chemical which is unfamiliar. Minimize exposure to all chemicals regardless of toxicity or your familiarity with them. Most laboratory chemicals have not been fully characterized with respect to their toxicity; therefore it is prudent to implement procedures that reduce the likelihood of exposure.

5.2.3 Written Safe Work Practices are required for "high hazard" operations and recommended for other potentially hazardous operations. Safe Work Practices should be developed by the PI, Faculty/Staff researcher/instructor, or chemical technician and reviewed using the Hazard Assessment tool found in Appendix Thirteen of this document. A list of "high hazard" operations requiring Safe Work Practices by classification is provided below.

5.2.4 Example High Hazard Operations Requiring Written Safe Work Practices

1. Equipment and processes which use carcinogenic, mutagenic, or teratogenic substances.
2. Equipment or processes which use more than 1 pint/1 pound / ~500 mL of organic solvents, acids, bases, oxidizers, heavy metals, toxic materials.
3. Equipment or processes which involve accessible hazardous electricity or ionizing and non-ionizing radiation, including laser light.
4. Powered machining areas and equipment.
5. Any other area/operation as deemed appropriate by the CHO, LSC, or EHS.

5.3 Personal Chemical Health and Hygiene

5.3.1 Having good personal chemical hygiene habits assist in minimizing chemical exposure. Assume that unknown materials are toxic, and that a mixture is more toxic than its most toxic compound.

5.3.2 The following considerations must be made when working with chemicals in a laboratory setting:

1. Skin contact with potentially hazardous, unknown, and/or uncharacterized chemicals should always be avoided.
2. Avoid inhalation of chemicals, never ‘sniff’ or taste to test chemicals.

3. NEVER use mouth suction to pipette chemicals or to start a siphon; a repeating pipette, pipette pump, pipette bulb, vacuum pump or apparatus, vacuum line, aspirator, or some other equivalent tool or method must be used to provide vacuum.
4. Contamination of food, drink, and smoking materials is a potential route for exposure to toxic substances. Food for human consumption shall be stored, handled, and consumed in areas free of hazardous substances.
5. Food and drink must not be permitted in areas where chemicals or chemical equipment are being used.
6. Glassware or utensils that have been used for laboratory operations should never be used to prepare or consume food or beverages. Laboratory refrigerators and ice chests shall be labeled **"NO FOOD OR DRINK"** and not be used for food storage.
7. Thoroughly wash hands and remove contaminated lab coats etc. prior to leaving laboratory.

5.3.3 In some cases it may be acceptable to store and consume food and drink in designated administrative areas in a larger laboratory area. Contact EHS to discuss specific exceptions.

5.4 Personal Protective Equipment (PPE)

5.4.1 The use of personal protective equipment (PPE) is needed to compliment the variety of engineering and administrative controls present in the laboratory environment. Operation-specific PPE requirements are provided in Safe Work Practices. The following is a listing of minimum PPE use guidelines for laboratory personnel:

5.4.2 Apparel

5.4.2.1 The following practices concerning apparel shall be observed at all times:

1. Wear appropriate clothing, including a protective apron or laboratory coat to protect against chemical splashes or spills, cold, and heat. Use protective apparel, including face shields, gloves, and other special clothing or footwear, as needed.
2. Protect skin and eyes from possible exposure to hazardous substances by use of appropriate laboratory clothing, gloves, safety glasses (in case of mechanical hazard), or goggles (in case of chemical hazard as per ANZI Z87.1-2003).
3. Remove jewelry from wrists and hands to prevent chemicals from collecting underneath, contacting electrical sources, catching on laboratory equipment, and/or damaging the jewelry itself.
4. Laboratory coats should not be taken beyond the boundaries of the working region to prevent spreading contamination to areas outside of a laboratory.
5. Take off laboratory coats immediately if they are contaminated with hazardous materials, and placed in a bag labeled hazardous waste for decontamination.
6. Confine loose apparel.
7. Never wear open-toed shoes or sandals in any laboratory area.
8. Gloves should not be worn outside of the laboratory due potential cross-contamination of hazardous substances with surfaces where other personnel/non-laboratory persons may have reasonable unprotected contact with said surfaces. Exceptions include transporting hazardous substances from one location to another, but exceptions must be expressly approved by the PI or Laboratory Manager. More information about gloves is described in section 5.4.2 and Appendix Three of this CHP.

5.4.2 Gloves

5.4.2.1 Gloves must be worn whenever working with hazardous chemicals, rough or sharp-edged objects, or very hot or very cold materials. Select gloves based on the material being handled, the particular hazard involved, and their suitability for the procedures being conducted. Check gloves visually for discoloration, punctures, and tears or by other means prior to each use and change them often, based on their frequency of use and permeability to the chemical(s) handled. Even appropriate, high-quality gloves will eventually be permeated by chemicals due to the substance and because of use. All gloves degrade with use and/or the glove eventually becomes chemically transparent to the substance used. For general information refer to Appendix Three or request additional information from your Department Safety Representative or EHS for glove compatibility.

5.4.3 Eye Protection

5.4.3.1 Safety glasses are required in all laboratory areas where hazardous materials are stored and used. The safety glasses shall be impact resistant eyeglasses with side shields. All persons who are working or visiting in the laboratory must wear safety goggles at all times chemicals are being used or handled. Safety glasses, carpenter's goggles or glasses with side shields are not acceptable for eye protection in the presence of hazardous chemicals as per ANSI Z87.1-2003.

5.4.4 Respirators

5.4.4.1 The use of respirators at SUNY Geneseo is governed by the requirements set forth to reduce exposure to airborne hazardous materials as defined by OSHA Permissible Exposure Limits (PELs). Respirators are generally not needed in a normal laboratory setting. However, if engineering and administrative controls cannot ensure concentrations of airborne hazardous materials are maintained below OSHA PELs, or when atmospheric conditions are unknown, respiratory protection is required. Contact EHS for more information.

5.5 Unattended Operations & Working Alone

5.5.1 General

5.5.1.1 Precautions should be taken for unattended laboratory operations carried out continuously or overnight. Unattended operations should be designed to be safe, and plans should be made to avoid hazards in case of failure. If possible, make arrangements for routine surveillance (e.g., each hour) of the operation, leave the lights on, and place an appropriate sign on the door to indicate that the operation is active but is unattended.

1. Names and telephone numbers of lab operator(s) are to be posted on the entrance door for unattended operations.
2. Operations requiring cooling water shall employ monitoring devices that will shut the operation down in the event of water supply failure.
3. In general, it is imprudent to work in laboratories alone. Arrangements should be made between individuals working in separate laboratories to crosscheck with one another periodically.
4. **Laboratory work known to be hazardous must not be undertaken by faculty/staff/students alone in a laboratory. At least two persons must be present. Safe Work Practices shall specify this requirement.**

5. Students shall not be left unsupervised while working in the laboratory, unless they have documented training records related to their activities.
    a) Regardless of training, students should always have readily available the after-hours and off-campus contact information of a faculty/staff member who is specifically aware of the hazards associated with the specific laboratory activities being performed.
    b) Please refer to EHS policies regarding undergraduate students in laboratories, and/or call EHS for clarification.

5.5.2 Working Alone

5.5.2.1 SUNY Geneseo employees should not work alone in laboratories when involved in highly hazardous operations. Examples of highly hazardous operations are:

1. Confined space entry locations.
2. Conditions requiring the use of Self-Contained Breathing Apparatus (SCBA), air-line respirators, or Supplied Air Breathing Apparatus (SABA).
3. Work on energized high voltage (600 volts or more) electrical equipment.
4. Work involving the potential for atmospheres Immediately Dangerous to Life or Health (IDLH). (e.g., those operations where engineering controls are not in place to preclude IDLH atmospheres from occurring).
5. Work on unguarded moving equipment or machinery.
6. Work on energized high-pressure systems or vessels.
7. Work with high-energy materials (i.e., oxidation, polymerization, radioactive, etc.).
8. Work in laboratories involving the handling and processing of bulk chemicals (e.g., greater than 4L [approximately 1 gallon] containers).
9. Any other work activity identified by the Faculty Member, PI, Laboratory Supervisor, Lab Manager, and/or EHS as being too hazardous to be performed alone.

5.6 Housekeeping

5.6.1 The following housekeeping practices shall be observed at all times in the laboratory:

1. There is a definite relationship between safety performance and orderliness in the laboratory. Work areas should be kept clean and free from obstructions. Cleanup should be completed following any operation or at least by the end of each work shift.
2. Stairways and hallways must not be used as storage areas.
3. Spilled chemicals shall be identified and isolated safely as soon as feasible, then cleaned up and disposed of properly. Only trained personnel shall perform spill clean-ups. ***All*** spills should be reported to PI, Faculty, and/or Laboratory Supervisor in charge of the laboratory. The supervising employee shall contact EHS and Campus Police (x5222) to report chemical spills if conditions warrant as described in section 5.13: Spills of Hazardous Materials.
4. Old containers and chemical wastes shall be disposed of promptly and not be allowed to accumulate in the laboratory. Wastes shall not be accumulated for more than 90 days except in designated satellite accumulation areas as per New York State DEC 2006 law “Hazardous Waste Manifest System and Related Standards For Generators, Transporters and Facilities” 372.1.e.7. Waste containers shall be labeled for contents and dated. An up-to-date waste log should be readily available near waste containers.

a. For more specific information pertaining to how to document and report hazardous chemical waste for disposal, see the following appendices in this document:

i. Appendix Nine – Labeling and Collecting Waste: Waste Classification,

ii. Appendix 10 – How to Label and Collect Waste: Campus Guidelines for Paper Tags, and/or

iii. Appendix 11 - How to Label and Collect Waste: Campus Guidelines for Online Submission

5. Non-hazardous materials spills (e.g. water) are to be cleaned up immediately.
6. Access to exits, emergency equipment, and essential equipment shut downs and controls shall never be blocked.
7. Equipment and chemicals all shall be stored properly; clutter should be minimized.

5.7 Glassware

5.7.1 The following Safe Work Practices shall be observed at all times in the laboratory:

1. Careful handling and storage procedures shall be used to avoid damaging glassware.
2. Adequate hand protection must be used when inserting glass tubing into rubber stoppers or corks or when placing rubber tubing on glass hose connections. Glass tubing shall be fire polished or rounded and lubricated, and hands should be held close together to limit movement of glass, should fracture occur. The use of plastic or metal connectors should be considered.
3. Glass-blowing operations shall not be attempted unless proper annealing facilities are available.
4. Vacuum-jacketed glass apparatus shall be handled with extreme care to prevent implosions. Equipment such as Dewar flasks must be taped or shielded. Only glassware designed for vacuum work shall be used for that purpose.
5. Hand protection shall be used when picking up broken glass.
6. Glass disposal boxes shall be made available where broken glass may be generated. When glass boxes are full, a work order should be submitted for pick-up and disposal.
7. Proper instruction and training shall be provided in the use of glass equipment designed for specialized tasks, which can represent unusual risks for the first-time user. (For example, separatory funnels containing volatile solvents can develop considerable pressure during use.)

5.8 Access to SUNY Geneseo Laboratories

5.8.1 Access to SUNY Geneseo Laboratories is controlled by Faculty and Professional Staff. SUNY Geneseo requires that every employee, visitor, contractor, or other person performing work at the site be familiar with, and observe the applicable SUNY Geneseo requirements. New employees and, where appropriate, contractors, students and visitors are required to receive chemical safety and hazard training matched to their responsibilities and duties. The responsible Faculty or Laboratory Manager/Supervisor ensures that this requirement is met in their areas.

Due to the potential hazards and liability issues, other persons, in particular children under the age of 16 are not permitted in hazardous work areas, with the exception of University-sanctioned activity, e.g., tours, open houses, or other University related business as authorized by the Principal Investigator or laboratory supervisor. In these instances, all children under the age of 16 must be under careful and continuous supervision.

5.9 Transport of Hazardous Materials On-Site or From SUNY Geneseo

5.9.1 Transport of hazardous materials containers on-site, within a building or back and forth to the hazardous materials storage facility must have secondary containment. The secondary containment shall involve the use of transport carts capable of containing all contents of the containers on the cart, or single-bottle secondary containment totes (safety carriers) designed specifically for transport of hazardous materials. Except for transport to the outside hazardous materials storage facility, transportation of hazardous materials by SUNY Geneseo students outside of a campus building is prohibited without documented permission of the PI/Faculty Professor/Laboratory Supervisor or Laboratory Manager. Transportation of hazardous materials by employee or student private vehicle or non-designated SUNY Geneseo vehicle is not permitted because of the possibility of spillage or breakage of the container and resulting risk of injury to personnel and damage to property.

Note: For the purpose of hazardous materials transport, there are no exempt quantities which do not require secondary containment as per New York State Department of Transportation (NYSDOT).

5.9.2 Shipping Biological Samples with Dry Ice

5.9.2.1 Dry ice, or frozen carbon dioxide, may pose an asphyxiation hazard during transportation inside sealed containers, such as a cargo hold on an airplane. Therefore, shipping dry ice to keep samples cold is a regulated activity by the US Department of Transportation under 49 CFR and if shipped internationally, IATA (International Air and Transportation Association).

5.9.2.2 Medical waste is not included in the exemption for “diagnostic or medical purposes” and is a fully regulated material and must follow all DOT rules for a hazard class 6 material.

5.9.2.3 Cellular materials, DNA, etc. being shipped to another college, university or hospital for research purposes is considered for “diagnostic or medical purposes” and thus exempt from the hazardous material ground transportation regulations according to UPS. However, if the package is shipped by domestic or international air travel, the package is NOT exempt and the shipper (you) must follow the instructions below. If steps are missed such as not declaring the shipment weight or lack of a diamond label of the appropriate size and color, or leakage from the container of biological contents, significant fines could result.

5.9.2.4 Federal regulations state that anyone wishing to ship dry ice must first have IATA/DOT training. Faculty/PI/Laboratory Supervisors wishing to ship packages including dry ice or sign any type of shipping documentation (such as a FedEx Airbill) for a dry ice shipment must contact EHS for appropriate training prior to initially preparing, shipping or authorizing dry ice shipments.

A. **Requirements for Preparing Dry Ice Shipment Containers:**

   a. Fill any empty space in the package with appropriate packing material to prevent product movement in transit

b. Wrap temperature-sensitive products in two watertight plastic bags or use absorbent material along with a plastic liner
c. Avoid shipping temperature-sensitive products over the weekend
d. Wrap the refrigerant in paper or another carton to slow the melting rate and prevent excess space when using dry ice
e. Do not place the refrigerant at the bottom of the package because cold air will not circulate
f. Do not seal the inner insulated container when using dry ice. Venting is required to allow some carbon dioxide gas to escape the package

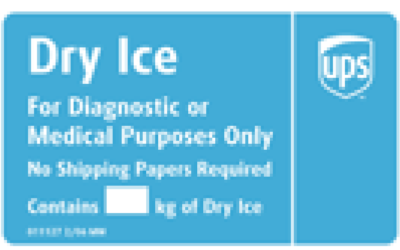
B. Preparing Dry Ice Shipments

In order to ensure laboratories shipping packages with dry ice meet state and federal shipping regulations, SUNY Geneseo personnel preparing dry ice shipments must strictly follow the guidelines listed below.

1. **U.S. Ground Shipments:**
   Dry ice shipments are not regulated for ground transport, simply process these shipments as a UPS Ground shipment. Follow labelling requirements.

Note: Dry ice shipments to and from Alaska, Hawaii, Puerto Rico and Catalina Island must be processed as air shipments.

2. **U.S. Domestic Air Shipments:**
   a. For all medical packages on dry ice (prepared under 49 CFR):
      i. No Hazardous Material Agreement is required
      ii. No Hazardous Material Shipping Papers are required
      iii. No acceptance audit is performed
      iv. Hazardous Material accessorial charges will not be applied
      v. Process through WorldShip® 2008 version 10.0 (or higher) or compatible software



      vi. Mark the outer carton with the words "Dry Ice for Medical Purposes" and the amount (weight) of dry ice contained in the package (e.g. 2 kg)
      vii. No other paperwork is required
      viii. *Dry Ice for Medical Purposes* stickers may be obtained free of charge (Item #011127) online or by calling 1-800-554-9964
      ix. For diagnostic and medical samples ONLY, up to 68 kg (150 pounds) of dry ice may be shipped

   b. For non-medical, non-hazardous U.S. domestic air packages with 2.5 kg (5.5 pounds) or less of dry ice (prepared under 49 CFR):
      i. No Hazardous Material Agreement is required
      ii. No Hazardous Material Shipping Papers required
      iii. No acceptance audit is performed
      iv. Hazardous material accessorial charges will not be applied
      v. Process through WorldShip 2008 version 10.0 (or higher) or compliant software
      vi. Mark the outer carton with:
         1. The words "Dry Ice" or "Carbon Dioxide, Solid"
         2. A description of the non-hazardous contents (e.g. food, meat)
         3. The amount of the dry ice contained in the package (or a statement that there is 2.5 kg [5.5 pounds] or less in the package)

vii. No other paperwork is required for these packages

c. **For non-medical U.S. domestic packages with greater than 2.5 kg (5.5 pounds) of dry ice (or all IATA prepared shipments containing dry ice):**

i. **The following are required by SUNY Geneseo:**

1. Contact EHS well in advance for advice in proper container selection and Hazardous Materials declarations.
2. Shippers of Hazardous Materials are required by US DOT to be trained and certified; contact EHS for training PRIOR to shipping.

ii. **The following are required under 49 CFR:**

1. UPS Dangerous Goods Agreement required
2. Hazardous Materials shipping papers
3. An acceptance audit is performed
4. The package must be properly marked as containing "Dry Ice" (or "Carbon Dioxide, Solid"), UN1845
5. The net weight of dry ice must be indicated on the shipping papers and can also be marked on the outer package

iii. **The following are required under IATA:**

1. Process through WorldShip 2008 version 10.0 (or higher), CampusShip or compliant software
2. An acceptance audit is performed
3. Mark the outer carton with:
   - The words "Dry Ice" or "Carbon Dioxide, Solid" and "UN1845
   - The amount of dry ice contained in the package in KG
   - Class 9 Diamond label

For further assistance with dry ice shipments, please contact EHS or call the UPS Hazardous Materials Support Center at 1-800-554-9964.

More information may be found online in the UPS Hazardous Materials Guide. View Hazardous Materials Guide

4. **International Shipments:**
International shipments containing dry ice may require the shipper to have a UPS International Special Commodities contract. For more information, please contact the UPS Hazardous Materials Support Center at 1-800-554-9964, or visit our online UPS Guide for Shipping International Dangerous Goods. More information may be found online in the UPS Guide for Shipping International Dangerous Goods. View UPS Guide for Shipping International Dangerous Goods

International dry ice packages require the following under IATA:

1. Process through WorldShip 2008 version 10.0 (or higher), CampusShip or compliant software
2. An acceptance audit is performed
3. Mark the outer carton with:

4. The words "Dry Ice" or "Carbon Dioxide, Solid" and "UN1845
5. The amount of dry ice contained in the package in KG
6. Class 9 Diamond label

5.10 Labeling of Hazardous Materials Containers

5.10.1 Reagent Chemical/Primary Chemical containers

5.10.1.1 All containers (including lab glassware, safety cans, and plastic squeeze bottles) must have labels that identify their chemical contents regardless of hazardous or non-hazardous contents (e.g. water). Primary responsibility is held by the department using/generating such containers. Experiments which carry over more than one employee/student shift or is otherwise stored must be properly labeled and contained.

5.10.1.2 Minimum Labeling Requirements

The minimum labeling requirements for storage containers are:

1. Label must be in English with full chemical name spelled out; structures, abbreviations and chemical formulas must be accompanied by a non-abbreviated English or IUPAC chemical name.
2. Label must include any appropriate hazard warnings.

5.10.2 Secondary Chemical containers

5.10.2.1 Exceptions to the labeling requirement are secondary containers (such as beakers, graduated cylinders or containers) used by one person during their shift and as long as the contents are used up or disposed of during the same shift. This prevents mishandling, misuse, or accidents as others in the lab may be unaware of the contents. Laboratory personnel should not work with a chemical stored in an unlabeled container when the contents are not known.

5.10.2.2 Secondary containers which are meant to be chemical storage for more than one employee shift must be labeled as storage containers according to the criteria listed above. Additional criteria may include:

1. If it is not practical to label a container, appropriate information may be placed on a sign kept next to the container.
2. Chemicals which are time sensitive or which produce peroxides must be dated indicating the date storage began and also dated when first opened.
3. Reagent squirt bottles must always be properly labeled, even if only used for water.
4. All containers used for baths, such as oil or alcohol baths, must be labeled.

5.10.3 On-site Developed or Synthesized Chemical containers

5.10.3.1 Laboratory-developed substances, including buffers, testing and reference samples, chemical intermediaries or derivatives, and non-commercially prepared chemicals must be identified and properly labeled.

1. If the volume is small, at a minimum, label the container with an identification number associated with a key, so individual constituents may be identified by referring to the procedure.

2. For larger volumes, consider assigning the IUPAC name based on IUPAC guidelines. Further information about IUPAC nomenclature can be found at multiple online resources, including: http://goldbook.iupac.org/
3. Additional requirements for handling synthesized material can be found in Section 11 of this CHP, "Requirements for the Use of High Hazard Materials and Equipment".

5.11 Chemical Storage

5.11.1 The separation of chemicals (solids or liquids) during storage is necessary to reduce the possibility of unwanted chemical reactions which may result from accidental mixing. There are several competing schools of thought regarding chemical storage classifications, and depending on the volume stored or used in a laboratory, this CHP does not advocate for any particular method beyond the classifications described below or in Appendix Two. Use either distance or barriers (e.g., trays) to isolate chemicals into the following minimum classifications.

Note: Additional information on chemical storage cabinetry is provided in Section 6.8.6 and Section 11.4.1.7. More information about specific storage group hazard classifications may be found in Appendix Two.

5.11.2 Minimum Storage Classifications

1. Flammable or combustible liquids (e.g., acetone, benzene, ether, alcohol).
2. Inorganic Acids (e.g., nitric, sulfuric, hydrochloric, perchloric)- treat acetic acid as a flammable liquid.
3. Bases (e.g., sodium hydroxide, ammonium hydroxide) and oxidizers and poisons.
4. Explosives or unstable reactive substances (such as picric acid), should be stored separately, in proper flammable storage. Contact EHS for additional information.
5. Other liquids (e.g., chloroform, trichloroethane).

5.11.3 Other Storage Notes

In addition to the above classifications:

1. Carcinogens should be stored in secondary containers that are chemically resistant and unbreakable.
2. Stored chemicals (such as peroxide formers) should be examined at least semiannually for deterioration, integrity and expiration dates. See Appendix Twelve.
3. The amount of chemicals permitted for storage should be kept as small as practical.
4. Reagent squirt bottles must be properly labeled and capped loosely when stored to prevent loss due to barometric pressure changes.
5. Exposure of chemicals to heat or direct sunlight shall be avoided.
6. Fume hoods are not intended as a primary storage area of chemicals as per NYS fire code. Chemicals temporarily stored in fume hoods should be kept to a minimum and should not block vents or alter airflow.
7. Lips, strips, or bars should be installed across the width of reagent shelves to restrain the chemicals in case of earthquake. Please contact EHS with questions for labs determined not to be prepared for earthquake events.
8. Chemicals must not be stored in the same refrigerator used for food storage. Refrigerators used for storing chemicals must be appropriately identified by placing the following label on the door (an example of such a label is shown is as follows).

CAUTION

REFRIGERATOR FOR CHEMICAL STORAGE ONLY. NO FOOD OR DRINK.

5.11.4 Chemical Storage areas will be labeled with a National Fire Protection Association (NFPA) diamond reflecting the hazards in the area. Reference the Hazard Communication Program for a discussion of the NFPA labeling system.

5.12 Compressed Gas Policy

5.12.1 Gas Cylinder Usage

5.12.1.1 To reducing risk to student, staff and faculty transporting, using, or in spaces where compressed gas cylinders are located, all personnel who are using the gas cylinder shall:

1. Know the contents of a cylinder and be familiar with the properties of that gas.
2. Never use a gas cylinder which cannot be properly identified. Do not depend on color coding for gas identification.
3. Ensure all cylinders are marked with an identification tag describing the name of the gas or mixture and illustrating one of three conditions, *full*, *in-service*, or *empty*.
4. Always wear proper PPE, including safety goggles, when handling or using compressed gases.
5. Handle cylinders carefully and fasten them in a secure manner at all times in an upright position when being transported and stored.
6. Transport cylinders only on a wheeled cart specifically designed for gas cylinders. Remove regulators and attach protective safety caps before transport.
7. Do not tamper with any part of a valve.
8. Do not strike an electric arc on a cylinder.
9. Use cylinders only with matched connectors and proper compressed gas regulators. Never install cylinder adapters or connectors on a regulator which were not designed for such use.
10. Leak-test all connections to a cylinder with a soap solution. Be cautious, any gas, regardless of hazard properties, can still cause asphyxiation due to gas displacement of oxygen.
11. Close cylinder valves when not in use, and then bleed pressure for the regulator.
12. Close valves on empty cylinders, remove regulators and mark as “empty”.
13. Never attempt to refill a cylinder.
14. Cylinders of compressed gases must be handled as high energy sources, and as such, as potential explosives.

15. When storing a gas cylinder, have the protective cap in place to protect the valve stem.
16. Do not expose cylinders to temperatures in excess of 122°F (50°C).
17. When classifying a gas mixture for use, base the chemical classification on the most hazardous component.
18. Electrically ground all cylinders containing flammable gases.
19. When using gases with cryogenic properties, allow adequate ventilation and wear proper PPE with the addition of heavy gloves. Ensure the gloves are loose fitting to facilitate fast removal in case of spillage.
20. When transporting cylinders on elevators, passengers not involved with the transport should be prohibited on the elevator until the cylinder has been unloaded.

5.12.2 Gas Cylinder Storage

When storing Gas Cylinders:

1. Store cylinders in a ventilated area away from heat and/or ignition sources.
2. Fasten cylinders securely to a wall or immobile support in an upright position at all times.
3. Cylinders in storage must be protected from weather and temperature extremes and direct sunlight.
4. Store flammable gases away from other gases, separating them by at least 20 feet of open space or by a wall with at least a 1-hour fire rating.
5. Safety caps must be securely fastened during storage.
6. Cylinders will not be stored or left unattended in hallways, corridors, stairways or other areas of access or egress.
7. When classifying a gas mixture for storage, base the classification on the most hazardous component.
8. When possible, store full and empty gas cylinder separately, ensuring proper labels are attached.

5.13 Spills of Hazardous Materials

5.13.1 Identify and isolate spilled chemicals as soon as safely feasible, then clean up and dispose of properly only if it is determined safe to do so (please see section 5.13.4 Laboratory Chemical Spill Response for additional information). There are certain chemicals which are acutely toxic and require special instructions for response, these include (but are not limited to) formaldehyde, hydrofluoric acid, mercury, and other heavy metals. Information about formaldehyde spill handling may be found in Section 11.1.6. Information about mercury spills may be found in Section 11.2.1. Information about heavy metal powder spills may be found in Section 11.2.2.

5.13.2 Only trained personnel shall perform spill clean-ups. ***All*** spills should be reported to the PI, Faculty, and/or Laboratory Supervisor in charge of the laboratory. The supervising employee *must* contact EHS and Campus Police (x5222) to report chemical spills if any of the following conditions occur:

1. Spills quantity of greater than 500mL (about 1 pint) or 500g (about 1 pound), with chemical(s) defined at minimum as a hazardous substance.
2. All spills involving chemicals defined as acutely hazardous (EPA p-listed chemicals).
3. And/or where there is the potential for personal injury, for environmental impact, and/or for property damage.

5.13.3 Small-Scale Spill Response

If the spill quantity is less than 500ml (about 1 pint) or 500g (about 1 pound), and does not cause personal injury, property damage, and/or significant environmental impact, it is considered Small-Scale. For Small-Scale spills, the following actions should be taken:

1. Wear appropriate PPE during clean up.
2. Pour appropriate sorbent and/or neutralizing agent on spill.
3. Clean up; place waste in labeled plastic bag or waste container for hazardous waste disposal, if appropriate.
4. Decontaminate spilled area if required.
5. If disposing of the container used to contain materials from the cleanup, document the container as hazardous waste using the SOP described in either:
    1. Online Waste Form submission as described in Appendix Eight, or
    2. Paper hazardous waste document submission as described in Appendix Seven.

5.13.4 Large-Scale Spill Response

If the spill quantity is greater than 500ml (about one pint) or 500g (about one pound), and/or has the potential to cause personal injury, environmental impact, or property damage, it is considered a Large-Scale spill and the following actions should be taken:

1. If in a laboratory hood, close the sash if it is safe to do so.
2. Evacuate people from the area.
3. Place a sign indicating a spill is present on the outside of the doors leading to the spill area, and ensure others who are not part of the clean-up related effort do not enter the spill area until cleanup has been completed.
4. If a student, contact the supervising PI/Faculty/Laboratory Manager for further instruction or if a supervisor cannot be contacted, go to step 8.
    - A. Unsupervised students MUST treat a Large-Scale spill as a High Risk Spill, see Section 5.13.4.1.
    - B. *If not a student*, move on to step 5.
5. Identify the spilled material.
6. Isolate the spilled material, if possible to do so safely.
7. If the material is flammable, turn off all ignition and heat sources.
8. Dial x5222 if on campus to contact Campus Police, if off campus dial 911.
9. Contact EHS by dialing x5663 from a campus phone.

5.13.5 Laboratory Chemical Spill Response Risk Determination

5.13.5.1 High Risk – High Risk Spills are determined by the classification of the chemical (i.e. acutely toxic, flammable, reactive, corrosive, and/or p-listed chemicals), the quantity involved, the unique circumstances involved, if extensive measures are required to contain or control the spill, if personal injury or contamination occurs[3,4], if there is property damage, or if other factors necessitate the need for emergency response. Additionally, spills are considered high risk if students are engaged with hazardous chemicals or chemicals with indeterminate hazards in a laboratory without direct and present supervision.

Spills involving mercury and hydrofluoric acid are considered high risk regardless of volume. Spills involving heavy-metal powders or formaldehyde may be considered high risk at significantly lower quantities than the threshold defined as Large-Scale in Section 5.13.3.

High Risk Spills incidents must be immediately reported to EHS by dialing x5663 during regular business hours or by calling Campus Police at x5222 after-hours.

5.13.5.2 Moderate Risk – Moderate Risk Spills are identified by personnel self-determining a "low comfort level" of response during regular business hours. Additional professional support, technical information or assistance may be needed[4].

Moderate Risk incidents should be reported to EHS during regular business hours.

5.13.5.3 Low Risk – Low Risk Spills are identified by personnel determining all of the following characteristics are present in a chemical spill incident:

1. Personnel involved fully understand the hazards and risks present
2. There is no personnel contact contamination, inhalation hazard, or injury
3. All proper PPE are available
4. Proper spill-control materials are available for the substance involved
5. Personnel have been trained to engage in spill clean-up procedures

5.14 Hazardous Waste Management

5.14.1 The information provided in this section is a practical overview of the guide to Hazardous Waste Management. The purpose is to ensure that waste is handled in a safe, legal, and cost-effective manner to ensure hazardous waste is properly managed. EHS administers a comprehensive program which ensures the college follows applicable EPA and NYSDEC hazardous waste regulations. Specific detailed information about the classification of hazardous materials as hazardous waste can be found in Appendix Nine of this document entitled, "How to Label and Collect Waste: Waste Classification". Further information about hazardous waste disposal using paper documents for submission may be found in Appendix Six, "Labeling and Collecting Waste: Campus Guidelines with paper tags" document, or hazardous waste disposal using the online webform for submission in Appendix Eight "Labeling and Collecting Waste: Campus Guidelines for online submission".

5.14.2 Identification of a Hazardous Waste

The general definition of hazardous waste is any substance documented for disposal which exhibits characteristic(s) including flammability, reactivity, corrosivity, or acute or chronic toxicity. Substances which may lack these characteristics may also be considered hazardous

[3] For all ***non-student*** employees, any exposure and injury due to chemicals should be reported on the SUNY Geneseo Accident Report Form and forwarded to the Office of Human Resources after appropriate signatures. More information can be found in Section Nine of this CHP and at: https://www.geneseo.edu/sites/default/files/sites/admin_finance/Policies/Accident%20Reporting%20Policy%206-604.pdf. The Employee accident report form can be found online at: https://www.geneseo.edu/sites/default/files/sites/hr/Accident%20Report%20Form.pdf

[4] For ***all*** students (for-credit, student-employee, student-researcher, or volunteer), SUNY Geneseo policy requires immediate report of any exposure or injury incident to campus police. For all non-emergency incidents, call Campus Police at x5651. For emergencies, dial x5222.

due to their concentration or quantity. A substance is only considered a waste after it is determined unusable and must be properly documented according to the SOP found in Appendix Seven or Appendix Eight.

5.14.3 Regulated Medical Waste

5.14.3.1 The regulated medical waste policy is covered by and coordinated through EHS. Laboratories generating biohazardous materials considered Regulated Medical Waste must contact EHS for collection approval, receive appropriate training, and to determine site-specific collection policies, and engage contracted disposal services.

5.14.3.2 Included in the regulated medical waste policy is the collection of sharps. All sharps to be disposed of (e.g. needles, syringes, lancets, exacto knife blades, razor blades, etc.) must go into designated and puncture-resistant red biohazard container labeled "sharps". If a laboratory group already keeps sharps in a container other than a red biohazard sharps labeled container, they will need to be transferred to the sharps container for proper disposal and storage to meet the requirements of the Regulated Medical Waste policy. Faculty/PI/Laboratory Supervisors and laboratory personnel utilizing sharps containers must have documented training through EHS prior to use.

5.14.3.3 Never fill a sharps container greater than ¾ full. Do not ever stick one's hands into a sharps container. Sharps must always be considered Regulated Medical Waste, and are disposed of utilizing a waste agency contractor not directly affiliated with the college. Contact EHS for more information about proper disposal methods when collecting sharps and when you wish to dispose of the container.

5.14.4 Hazardous Waste Containers

5.14.4.1 Labeling Hazardous Waste Containers

Containers must be compatible with the hazardous waste they are intended to store. Check with EHS for questions about compatibility of hazardous waste containers with specific waste concerns. It is critical that each container be labeled properly. Labels shall include, though not limited to, General description of waste (i.e. "Mixed Waste", "Organic Acids" "Inorganic Waste", etc.), unique identification number found on the "Hazardous Waste Tag" (described below), and the room number where the waste is generated AND stored. Waste containers must also have yellow SUNY GENESEO HAZARDOUS WASTE stickers affixed. A "Hazardous Waste Tag" with a unique ID Number must be associated with the waste container, along with a "Waste Log" with matching information from the waste tag.

Detailed instructions for documentation required with containers can be found in Appendix Seven or Appendix Eight of this document.

5.14.4.2 Storage of Hazardous Waste Containers

Hazardous waste must be disposed of in hazardous waste containers located in the same room the waste is generated. Waste containers may only be stored and used in the room in which it is labeled to reside, containers must never be transported to other locations outside of its designated room unless it is being collected by EHS personnel.

5.14.4.3 Notification

EHS must be notified prior to the commencing of activities which may generate hazardous wastes outside of regularly scheduled academic or research lab activities.

A department shall inform EHS of newly occupied or relocated research and/or academic laboratories prior to generating hazardous waste.

In the event of a spill or contamination of person or laboratory facilities due to hazardous waste, as per policy indicated in Section 5.13 – Spills of Hazardous Materials, EHS shall be notified immediately if a spill or contamination meet any of the criteria described requiring EHS contact.

Section Six

Working with Particularly Hazardous Substances

6.1 Particularly Hazardous Substances

6.1.1 As part of the Chemical Hygiene Plan (CHP) the OSHA Laboratory Standard requires provisions for additional personnel protection be included for activities involving particularly hazardous substances. These substances include "select carcinogens", reproductive toxins, and chemicals which are known to have a high degree of acute toxicity.

6.1.2 The OSHA Laboratory Standard states that personnel who engage in work involving particularly hazardous substances should consider the following provisions where appropriate:

1. Establishing a designated area for work with particularly hazardous substances
2. Use of engineering controls such as fume hoods or glove boxes.
3. Procedures for safe removal of contaminated waste.
4. Decontamination protocols and procedures.

6.1.3 Further information about creating controls, specific storage requirements, equipment and engineering controls, and response to containment failure of specific hazards and hazard classes of hazardous substances is detailed in Section Twelve of this CHP.

6.1.4 General guidelines and recommendations beyond those found in this CHP for the safe handling, use, and control of hazardous chemicals and particularly hazardous substances may be found in SDSs and other references such as Prudent Practices in the Laboratory[5] and Safety in Academic Chemical Laboratories[6]. Please contact EHS for additional information.

6.2 Establishing a Designated Area

6.2.1 For work involving particularly hazardous substances, laboratories should establish a designated area where only particularly hazardous substances will be used. Depending on the circumstances, the designated area could be an entire room out of a suite of rooms, or it could mean one particular work space or fume hood within a laboratory. The purpose is to designate a specific area of the laboratory that all users are aware of where particularly hazardous substances shall only be used.

6.2.2 In certain cases for establishing a designated area(s), Faculty/PI/ and/or Laboratory Supervisors may choose to restrict particularly hazardous substance use to a specific chemical fume hood, glove box, or other containment device. The designated area(s) should be included as part of the laboratory's SOPs and reviewed during lab-specific training.

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[5] Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards; National Academy of Sciences: Washington, D.C., 2011.

[6] Safety in Academic Chemistry Laboratories: Best Practices for First- and Second-Year University Students. 8th edition. Joint Publication of the American Chemical Society and Joint Board-Council Committee on Chemical Safety. Washington, D.C., 2017

6.2.3 Establishing a designated area not only provides better personnel and student protection, but may help minimize where potential contamination of particularly hazardous substances could occur. Once a designated area is established, a sign should be posted (on a glove box for example) indicating both 1) the area is designated for use with particularly hazardous substances and 2) a list of the particularly hazardous substances reserved for the area. It is important to also define special PPE requirements and/or special waste and spill cleanup procedures as well for designated areas if applicable. These and other special precautions should be included within the SOPs for the laboratory.

6.3 Safe Removal of Contaminated Waste and Materials

6.3.1 Some particularly hazardous substances (acute toxins, explosive chemicals, and some p-listed hazardous chemicals) may require special procedures for safe disposal of both waste and/or contaminated materials. Prior to utilizing standard waste submission procedures, contact EHS to determine proper disposal procedures. Once specialized disposal procedures have been identified, the methods must be included as part of the SOPs for the laboratory and all waste generating personnel must be trained and documented for the specialized procedures.

6.4 Decontamination Protocols and Procedures

6.4.1 Certain particularly hazardous substances may require special decontamination or deactivation procedures (such as hydrofluoric acid waste or ethidium bromide) for safe handling. Review SDSs and other reference materials when working with particularly hazardous substances to identify is special decontamination procedures are required. If special procedures are required, then this information must be included in the laboratory's SOPs and appropriate training shall be provided to laboratory personnel who work with these chemicals. Contact EHS for additional information.

6.5 Guidelines for Particularly Hazardous Substances

6.5.1 Laboratory personnel and students must always use engineering controls, wear proper PPE, follow SOPs, receive appropriate training, and practice good housekeeping when working with any chemicals. The following special guidelines should be adhered to when working with particularly hazardous substances:

1. Substitute less hazardous chemicals when possible to avoid working with particularly hazardous substances and keep exposures to a minimum
2. Always obtain prior approval from the Faculty/PI/Laboratory Supervisor before ordering any particularly hazardous substances.
3. Plan the experiment out in advance, including layout of apparatus, chemical and materials needed, and waste containers
4. Before working with any particularly hazardous substance, review chemical resources for any special decontamination/deactivation procedures and ensure the appropriate spill cleanup materials and absorbent are on readily available
5. Ensure that the appropriate PPE are available and worn, particularly gloves (check the glove selection charts in Appendix Three or call EHS at x5663).
6. Always use the minimum quantities of chemicals necessary for the experiment. If possible, try adding solvents directly to the original container and making dilutions directly from the acutely toxic substance container.

7. When possible, consider purchasing premade solutions to avoid handling powders. If powders must be used, it is best to weigh them in a fume hood. If it is necessary to weigh outside of a fume hood (because some particles may be too light and would pose more of a hazard due to turbulent airflow) then wear a dust mask when weighing the chemical. It is advisable to surround the weighing area with secondary containment and if the substance is not water-reactive, moistened paper towels to facilitate cleanup.
8. When weighing out dusty materials or powders, thoroughly clean up and decontaminate working surfaces once the mass measurements are complete.
9. Whenever possible, use secondary containment, such as trays, to conduct your experiment in and for storage of particularly hazardous substances.
10. Particularly hazardous substances should be stored by themselves in clearly marked trays or containers specifying the hazard is i.e. “Carcinogens,” Reproductive Toxins”, etc.
11. Always practice good personal hygiene, especially frequent hand washing, even when wearing gloves.
12. If it is necessary to use a vacuum for cleaning particularly hazardous substances, only High Efficiency Particulate Air (HEPA) filters are recommended for best capture and protection. Be aware that after cleaning up chemical powders, the vacuum bag and its contents may have to be disposed of as hazardous waste.
13. Ensure information related to the experiment and/or protocol is included within any SOPs.

6.6 Prior Review and Approval for Laboratory Operations Involving Particularly Hazardous Substances

6.6.1 The OSHA Laboratory Standard requires Chemical Hygiene Plans to include information on “the circumstances under which a particular laboratory operation, procedure or activity shall require prior approval”, including “provisions for additional employee protection for work with particularly hazardous substances” such as "select carcinogens," reproductive toxins, and substances which have a high degree of acute toxicity.

6.6.2 Prior approval ensures that laboratory personnel have received proper training on the hazards of particularly hazardous substances or with new equipment, and that safety considerations have been taken into account BEFORE a new experiment or protocol begins. While EHS can provide assistance in identifying circumstances when there should be prior approval before implementation of a particular laboratory operation, the ultimate responsibility of establishing prior approval procedures lies with the managing Faculty, PI/Laboratory Supervisor.

6.6.3 Managing Faculty/PI/Laboratory Supervisors must identify operations or experiments that involve particularly hazardous substances (such as "select carcinogens," reproductive toxins, and substances which have a high degree of acute toxicity) and highly hazardous operations or equipment which require prior approval. They must establish the guidelines, procedures, and approval process required. This information should be documented in the laboratory's or department's SOPs. Additionally, Faculty/PI/Laboratory Supervisors are strongly encouraged to have written documentation, such as “Prior Approval” forms to be completed and signed by laboratory personnel and/or students, and signed off by the Faculty/PI/Laboratory Supervisor and kept on file. Prior Approval forms must be kept on file for employees for a period of thirty years, and stored by the department. Prior Approval forms for students must be kept for seven years and stored by the managing faculty/PI/Laboratory Supervisor.

6.6.4 Examples where Faculty/PI/Laboratory Supervisors should consider requiring laboratory personnel or students to obtain prior approval include:

1. Experiments which require the use of particularly hazardous substances such as select carcinogens, reproductive toxins, and substances known to have a high degree of acute toxicity, highly toxic gases, cryogenic materials and other highly hazardous chemicals or experiments involving radioactive materials, high powered lasers, etc.
2. When a significant change is planned for the amount of chemicals to be used for a routine experiment such as an increase of 10% or greater in the quantity of chemicals normally used.
3. When a new piece of equipment is brought into the lab that requires special training in addition to the normal training provided to laboratory personnel or students.
4. When laboratory personnel or student(s) is/are scheduled or planning to work alone on an experiment or protocol which involves highly hazardous chemicals or operations.

Section Seven

Laboratory Hazard Control Measures & Equipment

7.1 General

1. Fume hoods and biosafety cabinets are different types of laboratory equipment providing distinct functions. Section 6.5 of this document will describe Chemical Fume Hoods, whereas Section 6.6 will describe Biological Safety Cabinets.
2. EHS will measure an employee's anticipated worse-case exposure to any regulated hazardous chemical if there is reason to believe that exposure levels for that chemical routinely exceed the OSHA Permissible Exposure Limit (PEL) or Threshold Limit Value (TLV).
3. Routine monitoring of airborne concentrations is not usually justified nor practical in laboratories, but may be appropriate in some situations. These include testing, redesigning, or introducing new fume hoods or other exhaust ventilation devices, or when a highly hazardous chemical or process is used in a manner which is likely to cause exposure.
4. EHS will promptly investigate all employee-reported incidents in which there is a possibility of employee overexposure to a hazardous chemical. If you suspect that chemical exposures may exceed the PEL, contact EHS. If symptoms are present, arrange for a visit with an occupational medical clinic or your personal physician.
5. Events or circumstances which might reasonably constitute overexposure include:
    A. A hazardous chemical leaked, spilled, or otherwise was released in an uncontrolled manner.
    B. Direct skin or eye contact with a hazardous chemical.
    C. Faculty, staff or students manifest symptoms, such as a headache, rash, nausea, coughing, tearing, irritation or redness of eyes, irritation of nose or throat, dizziness, loss of motor dexterity or judgment, and
    D. Some or all of the symptoms disappear when the person is taken away from the exposure area and breathes fresh air, and the symptoms reappear soon after personnel return to the area with the same hazardous chemicals.
    E. Two or more persons in the same laboratory area have similar complaints.

7.2 Chemical Control Criteria Guidelines

7.2.1 Exposures by inhalation of airborne contaminants (gases, vapors, fumes, dusts, and mists) must not exceed levels listed as permissible exposure limit (PEL) by OSHA and PESH (Public Employees Safety and Health Bureau), whichever is lowest. These TLV levels refer to airborne concentrations of substances and represent conditions under which it is believed workers may be repeatedly exposed without adverse effect. TLVs are normally published on manufacturer's Material Safety Data Sheets (MSDS) and/or Safety Data Sheets (SDS), which must be available in the laboratory area. If SDS are unavailable, please contact EHS.

7.2.2 In all cases of potentially harmful exposure, feasible engineering or administrative controls must first be established. In cases in which respiratory protective equipment either alone or with other control measures are required to protect the employee, the protective equipment must be approved by the LSC and with EHS for each specific use.

7.3 Hazard Control Prioritization

7.3.1 No laboratory can rely on one particular type of control technology to ensure that exposures to hazardous chemical agents are kept as low as reasonably achievable. The primary and most effective approach is through the use of engineering controls. Accompanying and complementing engineering hazard controls should be the appropriate combination of administrative procedures, specific training, and the use of PPE.

7.4 Recirculation of Air

7.4.1 Recirculation of contaminated exhaust air in laboratories using toxic, corrosive, flammable or other hazardous agents is prohibited.

7.4.2 Laboratory facilities using carcinogens and acute toxins which, if released, could pose a personal injury or environmental impact risk shall be designed during the construction or remodeling process to ensure a negative pressure differential exists between the laboratory and the exit corridor(s) servicing the laboratory. The only exception to this recirculation requirement is when standard or FDA validatable clean room requirements mandate the room be under positive pressure with respect to the surrounding facilities. For more information about air circulation requirements, please contact EHS.

7.5 Laboratory Chemical Fume Hoods

7.5.1 A chemical fume hood captures and exhausts chemical vapors and particles outside to prevent inhalation. Chemical fume hoods are intended for use of odorous, volatile chemicals and those with moderate to high levels of suspected or known toxicity. Fume hoods often do not filter air, and are only suitable for chemicals and non-sterile applications.

7.5.2 General Principles

1. Laboratory exhaust hoods should be considered as backup devices that can contain and exhaust toxic, offensive, or flammable materials when the material being used causes vapors, gas, or dust to escape from the apparatus used to contain said materials.
2. Hoods are <u>not</u> regarded as a means for disposing of chemicals either through sink disposal or evaporation.
3. Hoods should be evaluated by operators prior to and during each use by means of simple visual indicators (such as Mylar strips) for adequate airflow.
4. Except when adjustments of apparatus within the hood are being made, the hood sash should be kept closed. If the hood does not have a bypass grill, then the sash should be left open at least six inches to avoid the flow from being choked off. Vertical sashes should be left down and horizontal sashes closed. Sliding sashes should not be removed from horizontal sliding-sash hoods.
5. During operations, keep the face opening of a hood as small as possible to improve the performance of the hood. Reducing the opening in the laboratory hood by restricting the height of the sash may also provide protection from uncontrolled reactions, explosions, and spills due to chemical reactions, over-pressurization, etc.
6. Performance of a hood depends upon such factors as the placement of materials and equipment in the hood, room drafts from open doors or windows, turbulence caused by persons walking by, and the presence of the user in front of the hood. Keep apparatus back from the front edge of the hood to reduce the potential for

contaminant release. Also keep apparatus and materials away from the back edge to allow for proper operation of the hood through adequate air flow and suction.

7. Hoods are not intended for storage of chemicals, and such storage is contrary to NYS fire code. Materials stored in hoods should be kept to a minimum. Stored chemicals should not block vents or alter airflow patterns. Chemicals not in use must be covered or capped.
8. Laboratory personnel should be prepared for the event of ventilation failure or other unexpected occurrences such as fire or explosion in the hood.
9. Mechanical ventilation must remain in operation at all times when hoods are in use and for a sufficient time thereafter to clear hoods of airborne hazardous substances. When mechanical ventilation is not in operation, hazardous substances in the hood must be covered or capped.
10. Hoods must be inspected frequently and cleaned as necessary to ensure adequate airflow and the prevention of residue buildup. The Facilities Department in conjunction with EHS shall conduct a semiannual ventilation survey and post flow rate and date of test on each hood.

7.5.3 Hood Construction

1. Newly purchased laboratory hoods and installed exhaust ducting for solvent operations shall be constructed of non-combustible materials to reduce the potential of damage should a fire occur within the workstation.
2. Newly purchased laboratory hoods and exhaust ducting for corrosive applications shall be constructed from or coated with, materials that are resistant to corrosive compounds.
3. Provisions must be made for adequate make up air for all hoods that are used in a laboratory.
4. General airflow should not be turbulent and should be relatively uniform throughout the laboratory.
5. Laboratory-type hood face velocities (including wet bench enclosures) must be sufficient to maintain an inward flow of air at all openings into the hood under normal operating conditions. Air flow into hoods depends upon configuration but must be at a minimum average face velocity of at least 80 linear feet per minute (lfpm) with a maximum of 150 lfpm as an average range of measured air speed, except where more stringent special requirements are identified.
6. The face velocity must be obtainable with the movable sashes opened at least 18". Where the required velocity can be obtained by partly closing the sash, the sash and/or jamb must be marked to show the maximum opening at which the hood face velocity meets the requirements. Any hood failing to meet the requirements must be considered deficient in airflow and must be posted with placards, plainly visible, which prohibit use of hazardous substances within the hood.
7. When sufficient quantities of flammable gases or liquids are used, or when combustible liquids are heated above their flash points, hoods that are not bypassed must have permanent stops installed which restrict closure of the sash so that sufficient airflow is maintained to prevent explosions. Concentrations in the duct must not exceed 10% of the lower explosive/flammable limit. If there are concerns about flammable gas concentrations, please consult EHS.

8. Exhaust fan systems must be non-sparking where ignition sources are isolated if exhausting sufficient quantities of flammable vapors and corrosion resistant if handling corrosive vapors.
9. Exhaust stacks must be located in such a manner with respect to air intakes as to preclude the recirculation of laboratory hood emissions within a building.
10. Perchloric acid must be used in a closed system or within a specially designated acid fume hood with wash down systems to prevent the accumulation of explosive perchlorates in the fume hood.
11. Laboratory hoods should be seismically braced to prevent toppling or sliding during an earthquake.

7.6 Biological Safety Cabinets

7.6.1 The application of a biological safety cabinet is to filter air intake and exhaust, recirculating filtered air from inside the hood back into the laboratory or to the outside. The biological safety cabinet is intended to ensure sterility of the materials inside the hood and containment of infectious work. Biological safety cabinets are manufactured in three different classes (Class I, II, and III). The common feature in all biological Safety cabinets is the use of high efficiency particulate air (HEPA) filter(s). HEPA filters are rated to remove particles as small as 0.3 microns with 99.97% efficiency and when replaced appropriately according to manufacturer recommendations, will trap most bacteria and viruses. Vapors from chemicals (ethanol, formalin, toluene, etc.) and gases will not be captured nor removed by the HEPA filter. Some biological safety cabinets are totally exhausted (i.e. air exhausted to the outside) but are not chemical fume hoods and should not be used as a substitute for a dedicated chemical fume hood[7].

7.6.2 For more information regarding biological safety cabinets beyond what is described in this CHP, please contact EHS[8] at x5663

7.6.3 Class I Biological Safety Cabinet

7.6.3.1 Class I biological safety cabinets provide personnel and environmental protection, but do not provide sterile work surfaces. Airflow in a Class I biosafety cabinet is similar to one that is found in a chemical fume hood, drawing air away from personnel and across the working surface of the cabinet. The air is usually not totally exhausted outside of the laboratory. The exhaust air is HEPA filtered to prevent contamination of particulates and organisms. A class I biological safety cabinet is useful when containment is required, but not sterility of work.

7.6.4 Class II Biological Safety Cabinet

7.6.4.1 Class II biological safety cabinets are designed to provide personnel, product and environmental protection. Air is drawn around personnel into the front of the cabinet, providing protection to the operator. The air entering the cabinet is HEPA filtered to provide sterility as it flows across the work surface, minimizing cross contamination. Exhaust air then passes through another HEPA filter for release to the environment. Some class II

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[7] Keene, J. "Can a biological safety cabinet be used as a fume hood?" Global Biohazard Technologies, Inc., Midlothian, Virginia. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.226.277&rep=rep1&type=pdf

[8] "Primary Containment for Biohazards: Selection, Installation and Use of Biological Safety Cabinets, 3rd Edition" 2007. A joint publication of United States Department of Health and Human Services, Centers for Disease Control and Prevention, and National Institutes of Health. https://www.cdc.gov/biosafety/publications/bmbl5/bmbl5_appendixa.pdf

biological safety cabinets release air into the space surrounding the cabinet and some release to the outside. There are further divisions of Class II units, A1, A2, B1 and B2, based on the percentage of air which is recirculated and exhausted. Ask EHS if you are uncertain of the nature of your Class II biosafety cabinet.

7.6.5 Class III Biological Safety Cabinet

7.6.5.1 Class III biological safety cabinets are designed to provide maximum protection to personnel and the environment. These biosafety cabinets are gas-tight enclosures with non-opening view windows. Intake air is filtered through a HEPA filter and exhaust air passes through two HEPA filters before being released. Some class III biological safety cabinets can be called glove boxes (also see section 6.7).

7.6.6 Safe Practices When Working in Biosafety Cabinets

1. Do not cover the front and rear grilles with materials, supplies, or paper because this may compromise the cabinet's flow of air and lead to potential contamination issues or personnel exposure to the substances used in the cabinet.
2. Do not store supplies on top of the biological safety cabinet. It will block the HEPA filter(s) and this disturbance or subsequent damage can lead to failure of the cabinet to filter air properly.
3. Do not use an open flame in the biological safety cabinet. Open flames create significant turbulence that disrupt the laminar air flow in the cabinet. (The combination of an open flame and 70% ethanol (disinfectant) is responsible for many significant lab fires and destruction of biological safety cabinets). Use sterile disposable supplies or an electric bacti-cinerator or sterilizer instead.
4. Avoid moving one’s arms in and out of the cabinet during an experiment or work, and try to minimize activities which may cause air eddies (opening doors, personnel walking near cabinet, etc.). Small pockets of turbulence can compromise air circulation in the biological safety cabinet.

7.7 Other Ventilation Systems

7.7.1 Other local exhaust systems used in the laboratory, should be coordinated by Facilities Department in accordance with ACGIH, American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), National Fire Protection Association (NFPA) requirements and other nationally recognized standards.

7.7.2 Do not attach canopy hoods or snorkel systems to existing fume hood exhaust ducts without consulting Facilities and EHS.

7.7.3 Glove boxes generally operate under negative pressure, though some operate under positive pressure, in which case, leaks could create undesirable situations. Positive pressure glove boxes should be thoroughly tested before each use and a method of monitoring the integrity of the system should be in place (such as a shutoff valve or a pressure gauge designed into the system).

7.7.4 Any laboratory apparatus which may discharge hazardous vapors (vacuum pumps and distillation columns) should be vented to an auxiliary local exhaust system such as direct ducting, canopy, or snorkel hoods.

7.8 Safety and Emergency Equipment

7.8.1 Equipment Guarding

1. All machining, test, and mechanical equipment shall be adequately furnished with guards which prevent access to hazardous electrical connections, pinch points, or moving parts.
2. All guards must be inspected before using equipment.
3. Personnel and students shall not turn on, use, repair, or operate any hazardous laboratory equipment unless trained and authorized by the responsible personnel or faculty member. Documented training records must be kept to produce upon request. See Section Ten for recordkeeping detail requirements.

7.8.2 Shields

7.8.2.1 Safety shields must be used for protection against possible explosions or uncontrolled reactions. Laboratory equipment must be shielded on all sides so that there is no line-of-sight exposure to personnel. The sash on a chemical fume hood is a readily available partial shield. However, a portable shield must also be used, particularly with hoods that have vertical-rising sashes rather than horizontal-sliding sashes for operations having the potential for explosion such as:

1. Whenever a reaction is attempted for the first time (small quantities of reactants should be used to minimize hazards); and
2. Whenever a familiar test or reaction is carried out on a larger than usual scale.

7.8.3 Pressure

7.8.3.1 Standards for the use of pneumatic and high-pressure hydraulic equipment are available in American Society of Mechanical Engineering (ASME) documents however; the following are additional requirements for laboratory operations:

1. Reactions should never be carried out in, nor heat applied to, an apparatus that is a closed system unless it is designed and tested to withstand pressure.
2. Pressurized apparatus shall have an appropriate relief device.
3. If the reaction cannot be opened directly to the air, an inert gas purge and bubbler system should be used to avoid pressure buildup.
4. All pressurized gas cylinders and systems shall be installed and used in accordance with Safe Operating Procedures (SOP) developed by faculty or lab managers/supervisors and, if in question, reviewed and approved by EHS for safe equipment usage, handling, and storage.
5. When using glassware for high pressure purposes, consider the use of plastic safety-coated glassware.

7.8.4 Eyewash & Showers

1. Eyewash fountains are required if the substance in use presents an eye hazard[9] (e.g., particulates, corrosives, toxics). The eyewash fountain must provide a soft stream or spray of aerated water.
2. Safety showers must be provided in areas where a corrosive chemical or rapid fire hazard exists for immediate first aid response to chemical splashes and to extinguish

[9] Guidance for Hazard Determination For Compliance with the OSHA Hazard Communication Standard (29 CFR 1910.1200) https://www.osha.gov/dsg/hazcom/ghd053107.html

clothing fires. The shower must be capable of drenching the victim immediately in the event of an emergency.

3. Eyewash fountains and safety showers should be located close to each other so that, if necessary, the eyes can be washed while the body is showered. Access to these facilities must remain open at all times and within ten seconds of travel distance. In case of accident, flush the affected body part for at least 15 minutes. Report the accident to Campus Police at x5222 or 911 for assistance, and once appropriate, call EHS at x5663.
4. Eyewash and showers shall be tested and flushed by Facilities personnel at a minimum of a monthly interval to ensure they are operating properly. Inspection tags must be filled out at the time of inspection to document testing. Faulty equipment shall be repaired by Facilities, once a problem has been identified and reported to Facilities or once a work order has been submitted to the Facilities Department.

7.8.5 Fire Extinguishers

7.8.5.1 Laboratories using hazardous chemicals should have a BC or ABC rated, dry chemical fire extinguisher in close proximity of any exit for use on ordinary combustibles, flammable liquids, and electrical fires. If additional extinguishers are needed for an area, contact EHS for information concerning recommendations and requirements.

7.8.6 Flammable Liquid Storage Cabinets

7.8.6.1 Flammable liquid storage cabinets are a first line of defense to prevent dangerous situations inherent to short and long-term storage of appreciable quantities of flammable chemicals[10].

1. Generally, the minimum amount of flammable liquids necessary for one to several days of operation may be kept on hand and stored in a cabinet.
2. Capacity should not exceed the volume capacity rating of each chemical storage cabinet.
3. Cabinets must be labeled "Flammable"
4. Storage of flammable liquids in excess of ten gallons must be in an UL listed[11], Factory Mutual (FM) approved[12], flammable liquids storage cabinet.
5. Flammable liquids storage cabinets should be used for the storage of flammable and combustible liquids only. It is not advised to store corrosives, oxidizers, or reactive chemicals with flammable or combustible liquids.

7.8.6.2 Additional information regarding flammable storage cabinets may be found in Section 5.11, Section 11.4.7.1, and in Appendix Two.

7.9 Preventative Maintenance

7.9.1 Equipment Maintenance

7.9.1.1 Proper equipment maintenance is important for safe and efficient operation. Equipment should be inspected and maintained on a regular basis. Preventative equipment maintenance of facilities-related equipment (e.g., HVAC, ventilation hoods) is maintained by Facilities.

[10] Note: Storage cabinets for flammable liquids are not fireproof, they only protect the contents from extreme temperatures for a limited time to allow evacuation of personnel and prompt entry of fire fighters.

[11] UL Listing and Classification Marks: http://www.ul.com/marks/ul-listing-and-classification-marks/

[12] Factory Mutual Approval Guide: http://www.fmapprovals.com/

1. Facilities Department personnel have the right to refuse to enter a laboratory or do work on equipment if the area or equipment is not clear of hazards. Facilities personnel who are concerned with hazards or the safety of a project should report their concerns to the Faculty/PI/Laboratory Supervisor/Manager, and if the report is not addressed satisfactorily, to the Facilities Supervisor and/or EHS for follow-up.

7.9.2 Exhaust Ventilated Hood Performance Evaluations

1. All hoods are checked by the Facilities Department in coordination with EHS when they are first installed and semi-annually thereafter, for adequate ventilation performance. Performance measurements and the initials of the individual performing the test are left on the hood as record to verify performance.
2. Performance of a ventilation system must be checked whenever there has been a change in a system or location.
3. Laboratory ventilation equipment scheduled for maintenance or repair work must be cleaned and/or decontaminated.
4. All ventilation systems need routine maintenance to prevent blocked or plugged air intakes and exhaust, loose belts, bearings in need of lubrication, motors in need of attention, corroded duct work, and component failure.
5. Filters should be replaced periodically in certain types of ventilation systems, such as electrostatic precipitators and cyclones for dust collection.
6. Ventilation system monitoring devices such as a magnehelic gauge (analog or digital) or incline manometer should be installed in ventilation systems that control certain highly toxic operations, such as those involving carcinogens, to notify the user of malfunctions.

7.10 Laboratory and Equipment Decommissioning

7.10.1 Laboratory Cleanout

A laboratory cleanout encompasses removal of unwanted chemicals from research laboratories at the time of a laboratory closeout. Laboratory cleanouts and/or closeout usually occur when a lab is being closed down, relocating, or when large amounts of excess chemicals are no longer being used and necessitate removal. During a laboratory cleanout, in the event excess chemicals are identified for removal, there are some incidences these chemicals may not be considered routinely generated waste, and you may need to contact the EHS for assistance. Examples of such incidences include large volumes of unwanted chemical waste or chemicals that can be donated to other SUNY Geneseo campus laboratories. Please see the **Chemicals** section 6.10.4 below for further information.

7.10.2 Cleanout Responsibility

7.10.2.1 The Faculty member, PI or Laboratory Supervisor is ultimately responsible for assuring that all laboratory space occupied by their programs and/or activities is maintained free from undue hazards. In particular, when vacating laboratory space, the faculty member, lab manager/supervisor must ensure that all chemicals, radioactive materials, and/or hazardous wastes are removed and properly disposed. Proper disposition of all items in a laboratory are the responsibility of the vacating faculty member. Ultimate responsibility to carry out the required activities lies with the faculty department chair. EHS can provide assistance in labeling, packaging and removing chemicals and waste. If laboratory premises are left in an environmentally unacceptable state, it may be necessary to obtain the services of outside contractors to identify and dispose of unidentified chemicals and waste. Should this be necessary, the costs of these services may be borne by the vacating party or department.

7.10.2.2 EHS will verify the laboratories have been adequately closed out by the faculty member by completing a laboratory closeout survey utilizing the Laboratory Decommissioning Checklist (See Appendix Twelve – Laboratory Decommissioning Checklist). For any activities or areas in a laboratory where decontamination/cleaning is not completed or left in an environmentally unacceptable state, it may be necessary to obtain the services of outside contractors to identify and dispose of unidentified chemicals and waste, as well as clean-up any areas determined contaminated. If this is necessary, the costs of these services may be endured by the vacating party or department.

There may be specific questions or challenges unique to the shutdown of a particular laboratory, please contact EHS if you need specific information.

When occupying a new space, the party assuming responsibility for the laboratory is advised to assure that said space is free from hazards. Please call EHS for assistance.

7.10.3 Initiating the Laboratory Cleanout

Laboratory cleanouts should be conducted when:

1. The laboratory is being closed down (prior to shutdown)
2. The laboratory is moving locations (prior to the move)
3. The laboratory has accumulated an excess of chemical inventory not being used for a period longer than 2 years.

7.10.4 Chemicals

7.10.4.1 Disposal and/or Repurposing Chemicals

Under no circumstances may any chemical be disposed of into the sewer or trash (this includes chemicals commonly considered household chemicals such as cleaning solvents, paints, and adhesives). All containers of chemicals must be securely closed and legibly labeled with all associated contents.

Check all refrigerators, freezers, fume hoods and bench tops as well as storage cabinets for chemical containers. Determine which chemicals are usable in order to relocate/transfer responsibility for these materials to another party who will be willing to take charge of them and list them as additions to their chemical inventory. Prior planning provides for an efficient systematic transition to closeout laboratory activities to ensure compliance with applicable health and safety regulations.

7.10.4.2 Chemical Exchange and Intra-Campus Donation

Examples of chemicals eligible for transfer of responsibility through donation include reagent chemicals which have any number of the following characteristics:

- reagent chemicals in original containers which have not been opened, and/or
- reagent chemicals in original containers which are not contaminated, and
- reagent chemicals which are not expired.

Whenever possible, these chemicals should be offered on the SUNY Geneseo Unwanted Chemical Exchange for transfer to other Geneseo campus laboratories which may find use for them. Chemicals which do not fit the criteria for the Unwanted Chemical Exchange must be documented for hazardous waste removal. Please review the following link for more information: https://www.geneseo.edu/chemistry/mixed-and-individual-waste-forms

7.10.4.3 Chemical Transport

Chemicals identified for transport to another lab must be transported in a manner that prevents breakage or leakage and during transport shall be segregated by compatibility (please see Appendix Six for additional information about Chemical Segregation). If chemicals are not exchanging ownership and a new user cannot be found, the materials must be disposed of properly through the EHS hazardous materials management program (for more information: https://www.geneseo.edu/chemistry/waste-management).

7.10.4.4 Documenting Chemicals as Hazardous Waste for Disposal

1. Chemicals which have been identified for disposal shall be identified and documented to EHS for hazardous waste pickup using the online waste submission webform *or* through EHS-approved Hazardous Waste Tags. Ensure all chemicals and/or waste containers are labeled appropriately as per campus SOP found in Appendix Six – How to Label and Collect Waste: Waste Classification.
2. Determine the preferred hazardous waste submission method for the laboratory in question, using either of the following methods:
   A. SUNY Geneseo Hazardous Waste Online Webform using the campus SOP for online waste submission is found in Appendix Eight, or
   B. EHS–approved Hazardous Waste Tags using the campus SOP for paper forms waste submission is found in Appendix Seven.
3. Any containers not meeting all conditions as detailed in the appropriate waste management SOP will not be collected by EHS and the associated department may held responsible for associated cleanup costs. All containers must be clearly labeled and marked for pick up.
4. As you are documenting chemicals for hazardous waste pickup, please keep the following key points in mind:
   A. **Label Properly**: Abbreviations, chemical symbols, product names or formulas are not acceptable labeling. All chemical constituents must be spelled out using common names or IUPAC standard chemical name format.
   B. **Differentiate Containers**: For multiple containers of the same type of chemical constituent, record each container on a separate EHS-approved Hazardous Waste Log sheet. Do not combine or conglomerate different containers of like items on the same Hazardous Waste Log or on the same Hazardous Waste Webform instance when recording or when submitting chemicals as hazardous waste. When using the webform, submit each container separately. Be sure to include appropriate units of measure when recording quantity.
   C. **Physical characteristics**: If the material is being documented as hazardous waste, the appropriate physical state MUST be selected, solid, liquid, gas or multiphase. If the container contains multiphase waste constituents (i.e. liquids and solids, then "MULTIPHASE" must be selected. If a pH range is possible (i.e. if there are any aqueous components), an appropriate pH range for the material must be reported.
   D. **Compatibility**: When preparing chemicals for waste pickup or for transport within the college, choose the most appropriate Hazard Class to

store chemicals in preparation for EHS pick-up or while transporting. Obtain further information from EHS if necessary.

7.10.5 Compressed Gas Cylinders

Remove gas connections, replace cylinder caps, and return cylinders to suppliers.

7.10.6 Radioactive Materials/Sources or Radiation Producing Equipment

Contact the Campus Radiation Safety Officer (RSO) to transfer ownership of these materials to another authorized individual or to arrange for disposal.

7.10.7 Biohazardous Materials

1. Preparing Biohazardous Waste

   All biohazardous wastes, including culture stocks, must be properly decontaminated prior to disposal. Any materials to be transferred to a new location must be packaged properly. Proper packaging consists of a primary sealed container placed within a secondary sealed, unbreakable container with enough absorbent material in between to contain and absorb any spill.

2. Packaging and Labeling

   Once packaged, all biological materials must be properly labeled. Labels must include biological agent name, principle investigator, new location, biosafety level, contact telephone number, and if applicable, a FRAGILE notation. The universal biohazardous label must be used whenever packaging a biosafety level 2 or higher agent.

3. Transport

   If biological materials are to be transported over public roads, proper DOT packaging, labeling and manifesting regulations must be followed. Contact EHS for assistance in identifying a vendor who can perform this function.

7.10.8 Expired Peroxide-Forming Chemicals

7.10.8.1 Due to the uncertainty of the stability of expired peroxide forming compounds, this class of chemicals must be tested for peroxide concentration before preparation for transport to another location or for hazardous waste disposal. Please see Section 12.5.1 and Appendix Twelve for more information regarding peroxide-forming chemicals.

7.10.8.2 Contingent upon peroxide concentration test results, a container containing an expired peroxidizable organic chemical may have to be considered a hazardous reactive or explosive. Expired peroxide-forming compounds found in a laboratory which have not been characterized, tested and documented for hazardous waste disposal prior to laboratory decommissioning may incur a service fee for peroxide testing and characterization, and the vacating party and/or department may endure all fees associated with analysis and proper disposal.

7.10.8.3 More information regarding the procedures for testing and identification of peroxide-forming chemicals may be found in Appendix Twelve. Please contact EHS to find out more information about appropriate peroxide concentration test options for your laboratory situation.

7.10.9 Unknowns

Make every effort to identify and characterize every unknown compound present in the laboratory to be decommissioned prior to documenting containers for hazardous waste disposal. Determinations of unknowns can be exceptionally expensive if they must first be characterized by a contracted waste disposal agency. For chemical unknowns which cannot be or are not readily identified, the vacating party and/or department may endure the service fee for hazardous waste analysis prior to disposal.

7.10.10 Clean Up and Decontamination

7.10.10.1 All areas of chemical, radiological and biological agent use or storage must be cleaned, with the date of cleaning documented and signed off on the EHS-approved Laboratory Decommissioning Checklist form (Appendix Nine). This includes, but is not limited to, areas such as bench tops, chemical storage cabinets, laboratory hoods, biological safety cabinets, glove boxes, shelves, ovens, incubators, refrigerators and freezers. (If applicable, radioactive material use areas must be decommissioned in accordance with RSO protocols.)

7.10.10.2 All portable laboratory equipment (i.e. refrigerators, freezers, water baths, incubators, centrifuges etc.) which is either remaining in the laboratory or being moved to a new location must be decontaminated and signed off on the EHS-approved Laboratory Decommissioning Checklist form (Appendix Nine). Equipment which is being surplused, readied for transport to another location, or disposed of must be checked for hazardous material contamination as part of the decommissioning process. Equipment decommissioning and decontamination may require support from EHS, Facilities Department and/or outside contractor services. The managing Faculty, PI, and/or Laboratory Supervisor is responsible to ensure that the decommissioning process leaves the equipment free of hazardous contamination prior to off-site transport or shutdown in-place.

7.10.10.3 Laboratory hoods and biological safety cabinets must be properly decontaminated and signed off on the EHS-approved Laboratory Decommissioning Checklist form (Appendix Nine). Notify EHS if there are any current or past practices that might reveal potential problems. For example, certain chemicals such as formaldehyde, hydrofluoric acid, mercury, perchloric acid, etc., may remain on surfaces, equipment or building systems presenting significant workplace health hazards if not addressed properly. In cases where biological materials were used, an appropriate disinfectant must be utilized. Biosafety cabinets which have been moved must be re-certified after installation by a qualified contractor.

Please see Appendix Nine for the Laboratory Decommissioning Checklist.

Please contact EHS for specific information about Transporting Hazardous Chemicals.

Section Eight

Hazardous Communication and the Lab Standard

8.1 Hazard Communication

8.1.1 Hazard Communication Standard

The Occupational Safety and Health Act established the Occupational Safety and Health Administration (OSHA) in 1970 within the US Department of Labor. The original Act decreed employees must be informed of all hazards to which they are exposed on the job. Later, OSHA implemented this instruction by enacting the Hazard Communication Standard (HCS) as 29 CFR 1910.1200, and the HCS became effective in 1986. A fundamental premise of the HCS is ensuring employees who may be exposed to hazardous chemicals in the workplace have a right to know about the hazards and how to protect themselves. The HCS is therefore sometimes referred to as the "Worker Right-to-Know Legislation", or more often just as the "Right-to-Know" law. Although the original HCS applied only to the manufacturing industry, subsequent court challenges have expanded the scope of the law so that today the HCS applies to nearly all sectors of the work force, and recent national litigation examples have been interpreted as expanding the definition to include laboratories at academic institutions[13].

8.1.2 The Lab Standard

8.1.2.1 Laboratories, such as the teaching labs and research labs at SUNY Geneseo are also covered by the Occupational Exposure to Hazardous Chemicals in Laboratories Standard (29 CFR 1910.1450). This standard is also known as the "Lab Standard". Analogously, the University's Hazard Communication Plan (based on the OSHA HCS) specifies that laboratories are subject to SUNY Geneseo's Chemical Hygiene Plan (CHP).

8.1.2.2 The Lab Standard is a more technical standard than the HCS, and includes additional material, such as requirements having to do with the proper maintenance of fume hoods and other safety equipment. The SDSs, chemical labels, and other compliance measures that are most often encountered are often the same in the HCS and the Lab Standard regardless of which standard technically covers a situation. Please contact EHS with specific questions.

8.2 Chemical Hazard Classification Systems

8.2.1 Chemical classification systems are designed to communicate hazards. The three most widely used classification systems are the OSHA Globally Harmonized System for Classifying and Labeling Chemicals (GHS) implemented under the OSHA Hazard Communication Standard, the National Fire Protection Association (NFPA) system of classifying the severity of hazards, and the Department of Transportation (DOT) hazard classes. These classification systems are used by chemical manufacturers when creating Safety Data Sheets (SDS) and chemical labels, therefore it is important that SUNY Geneseo lab personnel and students understand the basic elements of each classification system.

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13 SUNY System Webinar: Labs and Liabilities. Jarvis, J. http://system.suny.edu/media/suny/content-assets/documents/capital-facilities/environmental-health/Labs-and-Liability-presentation---SUNY-webinar.pptx

8.2.2 Globally Harmonized System for Classifying Chemicals

The Globally Harmonized System (GHS) is a world-wide system adopted by OSHA for standardizing and harmonizing the labeling and classification of chemicals. The objectives of the GHS are to:

1. Define the health, physical, and environmental hazards of chemicals.
2. Create a classification process which use available data on chemicals for comparison with the defined hazard criteria (numerical hazard classification is based on a 1 – 5 scale, 1 being the most hazardous and 5 being the least hazardous).
3. Communicate hazard information, as well as protective measures, on labels and the associated Safety Data Sheet (SDS).

8.3 The Safety Data Sheet

8.3.1 Information on hazardous properties of chemical substances is generally accessed through the Safety Data Sheet (SDS). While the SDS are the modern standard for OSHA required hazardous properties documentation, Material Safety Data Sheets (MSDS) and SDS are often used interchangeably colloquially. This common assumption of interchangeability is technically incorrect, as MSDS are an obsolete form of hazard communication as of 2012. The difference between these two documents is explained further in this section.

8.3.2 Summarized information regarding the specific use, storage, and accessibility of SDS as well as disposal of obsolete SDS and MSDS are detailed in Appendix Four of this CHP.

8.3.1 The MSDS is now known as the SDS

8.3.1.1 For many decades, the MSDS had been the back-bone of OSHA's Hazard Communication Standard (HCS). However, the Hazard Communication Standard has been revised by OSHA to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS), resulting in substantial changes to the MSDS.

8.3.1.2 Based on the MSDS provisions in HazCom 1994, there were a number of different MSDS styles and formats in use in the United States, the most common being the 8 section OSHA MSDS and the 16 section ANSI standard MSDS. OSHA's adoption of GHS via HazCom 2012 on the other hand, mandated the use of a single GHS format for SDS, a format which features 16 sections in a strict ordering. Another change due to the GHS is the renaming of Material Safety Data Sheets from MSDSs to simply Safety Data Sheets (or SDSs.)

8.3.1.3 Unfortunately, the dropping of the MSDS name and format has caused more consternation than is warranted. An SDS is a structured MSDS and they are very similar documents, especially in terms of the role they play in the HCS. In fact, the GHS SDS format is nearly identical to the ANSI Standard 16 section MSDS – with a couple of notable modifications.

8.3.3 Defining the SDS and MSDS

8.3.3.1 The SDS is the current standard of the document which gives detailed information about a material and about any hazards associated with the material. OSHA specifies that each SDS must include, at a minimum, the information in the 16 sections listed below. The GHS sets forth certain responsibilities having to do with SDSs:

8.3.3.2 Properties of a Safety Data Sheet (SDS)

As mentioned above, the GHS formatted SDS has 16 sections (source: OSHA SDS Quick Card). The OSHA-mandated SDS information is as follows[14]:

1. Section 1, Identification includes product identifier; manufacturer or distributor name, address, phone number; emergency phone number; recommended use; restrictions on use.
2. Section 2, Hazard(s) identification includes all hazards regarding the chemical; required label elements.
3. Section 3, Composition/information on ingredients includes information on chemical ingredients; trade secret claims.
4. Section 4, First-aid measures includes important symptoms/ effects, acute, delayed; required treatment.
5. Section 5, Fire-fighting measures lists suitable extinguishing techniques, equipment; chemical hazards from fire.
6. Section 6, Accidental release measures lists emergency procedures; protective equipment; proper methods of containment and cleanup.
7. Section 7, Handling and storage lists precautions for safe handling and storage, including incompatibilities.
8. Section 8, Exposure controls/personal protection lists OSHA's Permissible Exposure Limits (PELs); Threshold Limit Values (TLVs); appropriate engineering controls; personal protective equipment (PPE).
9. Section 9, Physical and chemical properties list chemical characteristics.
10. Section 10, Stability and reactivity lists chemical stability and possibility of hazardous reactions.
11. Section 11, Toxicological information includes routes of exposure; related symptoms, acute and chronic effects; numerical measures of toxicity.
12. Section 12, Ecological information
13. Section 13, Disposal considerations
14. Section 14, Transport information
15. Section 15, Regulatory information
16. Section 16, Other information, includes the date of preparation or last revision.

8.3.3.3 Properties of an obsolete Material Safety Data Sheets (MSDS):

When the MSDS was the standard prior to 2012, OSHA specified that each MSDS included, at a minimum, the information listed in the 12 sections listed below. Beyond that, OSHA did not specify the exact format of the MSDS, nor even how the information should be broken into sections, and so MSDSs prepared by different manufacturers tend to look different and contain different information. Even MSDSs for the same chemical can be quite different if they were prepared by different manufacturers or even from the same manufacturer if revisions were published over a period of time.

[14]Note: Due to other Agencies regulating this information, OSHA does not enforce Sections 12 through 15 (29 CFR 1910.1200(g)(2)).

8.3.3.4 The OSHA-mandated MSDS information was as follows[15]:

1. It is the responsibility of the manufacturer of a material to determine what hazards are associated with the material, to prepare an MSDS for the material, and to provide the MSDS to any recipients of the material.
2. It is the responsibility of an employer to provide MSDSs and training in their interpretation to the employees. MSDSs for hazardous materials must be immediately available in the workplace.
3. It is the responsibility of the employees to read and understand the MSDSs of any chemicals used on the job.
4. The chemical identity as listed on the label of the bottle including all ingredients with both the chemical and common names of all hazardous ingredients
5. Physical and chemical characteristics (melting point, flash point, etc.)
6. Physical hazards (fire, explosion, and reactivity data)
7. Health hazards, including signs and symptoms of exposure
8. Primary route(s) of entry into the body
9. Exposure limits as set by OSHA or other agencies
10. Whether the chemical is a confirmed or potential carcinogen as determined by OSHA or other agencies
11. Precautions for safe handling and use
12. Applicable control measures
13. Emergency and first aid procedures
14. Date of preparation and latest revision of the MSDS
15. Contact information of the preparer of the MSDS

8.3.4 Reading a SDS or a MSDS

8.3.4.1 The challenge in interpreting an SDS or MSDS is making sense of the sometimes confusing language. Whereas a SDS is standardized, an MSDS is more difficult to interpret because for there was no standardized format.

8.3.4.2 A good way to get an idea of the nature of a particular chemical from its SDS or MSDS is to read the hazards information and the toxicity information.

8.3.4.3 It is important to thoroughly familiarize oneself with the hazards of a chemical by reading the entire SDS or MSDS. If there is difficulty interpreting some of the language used in an SDS or MSDS, an online MSDS Dictionary which defines hundreds of medical and technical terms used in an either a SDS or MSDS can be found at: http://www.msdssearch.com/dictionaryn.htm

8.3.5 SDS and MSDS accessibility

8.3.5.1 Maintain Current SDS

Manufacturer-generated SDS of each unique chemical in laboratory must be current from the time of chemical container receipt to a laboratory or when chemical ownership is transferred internally to another laboratory within the college. If an SDS is inadvertently not received at the time of the first shipment of a chemical, a copy may be obtained from the manufacturer or vendor. If a copy is not available online, contact the manufacturer to request a copy. If

[15] Note the information below lists what was to be included in an MSDS. Often, additional information was included, depending on which manufacturer produced the MSDS in question. There was no standard format for an MSDS.

the manufacturer is not able to provide a SDS or is unable to be contacted, contact EHS to report the issue.

8.3.5.2 Pure chemicals or solutions generated or synthesized on-site are not required to have associated SDS in a laboratory, even if SDS are available for the product produced if the product or solutions will only be stored or used on-site. If, however, the chemicals or solutions produced at the college are shipped or transported from SUNY Geneseo, OSHA's Hazard Communication Standard (HCS) 29 CFR 1910.1200 requires that the manufacturer of a hazardous chemical prepare and transmit SDSs with an initial shipment of any hazardous material. Research laboratories synthesizing or producing chemicals are considered chemical manufacturers if they ship hazardous chemicals, and must develop SDSs for known and novel hazardous chemicals produced when distributed elsewhere[16]. While the HCS is based on known information and does not require testing of chemicals in determining health effects, any relevant information which is known about the chemical or the mixture must be conveyed to a generated SDS. Please contact EHS for more information before shipping or transporting synthesized chemicals to off-campus locations.

8.3.5.3 Physical Accessibility

Every laboratory using hazardous chemicals must have, readily accessible to personnel and students, an SDS for every hazardous material used in the area (or if an updated SDS is unavailable, the legacy MSDS from when the chemical was received). Per PESH regulations, both SDS and MSDS must not be locked away or difficult to find, and must be in print copy or on a local hard drive of a dedicated laboratory computer in the laboratory in which chemicals are used. Network or online access to SDS through a laboratory computer are not sufficient methods of access. There must not be password protection on a lab computer hosting SDS documents to ensure ease of access to SDS files.

8.3.5.4 Faculty/PI/Laboratory Supervisor must maintain an accurate inventory of SDS/MSDSs for their area. The SDS inventory must be alphabetized (by trade name) and kept in a conspicuous location in a binder with the label at minimum displaying “Safety Data Sheets”. In some cases an MSDS or SDS is not needed for all chemical products, such as when a commercial product is used in a similar household application as the manufacturer suggests. Please contact EHS with any questions about SDS storage requirements.

8.4 The NFPA Identification System

8.4.1 The National Fire Protection Agency (NFPA), in section 704 of the National Fire Code, outlines a system for identifying the hazards associated with materials. The system was developed primarily with the needs of fire protection agencies in mind but it is of value to anyone who need to handle potentially hazardous material.

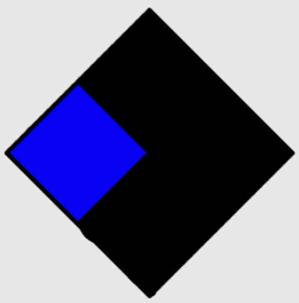
8.4.2 The hazard identification signal is a color-coded arrangement of numbers and/or letters arranged in a diamond shape. NFPA Hazard diamonds are displayed on any container which stores or transports hazardous chemicals, including trucks, storage tanks, bottles of chemicals, and in various other places. The blue, red, and yellow fields (health, flammability, and reactivity, respectively) all use a numbering scale ranging from 0 to 4.

8.4.3 A value of zero (0) means that the material poses essentially no hazard, and a rating of four (4) indicates extreme danger. The white field is reserved for "special precautions". Two "official" values are specified in NFPA 704: "**OX**", indicating that the chemical possesses

[16] OSHA Standard Interpretations: https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=24782

oxidizing properties, and "~~W~~", indicating that the chemical is unusually reactive to water. Other values sometimes appear in the white field as well, including indicators for substances which are acidic, alkaline, corrosive, or those which present a radiation hazard.

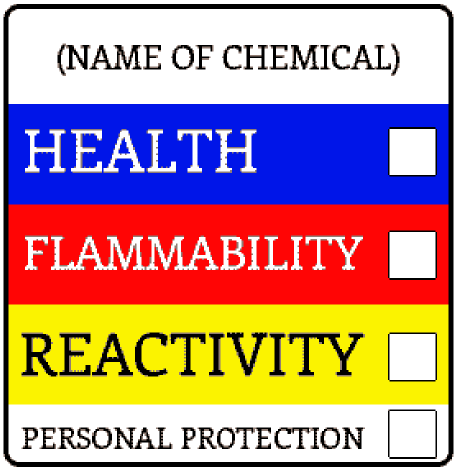
8.4.4 Decoding the NFPA Identification System

	**Health Hazard** **4** Materials that, on very short exposure, could cause death or major residual injury (including those that are too dangerous to be approached without specialized protective equipment) **3** Materials that, on short exposure, could cause serious or permanent injury (including those requiring protection from all bodily contact) **2** Materials that, on short or intense exposure, could cause temporary incapacitation or residual injury **1** Materials that, on exposure, could cause significant irritation, but only minor residual injury **0** Materials that, on exposure under fire conditions, would offer no hazard beyond that of ordinary combustible materials
	**Flammability Hazard** **4** Materials that: will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature; are readily dispersed in air; will burn readily **3** Liquids and solids that can be ignited under almost all ambient temperature conditions. These materials produce hazardous atmospheres with air under almost all ambient temperatures (or, though unaffected by ambient, are readily ignited under almost all conditio **2** Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur **1** Materials that must be preheated before ignition can occur **0** Materials that will not burn
	**Instability Hazard** **4** Materials that, in themselves, are capable of detonation, explosive decomposition, or explosive reaction at normal temperatures and pressures **3** Materials that, in themselves, are capable of detonation, explosive decomposition, or explosive reaction, but that require a strong initiating source (or that must be heated under confinement before initiation) **2** Materials that readily undergo violent chemical change at elevated temperatures and pressures **1** Materials that, in themselves, are normally stable BUT can become unstable at elevated temperatures and pressures (or that react vigorously with water, but not violently) **0** Materials that, in themselves, are normally stable, even under fire conditions

	**Special Hazard** (selected examples) **OX** Used to identify oxidizing material (oxidizers) **~~W~~** Materials that exhibit reactivity with water

8.5 The HMIS Identification System

An example of the Hazardous Material Information System (HMIS) Label.



8.5.1 HMIS - the Hazardous Material Information System

8.5.1.1 The Hazardous Material Information System (HMIS) is a labeling system developed by the National Paint and Coatings Association (NPCA) and sold through Labelmaster, Inc. An example of a HMIS label appears in this section of the CHP. This system uses a label with four color bars and a blank bar at the top where the name of the chemical should appear. The HMIS system uses blue, red, and yellow colored bars. These bars indicate, respectively, the health, flammability, and reactivity hazards associated with the material. A numbering scale ranging from 0 to 4 is used in each of these bars, with a value of zero indicating that the material poses essentially no hazard, and a rating of four indicating extreme danger. The fourth, white bar is marked "personal protection". A letter (the letters used are A through K, and X) is placed in this bar to indicate the kind of personal protective equipment which should be used to safely handle the chemical.

8.5.1.2 Another very similar labeling system, the Hazardous Material Identification Guide (HMIG), was developed and is sold through Lab Safety Supply. This system is identical to HMIS with the exception that the fourth, white bar is marked "protective equipment" in the HMIG system.

8.5.1.3 Although the details of how numbers are assigned may vary somewhat between systems, the HMIS/HMIG system is essentially the same overall scheme as is used in the NFPA system, but there are differences.

8.6 The Differences Between NFPA and HMIS

8.6.1 As explained previously, both the NFPA and HMIS/HMIG systems are similar to the extent that both use the same colors to indicate the hazards associated with a chemical (blue for health, red for flammability, and yellow for reactivity). Both systems also use a scale of 5 numbers (0 through 4) to represent the relative degree of the hazard, 0 indicating the least and 4 indicating the most hazardous.

8.6.2 The differences between the systems are minimal, with two significant exceptions. Firstly, the layout differs (NFPA using 4 diamonds and HMIS/HMIG using stacked bars). Secondly, the most significant difference is the intended audience for each of the systems. The HMIS/HMIG systems were designed to be compliant with the HCS, and targets employees who must handle hazardous chemicals in the workplace. The NFPA system, however, was developed to alert firefighters to the hazards of materials present at the scene of a fire. Therefore the numbers assigned in the NFPA system assume that a fire is present. Since no such assumption is made with the HMIS/HMIG system, hazard ratings can differ from system to system, even for the exact same chemical.

8.6.3 It should also be noted that the manufacturers of chemicals and materials assign hazard ratings, rather than the government. Therefore, number values will change from manufacturer to manufacturer according to their individual interpretation of the level of hazard present.

8.6.4 However, despite any differences between systems or manufacturers hazard levels, a hazardous chemical will remain a hazardous chemical. Any discrepancy between the systems or between two manufacturers will only result in a hazard rating being changed by an increment of 1, at the maximum. A chemical rated with a health hazard of "4" by one manufacturer will never be rated lower than "3" by any other manufacturer.

8.7 Where to find Hazard Ratings

8.7.1 The source of all published NFPA ratings is the NFPA. Some NFPA Standards which list ratings are NFPA 49, "Hazardous Chemicals Data," and NFPA 325, "Guide to Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids." HMIS/HMIG ratings can be found in selected vendor and manufacturer catalogs.

Section Nine

Training and Responsibilities

9.1 Introduction

9.1.1 Faculty, staff, and students must be provided area-specific training on the hazards to which they may be exposed and the means to avoid these hazards. Area-specific training is defined in Section 8.1.1. Student training is provided by faculty, department staff, or a designated Department Representative with the assistance of EHS. Faculty or Staff must be provided access to training for annual training requirements as defined by OSHA, PESH, and New York State regulations. New Faculty or Staff must receive "On the Job Training" for hazardous operations by a laboratory supervisor or Laboratory Safety Representative with the assistance of EHS. Training must be updated and training records documented when a new hazard is introduced into the laboratory.

9.1.2 For additional information on Hazard Communication, refer to the SUNY Geneseo Hazard Communication Program detailed in Section Seven – The Hazard Communication Program. For additional or more specific information on training and training documentation requirements, please contact EHS.

9.2 Training

As a minimum, area-specific training must include:

1. The use of Safe Work Practices (defined in Section 5.2)
2. An indication of which operations involve hazardous materials and/or hazardous equipment
3. Potential chemical, physical, and/or biological hazards
4. Applicable health and safety standards
5. Purpose and results of exposure monitoring for chemical and physical hazards
6. Purpose and use of control measures
7. Requirements for use of personal protective equipment (See Appendix Five)
8. Detection systems, odor and irritation threshold for chemicals, monitors, alarms, odors, symptoms, etc.
9. Safety Data Sheet location(s) and how to use, interpret and implement precautions outlined in the SDS (See Section 7.3 of the CHP)
10. Information regarding hazardous materials and possible reproductive effects (See Appendix Five)
11. Information regarding known special hazards concerning chemicals or hazards known to be reproductive hazards. (See Appendix Five)
12. The requirements of the Hazard Communication & Chemical Hygiene Standards
13. Non-routine tasks
14. Labeling, postings, and signage requirements

9.3 Responsibilities

9.3.1 It is the faculty or staff member's responsibility to work safely and ensure that also students work safely to prevent harm to themselves, the general public, and environment. SUNY Geneseo safety standards must be observed. To assist Faculty and Staff, general health and safety training is coordinated by EHS upon request. Any condition that may lead to a violation of these standards must be reported immediately to the Safety Officer and/or the Department Safety Representative and EHS. Faculty and Staff are obligated to stop work under unsafe conditions and report any injuries received while on duty. Faculty and Staff are obligated to report all student injuries and chemical exposure to Campus Police. In addition, Faculty and Staff are obligated to respond to emergencies by following laboratory emergency procedures.

9.3.2 Personnel must be instructed about potential hazards involved in the lab, proper safety precautions to follow and emergency procedures to use if an accident should occur. Examples of training required for laboratory personnel include:

1. Hazard Communication
2. Chemical Hygiene & Safety in the Laboratory
3. Hazardous Waste Generator Training
4. Emergency Procedures

9.3.3 Other training which may be required depending on lab assignments, chemical agents and/or physical hazards include:

1. Radiation Safety
2. Respirator Use
3. Laser Safety
4. Specialized Chemical Safety Training
5. Hearing Conservation
6. CPR
7. AED
8. First Aid
9. Fire Extinguisher Use
10. Lockout, Tag-out, and Electrical Safety
11. Spill response

9.4 Resources

9.4.1 Information on hazardous properties of chemical substances can be accessed through Material Safety Data Sheets/Safety Data Sheets and Laboratory Safety references listed in Section Twelve. For a thorough discussion on how to use and understand Material Safety Data Sheets (MSDS) and Safety Data Sheets (SDS), reference both Section 8.3 and Appendix Four. Reference material including but not limited to safety videos, training document templates, and official safety documentation forms can be found by contact EHS at x5663 and online at the SUNY Geneseo EHS website at www.geneseo.edu/EHS. Further supplementary information may be found through The Merck Index and by referencing the 2011 "Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards" published by the National Research Council. Additional Geneseo-specific safety resources may be also online through the SUNY Geneseo Chemistry Stockroom website at www.geneseo.edu/chemstockroom, and may be useful for various college department labs.

Section Ten

Medical Consultations and Monitoring

10.1 Criteria for Selection

10.1.1 All college employees/students working with hazardous chemicals in a laboratory setting have an opportunity to receive medical consultation, including any follow-up examinations which the examining physician determines to be necessary, under the following circumstances:

1. Personnel reported or known to be working with hazardous substances at concentration levels which exceed OSHA action limits and therefore require medical evaluation per OSHA requirements.
2. Personnel showing signs or symptoms associated with exposure or over-exposure to a hazardous substance in a laboratory setting.
3. Anyone using a respirator or air purifying, air supplied, or self-contained breathing apparatus.
4. If a spill, leak, explosion, or other occurrence occurs in a laboratory setting resulting in the likelihood of an exposure exceeding the permissible exposure limit (PEL). The consultation may determine the need for further examination.

10.1.2 In the event a medical consultation is deemed necessary, and an injured *non-student* employee is unable to complete the Accident Report Form at the time of the incident, the managing Faculty Member/Principle Investigator (PI)/Laboratory Supervisor will complete the Accident Report Form for submission to the SUNY Geneseo Human Resources office.

10.1.3 All student injuries must be reported immediately to campus police.

10.2 Examinations

1. For personnel, medical examinations shall be done with no loss of personal accrual and at no cost to the employee.
2. Examination content will be determined by existing federal and state regulations and supplemented by any additional criterion determined by the licensed physician performing the exam.
3. In cases of exposure incidents or suspected exposures above the PEL as listed below, exposure assessments will be conducted following medical treatment.
    - A. Hazardous chemical leak, spill, cylinder release
    - B. Direct skin contact with hazardous material
    - C. Symptoms including headache, rash, nausea, coughing, tearing, irritation or redness of eyes, diziiness, etc. felt when working with or near hazardous chemicals
4. For examinations resulting from exposures to OSHA-regulated substances, the exam frequency will be the period specified in the OSHA standard.
5. For examinations resulting from potential overexposure to hazardous substances, a licensed physician will determine the examination frequency.

10.2.1 In the event of need for medical examination, the following information should be supplied to the attending physician or medical health care professional:

1. Identity of the hazardous chemical(s) which the employee may have been exposed, and the SDS/MSDS for the chemical(s)
2. Conditions to which the exposure occurred and any report data available
3. Description of signs and symptoms of exposure, if any

10.3 Hazardous Materials and Reproductive Effects

10.3.1 Personnel may be exposed to hazardous agents that pose a reproductive hazard such as infertility, hormonal changes, birth defects and genetic damage. These agents include ionizing radiation, alcohol, cigarette smoke, pharmaceuticals, and some of the thousands of different chemicals that are used in the home or workplace. Although many of these have been tested to determine whether they cause acute (immediate) effects on the body, few have been studied to see if they cause birth defects (teratogens) or genetic defects (mutagens). Even fewer have been studied to see if they can cause infertility, reduced sperm count, menstrual disorders, or other disorders relating to reproduction. Therefore, EHS and the faculty, PI, or staff member shall consider the potential reproductive effects of chemicals prior to selecting materials for use, and where feasible, preclude or limit their use.

10.4 Hazardous Materials and Pregnancy

10.4.1 The primary path for hazardous substances to reach a fetus is through the placenta. Many chemicals and drugs that enter a pregnant person's body (through breathing, swallowing, absorption through the skin, etc.) will eventually enter the pregnant person's blood circulation, cross the placenta and thus affect the developing fetus. The concentrations of toxic substances needed to enter the pregnant person's body, reach the fetus, and potentially harm it are generally unknown.

10.4.2 Communication Recommendations

10.4.2.1 Due to protections from the Federal Pregnancy Discrimination Act[17], SUNY Geneseo may not compel a person to disclose their pregnancy, and it is illegal to assign a pregnant person to different tasks simply because of pregnancy. If a person willingly informs the college of their pregnancy, then additional assessments, precautions, or other accommodations should be discussed with their faculty/laboratory supervisor.

10.4.2.2 The fetus is usually most vulnerable in the early weeks of pregnancy (first 13 weeks or trimester)[18] but may also be at risk throughout a pregnancy. In light of the potential harm from workplace exposures to both the pregnant person and their developing fetus, it is important and strongly encouraged that the employee or student who is pregnant inform their supervisor of the pregnancy as soon as possible. This recommendation is not intended to discriminate against pregnant people; rather, it is intended to provide the pregnant person the opportunity to discuss the possible hazards and potential options to ensure they are fully informed with all known information so they may communicate more effectively and make informed choices about the workplace/academic laboratory with their personal physician or health care professional.

10.4.3 Student Recommendations and Responsibilities

Students who determine or suspect they are pregnant while enrolled in a laboratory course or laboratory research are very strongly encouraged to talk with their personal physician or medical health care professional about the laboratory courses in which they are enrolled.

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[17] United States Equal Opportunity Employment Commission Federal Pregnancy Discrimination Act https://www.eeoc.gov/eeoc/publications/fs-preg.cfm

[18] Reproductive Health and the Workplace. Center for Disease Control (CDC) https://www.cdc.gov/niosh/topics/repro/pregnancyjob.html

Additionally, students who are pregnant and wish to continue in a laboratory course or research where they may be exposed to hazardous material are strongly encouraged to read and complete the Student Pregnancy Advisement Form, and then submit the completed form to their supervising Faculty/Instructor/PI/Laboratory Supervisor. Students are advised they are allowed and encouraged to request all applicable SDS in print form of hazardous chemicals to which they may be exposed, so they may review and consult with their physician. The supervising Faculty/Instructor/PI/Laboratory Manager must provide SDS documentation to the student within a reasonable period from the time of the initial request.

10.4.4 The Student Pregnancy Advisement Form

The Student Pregnancy Advisement Form is a voluntary disclosure form for students enrolled in laboratories or engaging in research at SUNY Geneseo. The form is found online at https://www.geneseo.edu/ehs/forms. If a student submits the Student Pregnancy Advisement form to their supervising Faculty/PI/Laboratory Supervisor, the supervising personnel must keep a copy in their records and submit a duplicate copy of the form to EHS.

Section Eleven

Recordkeeping

11.1 Specific Recordkeeping Responsibilities:

11.1 Accurate documentation and recordkeeping of exposure monitoring, medical surveillance, and health and safety training is an important component of this CHP. This section defines the recordkeeping requirements for important aspects of the Plan.

11.1.1 Current chemical inventories, MSDS/SDS for each laboratory shall be readily available for staff and faculty access and reference in the event of an emergency. *Responsibility: Faculty Member, Principle Investigator, Laboratory Supervisor/Manager.*

11.1.2 Exposure records for hazardous chemicals and harmful physical agents will be maintained for the duration of employment plus 30 years per 29 CFR 1910.20. *Responsibility: EHS.*

11.1.3 Medical records for staff or faculty exposed to hazardous chemicals and harmful physical agents will be maintained for the duration of employment plus 30 years per 20 CFR 1910.20. *Responsibility: Human Resources*.

11.1.4 Additionally, the following records must be kept for a minimum of three years unless otherwise specified:

1. Staff and Faculty Training Records; *Responsibility: EHS.*
2. Student Training Records Responsibility; *Faculty, PI, or Laboratory Supervisor/Manager primarily responsible for a lab.* ***Student training records must be held by the responsible Faculty/PI/Laboratory Supervisor for seven years***.
3. Area-Sponsored or Area-Specific Classes including Training on Safe Work Practices presented to students by faculty or staff; *Responsibility: Faculty*.
4. Accident Investigations; *Responsibility: EHS.*
5. Lab Safety Committee Meeting Minutes; *Responsibility: EHS, Department Safety Representative(s).*

11.2 Superseded and Obsolete Records from the Laboratory:

11.2.1 Changes in laboratory operations may cause training records to become superseded or obsolete.

1. Obsolete Exposure Information

   Superseded and obsolete information concerning the chemicals stored and used in a laboratory must be archived for 30 years even if the chemical is no longer in use or present in the inventory. This record storage requirement includes MSDS/SDS records. MSDS/SDS of superseded or obsolete chemicals in the inventory must be submitted to EHS for storage.
2. Other Obsolete Documents

   Training records not directly pertaining to potential chemical exposures may be discarded if they are no longer current after three years for faculty/staff, and after seven years for students.

3. Records from Decommissioned Laboratories
   The responsible department must archive any records pertaining to possible personnel/student exposures for 30 years after decommissioning a laboratory.

Section Twelve

Requirements for the Use of High Hazard Materials and Equipment

12.1 Chemical Carcinogens

12.1.1 Introduction

This section describes the recommendations and requirements established to govern the use of substances that pose a potential carcinogenic risk. A carcinogen is any substance or agent which is capable of causing cancer, the abnormal or uncontrolled growth of new cells in any part of the body in humans or animals. Carcinogens are chronic toxins with long latency periods that can cause damage after repeated or long-duration exposures and often do not have immediately apparent harmful effects. All SUNY Geneseo personnel using chemical carcinogens are expected to be familiar with these standards and guidelines and conduct their operations accordingly.

12.1.2 Purpose

The purpose of these guidelines is to assist the faculty and staff in the selection and use of appropriate safeguards. These safeguards consist of good laboratory practices and engineering controls which permit the safe use of high hazard chemicals by maintaining as low exposure to these substances as reasonably achievable. In selecting appropriate safeguards, specific attention must be given to:

1. The quantity of the chemical carcinogen used
2. The physical and chemical properties
3. The carcinogenic potency
4. The type of research and experimental procedures involved
5. The engineering controls available in the laboratory
6. The applicable health and safety standards

12.1.3 Scope

"*Select carcinogens*" are those which are listed as known or probable human carcinogens by any of the following sources:

1. American Conference of Governmental Industrial Hygienists (ACGIH)
2. International Agency for Research on Cancer (IARC)
3. National Toxicology Program (NTP)
4. Occupational Safety and Health Administration (OSHA)

12.1.4 Responsibilities

Chemical carcinogen safety for various agencies at SUNY Geneseo are described below. A more detailed review of responsibilities is provided in Section Two of this CHP.

12.1.4.1 SUNY Geneseo EHS

1. Recommends and reviews policies and procedures that provide for the safe conduct of work involving high hazard materials such as carcinogens
2. Reviews the status of compliance with these established practices
3. Investigates all reported incidents that result in exposure of chemical carcinogens to personnel or the environment and recommends corrective actions to reduce the potential for recurrence
4. Supervises cleanup operations where incidents have resulted in significant contamination of laboratory areas or personnel
5. Determines if the use of a carcinogen creates a significant potential for occupational exposure
6. Evaluates operations for compliance with OSHA requirements
7. Provides technical guidance to personnel and students regarding the selection of appropriate laboratory practices and engineering controls

12.1.4.2 Faculty, Principle Investigators, Laboratory Supervisors and Managers

1. Prepares safety plans, specific laboratory Safe Work Practices, or experimental and research protocols describing the use of a chemical carcinogen and the procedures used to control exposure before the initiation of an operation or when significant process changes occur
2. Employs and ensures the use of appropriate laboratory practices, engineering controls, and personal protective equipment that reduce the potential for exposure to that level which is as low as reasonably achievable
3. Informs students under their supervision of the potential hazards associated with the use of carcinogens and ensures proper documentation of training and instruction in the use of laboratory practices, engineering controls, and emergency procedures
4. Conducts an annual review of specific laboratory Safe Work Practices
5. Reports to EHS any incident that results in the exposure of personnel to carcinogens
6. Reports to EHS any incident that results in danger of environmental contamination from carcinogens
7. Provides any necessary assistance during accident investigations

12.1.4.3 All Personnel shall ensure Students:

1. Know and comply with laboratory safety practices required for the assigned task
2. Wear appropriate PPE
3. Report all unsafe conditions to the supervising faculty or staff member
4. Attend appropriate training in safety procedures for handling and using carcinogenic materials provided by the faculty member or Laboratory Supervisor/Manager
5. Report to EHS all facts pertaining to incidents resulting in exposure to carcinogens or environmental contamination

12.1.4.4 Special Labeling for Highly Toxic Materials:

1. All containers which hold carcinogens, reproductive toxins, and acutely toxic reagents and chemicals must be properly labeled with the health hazards posed by the chemical.

12.1.5 Laboratory Practices and Engineering Controls

12.1.5.1 The laboratory practices and engineering controls included in this section provide general safeguards that are recommended for the use of chemical carcinogens. To select the appropriate safeguards, knowledge is required of the physical and chemical properties, the proposed use, the quantity needed, the carcinogenic and other toxic hazards, and the applicable health and safety standards. Careful judgment is therefore essential in planning any activity that involves chemical carcinogens. EHS is available to assist the faculty and staff in selecting the appropriate safeguards.

12.1.5.2 Personal Practices

1. Disposable lab coats are recommended when laboratory personnel must work with chemical carcinogens in excess of 0.1% concentration.
2. Wear gloves appropriate to the task. Discard after each use and immediately after any obvious contact.
3. Wear appropriate eye protection. The type of eyewear used will depend upon the hazard presented by the operation and chemical in use.
4. Do not eat, drink, smoke, chew gum or tobacco, apply cosmetics or store utensils, food, or food containers in laboratory areas where chemical carcinogens are used or stored.
5. Do not pipette by mouth--use mechanical aids.
6. Wash hands immediately after the completion of any procedure. Wash immediately after exposure, or if appropriate, shower the affected area.

12.1.5.3 Operational Practices

1. Label all primary and secondary containers. To determine appropriate labels and signs, contact the EHS for guidance. (reference labeling requirements discussed in Section 5.10 of this CHP).
2. Limit entry to personnel authorized by the supervising Faculty member/PI/Laboratory Supervisor for entry to work or storage areas. Facilities Department and emergency personnel must be advised of potential problems and hazards before entering these work or storage areas.
3. Individuals who are pregnant should consult with the supervising authority before the start of any laboratory activity involving chemical carcinogens (reference hazardous materials and pregnancy discussed in both Section 10.4 and Section 12.2 of the CHP).
4. Cover work surfaces with stainless steel or plastic trays, absorbent paper with a moisture-proof lining, or other impervious material. Decontaminate or discard the protective covering materials as hazardous waste after the procedure has been completed.
5. Conduct aerosol-generating procedures or procedures involving volatile carcinogens in a chemical fume hood, a glove box, or other suitable containment equipment. Examples of aerosol-producing operations include the opening of closed vessels, transfer operations, preparation of mixtures, blending, sonification, and open vessel centrifugation.
6. Capture vapors or aerosols produced by analytical instruments with local exhaust ventilation or ventilation into a chemical fume hood.

7. Decontaminate obviously contaminated equipment.
8. Transfer carcinogens in tightly closed containers placed within a durable outer container.
9. Keep working quantities to a minimum.
10. Dissolve finely divided powdered carcinogens, if possible, into a liquid. This reduces the possibility of generating an aerosol.
11. Use mixtures that are as dilute as possible.
12. Place contaminated materials in a closed plastic bag and sealed primary container. Place the primary container in a durable box before transporting.
13. Inactivate carcinogens, if possible, before disposal. Consult with EHS for additional information on waste disposal.
14. When cleaning, use a wet mop or vacuum cleaner equipped with a high efficiency particulate (HEPA) filter to remove dusts. Do not dry sweep or dry mop as this may aerosolize contaminated material.
15. Protect vacuum lines, pumps, and equipment with absorbent liquid trap and a HEPA filter to prevent entry of any chemical carcinogens into the system. When working with volatile carcinogens, use a separate vacuum pump placed within or vented to a chemical fume hood. This pump should be labeled for carcinogen use and the oil discarded as carcinogen waste when it is changed.

12.1.5.4 Facility Requirements

1. Provide a handwashing facility within the work area. The use of a liquid soap is recommended.
2. Provide an emergency eye wash facility in each laboratory. A safety shower should also be installed in the area if corrosive chemicals are being stored, transported, or dispensed. The eyewash and/or shower shall be located in close proximity to the chemical operations area.

12.1.6 Formaldehyde

12.1.6.1 Formaldehyde is a colorless, highly toxic, and flammable gas at room temperature which can be irritating to the eyes, nose, and upper respiratory tract. It is a strong smelling chemical commonly used in research and medical laboratories as an aqueous solution. Formaldehyde can act as a sensitizing agent; repeated skin exposure to formaldehyde can cause sensitization in certain individuals, resulting in allergic dermatitis. It is a suspected human carcinogen and a suspected reproductive hazard. Acute exposure is highly irritating to the respiratory system and can cause headaches and eye and throat irritation at very low concentrations.

12.1.6.2 The aqueous solution formalin is 37-40% formaldehyde. Paraformaldehyde is the crystallized polymer of formaldehyde that is weighed out and dissolved in solution for experimentation or cell and tissue fixation. Both formalin and paraformaldehyde solutions of concentrations at 3-10% are typically used to perfuse or fix tissues.

12.1.6.3 OSHA's Formaldehyde Standard (29 CFR 1910.1048) protects workers exposed to formaldehyde from formaldehyde gas, its solutions, and various materials which release formaldehyde. OSHA has adopted a permissible exposure limit (PEL) of 0.75 ppm (parts per million) for airborne formaldehyde averaged over a Time Weighted Average (TWA) 8-hour work shift, with an action level of 0.5 ppm. Formaldehyde can be smelled at less than 0.5 ppm. A short-term exposure limit (STEL) of 2 ppm for 15 minutes has also been established. The American Conference of Governmental Industrial Hygienists (ACGIH) has established a much lower Threshold Limit Value-Ceiling for formaldehyde of 0.3 ppm, which should never be exceeded in any SUNY Geneseo laboratory. OSHA training and monitoring via personal dosimetry is required by anyone exposed above 0.1 ppm for an 8-hour period.

12.1.6.4 Minimizing Exposure to Formaldehyde

1. All work with concentrated formalin solutions must be done in a chemical fume hood. If work cannot be done in a hood, EHS must be contacted to assure that hazardous exposures to faculty, staff and students are prevented. Recommendations for protocol modification or protective equipment will be made based on the circumstances.
2. Formaldehyde splashed in the eye(s) can cause irreversible damage to the cornea. Safety goggles must always be worn when working with formaldehyde.
3. Gloves must be worn whenever using formaldehyde or formaldehyde derivatives. Latex gloves may provide some protection against formaldehyde liquids, however butyl or nitrile gloves are recommended.
4. Significant formaldehyde exposures can occur while dissecting or working with tissue specimens perfused with or fixed in formaldehyde. Chemical exposures can be minimized by working in a hood or allowing tissues to "air out" in a well-ventilated area prior to handling the specimen. Eliminating puddles of formaldehyde in the specimen by rinsing or blotting the excess with paper towels while wearing appropriate gloves may reduce exposure.

12.2 Reproductive Toxins[19]

12.2.1 A reproductive toxin is defined by the OSHA Lab Standard defines as a chemical "which affects the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis)".

12.2.2 It is common for reproductive toxins to be chronic toxins which cause damage after repeated or long duration exposures and may have long latency periods. Persons who are able to become pregnant should be especially careful when handling reproductive toxins. Persons who are pregnant, persons intending to become pregnant[20], or persons with male reproductive systems who are seeking to have children[21], should seek the advice of their physician before working with known or suspected reproductive toxins.

12.2.3 It is important to be aware of the threats to reproductive health and prevent potential reproductive hazard exposures for employees and students of any sex who work with known and suspected reproductive toxins including chemical, biological, radiological, and physical agents. EHS is available for personnel and students to consult with about concerns or questions on reproductive hazards, conduct workplace hazard assessments, and limitedly provide recommendations to address or eliminate specific reproductive risks. It is also important to consult with your personal physician about risks associated with chemicals known to be reproductive toxins. As with any particularly hazardous substance, work

[19] While both the understanding of and terminology defining biological sex, gender identity, and gender expression continues to evolve, the legislative language used by OSHA to define and refer to reproductive toxins has not. In order to be more inclusive, terminology used by OSHA specifying 'women' or 'females' and 'men' or 'males' have been modified in this CHP to specify 'persons', unless context involves information otherwise unambiguously specific to male or female reproductive systems.

[20] NIOSH The Effects of Workplace Hazards on Female Reproductive Health
http://www.cdc.gov/niosh/docs/99-104/pdfs/99-104.pdf

[21] NIOSH The Effects of Workplace Hazards on Male Reproductive Health
http://www.cdc.gov/niosh/docs/96-132/

involving the use of reproductive toxins should adhere to the Guidelines for Particularly Hazardous Substances.

12.2.4 Due to protections from the Federal Pregnancy Discrimination Act[22], SUNY Geneseo may not compel a person to disclose their pregnancy. If a person willingly informs the college of their pregnancy, then additional assessments, precautions, or other accommodations should be discussed with their faculty/laboratory supervisor.

12.2.5 More information on reproductive toxins, including numerous useful web links, can be found on the OSHA Safety and Health Topics for Reproductive Hazards[23] webpage. A CHP quick-reference information guide pertaining to reproductive toxins can be found in Appendix Five. The State of California has also developed an extensive list of "Reproductive Toxins Known to the State of California through Prop 65"[24]. Please note, this list is referenced as supplemental information to the OSHA, NTP and IARC chemical lists and is not legally mandated by New York State.

12.3 Toxic Metals and Metal-Containing Compounds and Solutions

12.3.1 Toxic metals and metal-containing compounds and solutions may be used in many forms at SUNY Geneseo. This section is intended to provide some general information on mercury and other toxic heavy metals which may be found in laboratory operations.

12.3.2 Mercury

12.3.2.1 Elemental (metallic) mercury is a toxic silver liquid metal which readily vaporizes at temperatures as low as 10°F. Mercury vapor is colorless, odorless, and toxic. Vapor exposure can occur through inhalation or absorption through skin. Health effects resulting from prolonged mercury exposure include fatigue, weight loss, anorexia, gum inflammation, and tremors of the hands. Acute health effects resulting from short-term exposure to mercury vapor include symptoms such as coughing, chest pain, bronchitis, excessive salivation, and the presence of a metallic taste in the mouth.

12.3.2.2 Mercury, though minimized in use, is found in many areas of campus in items and devices such as thermometers, switches, barometers, and thermostats. Metallic mercury and mercury compounds are very hazardous; unwanted and spilled materials are regulated as hazardous wastes. Never dispose of any residual mercury material into the trash. By New York State and Federal law, metallic mercury must never be disposed of down the drain.

12.3.2.3 Small Mercury Spills, less than 25mL.

Mercury spills must be cleaned immediately; most spills do not pose a high risk as long as it is contained quickly and has not contaminated personnel. Wear appropriate PPE when cleaning, including gloves and safety glasses or safety goggles.

Small spills may be cleaned up by personnel, contact EHS with questions and to report the spill.

1. **DO NOT** use a broom or a regular vacuum to collect mercury. This will result in additional contamination and the spreading of mercury vapors.

[22] United States Equal Opportunity Employment Commission Federal Pregnancy Discrimination Act https://www.eeoc.gov/eeoc/publications/fs-preg.cfm

[23] OSHA Reproductive Hazards Webpage: https://www.osha.gov/SLTC/reproductivehazards/

[24] The Proposition 65 List: https://oehha.ca.gov/proposition-65/proposition-65-list

2. **DO NOT** place glass from mercury-containing devices (e.g. thermometers, barometers, etc.) into a broken glass box. All mercury contaminated debris must be disposed of as hazardous waste.
3. If mercury beads are unable to be collected due to inaccessibility (e.g. mercury beads between floor tiles), a slurry consisting of sulfur powder and water should be spread over and into the contaminated area.
    A. The slurry oxidizes the mercury metal to mercury sulfide, reducing the potential for the release of mercury vapor.
    B. The slurry should be allowed to set for approximately 24 hours to complete the reaction and then may be cleaned with soap and water, all of which must be disposed of as hazardous waste. Do not use a broom or vacuum to clean the slurry, wear appropriate PPE, and wipe the slurry into
    C. If excessive pink or brown spotting is noted after the 24-hour contact period, the slurry should be wiped up with all cleanup materials being disposed of as hazardous waste.
4. If the mercury spill occurs on a carpeted area, immediately contact EHS at x5663 and exit the spill area. Avoid using mercury containing devices in carpeted areas.

12.3.2.4 Large Mercury Spills, greater than 25mL.

For large spills, contact EHS for further assistance.

1. Evacuate the spill area and inform others to exit the area. Do not walk through the area with the mercury spill.
2. Close doors to the spill area.
3. Contact EHS at x5663 or if after regular business hours, call University Police at x5222.
4. Place a sign indicating a mercury spill is present on the outside of the doors leading to the spill area, and ensure others who are not part of the clean-up related effort do not enter the spill area until cleanup has been completed.

12.3.3 Heavy Metal Powders

12.3.3.1 Heavy metals such as arsenic, barium, cadmium, chromium, lead, nickel, silver, selenium, etc. and their ionic or organometallic compounds are often highly toxic and care to minimize exposure must be employed. Powdered metals are positively charged and spread easily when spilled. Caution must be used to prevent the contamination of the entire lab and adjacent areas.

12.3.3.2 In the event of a large-scale[25] heavy metal power spill:

1. Step slowly to leave the area as the area is evacuated
2. Leave your shoes and any contaminated clothing (i.e. your lab coat and/or other clothing) at the door
3. Secure the lab and put signage up indicating the area must not be accessed
4. Call EHS at x5663 during regular business hours or call campus police at x5222 after hours
5. Avoid tracking through the hallways and other rooms, contamination may be spread unknowingly.

[25] Large-scale spill, as defined in this CHP in Section 5.13.3

12.4 Acutely Toxic Substances

12.4.1 OSHA defines a chemical as being acutely toxic if it falls within any of the following categories:

1. A chemical that has a median lethal dose (LD50) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
2. A chemical that has a median lethal dose (LD50) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.
3. A chemical that has a median lethal concentration (LC50) in air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

12.4.2 SDS and other chemical references may be used to determine if a chemical meets one of the listed definitions to be considered acutely toxic. As with any particularly hazardous substance, work involving the use of acute toxins should adhere to the Guidelines for Particularly Hazardous Substances. In addition to following the Guidelines for Particularly Hazardous Substances, additional guidelines for working with acute toxins include:

1. Considering security through storing acutely toxic substances in a locked storage cabinet
2. Being aware of any special antidotes in case of accidental exposure (hydrofluoric acid and inorganic cyanide exposures, for example)
3. Giving particular attention to the selection of appropriate gloves and other first line of defense personal protective equipment.
4. Not working with highly toxic substances outside of a fume hood, glove box or ventilated enclosure.

12.5 Reactive Chemicals

12.5.1 Peroxidizable Compounds

12.5.1.1 Peroxidizable compounds are a class of chemicals which have the ability to form shock-sensitive and potentially explosive peroxide contaminant crystals. Certain chemicals can turn into dangerous organic peroxides with prolonged storage and/or concentration. Peroxide-forming chemicals react with oxygen, even at low concentrations, to form unstable and reactive peroxy compounds. The risk associated with peroxide formation increases if the peroxide precipitates or crystallizes, or becomes concentrated by evaporation or distillation. Factors which affect rate of peroxide formation include exposure to air, light, heat, moisture, and contamination from metals.

12.5.1.2 Avoid the prolonged storage of all peroxide-forming chemicals. It is extremely important to follow procedures to properly identify, handle, store, and dispose of peroxide-forming chemicals. Appendix Twelve in this CHP lists various classes of compounds known to auto-oxidize to form peroxides and classes of chemicals that can form peroxides upon aging. These lists are categorized by the rate at which the chemicals must be tested to maximize safety.

12.5.1.3 Many compounds, including isopropyl ether, ethyl ether, dioxane, tetrahydrofuran, and other alkyl ethers can go under auto-oxidation to form peroxides on exposure to air and light. Because these chemicals are often packaged in an air atmosphere, peroxides can form even though the containers have not been opened. The longer the storage period of these chemicals, the greater the probability an appreciable concentration of dangerous peroxides to form. Especially dangerous are ether bottles that have evaporated to dryness. Peroxide-forming chemicals contain a reactive hydrogen atom that is "activated" by adjacent structural components. Reactive hydrogen atoms are most found on the following compounds:

1. Ethers and acetals with α-hydrogen, especially cyclic ethers and those containing primary and secondary alkyl groups
2. Compounds containing benzylic hydrogens
3. Compounds containing allylic hydrogens, including most alkene, vinyl and vinylidene compounds, and dienes.

12.5.1.4 Generally, the presence of two or more of these structural features increases the risk of peroxidation. Within a particular class of peroxidizable chemicals, the peroxidation potential decreases with increasing molecular weight of the compound. Compounds with ten or more atoms at a peroxidizable site are normally not considered peroxidation hazards. Additionally, increased volatility of the parent chemicals increases the likelihood that dangerous levels of peroxides will form, since evaporation leads to concentration of the peroxide product. Volatility refers to the tendency of a substance to evaporate.

12.5.2 Hazards

12.5.2.1 Use of peroxidizable solvents in distillation or chemical synthesis procedures, which involve heating and concentrating contaminating peroxides present the highest risk of explosion; whereas solvent extraction procedures generally present a low risk.

12.5.2.2 When peroxides form, these chemical derivatives are highly unstable and explosive and may detonate if subjected to high temperature, shock, or friction. Concentration by evaporation or distillation of the peroxide-forming compound increases the risk of detonation.

12.5.3.2 Precautions

1. Ethers containing an inhibitor should be purchased when possible
2. Ethers should be kept in cans rather than glass bottles
3. Ethers should be stored in as cool of a location as feasible (but not stored in refrigerators unless explosion proof)
4. Ethers should always be tested for peroxide content before any distillation procedure and, of course, should not be used if peroxides are found to be present
5. Safety shields should be placed in front of reaction vessels or distillation apparatus in hoods when they involve ethers
6. At least 10% remaining material in distillation should remain, do not distill to dryness due to the dangers of concentrating auto-peroxidation derivatives
7. Containers of ether must indicate the date of purchase, written on the outside surface. The container shall be labeled when received and when it is opened by the user
8. Any container of uncertain age or condition must not be opened, particularly when the cap or stopper is tightly stuck
9. Suspected containers for auto-peroxidation must not be moved or disposed of without EHS assistance due to the potential for an explosion hazard.

12.6 Solvents

12.6.1 Many laboratories at SUNY Geneseo use organic solvents. This section provides some general guidelines and background information on these materials. Examples of solvents used at SUNY Geneseo include reagent alcohol, isopropyl alcohol, methanol, acetone, benzene, toluene, dichloromethane, chloroform, and in rare circumstances, carbon tetrachloride. Some of these solvents are flammable and most of them cause narcosis upon prolonged inhalation and defatting of the skin upon prolonged or repeated contact.

12.6.2 Flammable and Combustible Solvents

12.6.2.1 Classifications

Flammable and combustible liquids (many are solvents) are defined and divided into classes as shown below.

1. Flammable Liquids (Class I). Liquids having flash points below 100°F (37.8°C) and having vapor pressures not exceeding 40 psi (absolute) at 100°F (37.8°C). Flammable Class I liquids are subdivided as follows:
2. Class IA. Liquids having flash points below 73°F (22.8°C) and boiling points below 100°F (37.8°C). Flammable aerosols (spray cans) are included in Class IA.
3. Class IB. Liquids having flash points below 73°F (22.8°C) and having boiling points at or above 100°F (37.8°C).
4. Class IC. Liquids having flash points at or above 73°F (37.8°C) and below 100°F (37.8°C).
5. Combustible Liquids: Any liquid having a Flash Point at or above 100°F (37.8°C).

12.6.2.2 Properties

12.6.2.2.1 Flammable and combustible liquids (including oils, greases, tars, oil base paints, lacquers) and flammable gases as well as flammable aerosols (spray cans) will be detailed further.

12.6.2.2.2 Water should not be applied to flammable and combustible liquids. The use of water may float burning liquids, causing the fire to spread more rapidly. Flammable and combustible fires are usually extinguished by excluding the air around the burning liquid. This is accomplished by one of several approved types of fire extinguishing agents, e.g., carbon dioxide, ABC multipurpose dry chemical, Purple K and Halon 1301 (a vaporizing liquid that breaks the flame front).

12.6.2.2.3 Technically, flammable and combustible liquids do not burn. However, under appropriate conditions, they generate sufficient quantities of vapors to form ignitable vapor-air mixtures. As a general rule, the lower the flash point of a liquid, the greater the fire and explosion hazard. (The flash point of a liquid is the minimum temperature at which it gives off sufficient vapor to form an ignitable mixture with the air near its surface or within its containment vessel). Many flammable and combustible liquids also pose health hazards.

12.6.2.2.4 It is the responsibility of the user to ensure that all flammable and combustible liquids are properly identified, labeled, handled, and stored. If assistance is required, contact EHS.

12.6.2.3 Fire Hazards

12.6.2.3.1 Fires involving flammable and combustible liquids are especially dangerous because they are extremely exothermic, causing the fire to spread rapidly. The handling and use of these combustibles presents a significant source of fire hazard. Misuse or improper storage threatens not only the researcher and the experiment, but also the laboratory unit and the entire building.

12.6.2.3.2 Liquids with flash points below room temperature (Class IA and IB liquids) continually emit sufficient quantities of vapors to be ignitable, except when chilled to temperatures below their flash points. Even when chilled, if spilled on a floor or work surface, they will heat rapidly and may pose severe fire and explosion hazards. Liquids with flash points above room temperature (Class IC, II, IIIA, and IIIB liquids) can easily be heated to the point at which they will create flammable vapor-air mixtures.

12.6.2.3.3 Flammable liquid vapors are heavier than air. They can travel for appreciable distances and accumulate in low places. Since it is the vapor of a flammable liquid that burns, the fire hazard may not be confined to the immediate vicinity of actual use. Vapors can be ignited several hundred feet from the point of vapor generation. Flammable liquid vapors generally have low ignition-energy requirements and can often be ignited by small sparks from electrical motors, switches, relay contacts, etc.

12.4.2.4 Precautions

12.6.2.4.1 Recommended precautions are based on the properties of the liquid to be used and the intended application. The user cannot make a correct decision on necessary precautions unless the properties of the liquid are known and the intended use is reviewed form a safety standpoint.

12.6.2.4.2 There must be sufficient ventilation to preclude the accumulation of flammable vapors. Flammable liquids should be used in a fume hood or with local exhaust ventilation. Normal room ventilation may be sufficient to permit small-scale use of flammable liquids (milliliter quantities). However, if larger quantities of liquid must be used in such facilities, it will be necessary to ensure additional ventilation by opening doors and windows or providing some form of temporary exhaust ventilation. Extreme care must be exercised when using flammable liquids in closed spaces with minimal ventilation (such as glove boxes and tanks). Even milliliter quantities of flammable liquids can cause the build-up of explosive mixtures in the confined space.

12.6.2.5 Refrigerators and Freezers

12.6.5.5.1 Ordinary domestic refrigerators or freezers must not be used for the storage of flammable liquids because they contain certain built-in ignition sources (such as electrical contacts). These sources of ignition may initiate a fire or an explosion if flammable vapors are present. Explosion-proof and flammable material refrigerators and freezers specifically designed and approved for storage of flammable chemicals are now available commercially. Explosion-proof and flammable material refrigerators must not be plugged into a wall outlet directly using a three-prong plug due to the risk of an ignition source. The electrical source for an explosion-proof unit must be on its own circuit. The unit must also be serviced and inspected by a qualified college electrical technician for the installation of and before using the unit.

12.6.2.5.2 Laboratory and laboratory storeroom non-explosion-proof chemical storage refrigerators and freezers must bear a clearly displayed label, which minimally must read as below:

CAUTION
REFRIGERATOR FOR CHEMICAL STORAGE ONLY. NO FLAMMABLES STORAGE. NO FOOD OR DRINK.

12.6.2.5.3 Laboratory and laboratory storeroom explosion-proof chemical storage refrigerators and freezers must bear a clearly displayed label, which minimally must read as below:

CAUTION
REFRIGERATOR FOR CHEMICAL STORAGE ONLY. NO FOOD OR DRINK.

12.6.2.6 Safety Cans

A safety can is a closed container of not more than 5 gallons capacity, which includes a flash arresting screen, spring closing lid and spout cover[26]. Safety cans are designed to safely relieve internal pressure of the liquid contents when subjected to fire exposure

12.6.2.7 Storage Cabinets

Storage cabinets must be designed and approved for the anticipated usage. Flammables storage cabinet specifications are defined by NFPA 30, Flammable and Combustible Liquids Code. While cabinets can be constructed using NFPA 30 rules in mind, commercially available cabinets are recommended as an easier means of obtaining the protection. Approved and listed cabinets are produced by many different companies, and Factory Mutual approved metal storage cabinets are available in various sizes from vendors. It is important to keep in mind the following key points so as not to defeat the purpose of flammables cabinets.

1. Doors on cabinets should be kept closed and latched. Automatic closing doors should be checked regularly for complete closing upon release
2. Liquid storage containers should be stored in the cabinet when not in active use
3. Vents on cabinets are not required, but they are often provided.

[26] 29 CFR 1926.155(1)

A. If vents are provided and not used, the vent openings must be sealed with the stoppers supplied with the cabinet or with stoppers supplied by the manufacturer of the cabinet.

B. If the cabinet is vented, flame arrestors should be provided on the openings. Additionally, the vents should be extended to a safe location, generally outside the building.

4. Each cabinet must be conspicuously labeled “Flammable - Keep Fire Away.”

12.6.2.8 Allowable Quantities

12.6.2.8.1 To adequately manage the exposure hazards in each building, or fire-separation area in each building, it is necessary to consider the needs of all users, and/or of user groups in aggregate, for each building or fire-separation area. The restrictions set forth below provide guidance for lower usage levels of organic solvents. In general, quantities in excess of one week of usage should not be stored in open and unprotected spaces outside of a proper flammables cabinet. If the need for larger quantities is anticipated, contact EHS for assistance.

12.6.2.8.2 The maximum allowable quantities of flammable and combustible liquids outside designated and approved storage rooms or facilities are listed below:

1. Less than one gallon (3.8 liters) of Class I and Class II liquids combined, in glass or plastic containers, is the maximum allowed outside of approved storage cabinets when not actually in use
2. One gallon (3.8 Liters) is the maximum allowable container size for general dispensing of Class I and Class II liquids unless in an approved safety can
3. Where more than one laboratory unit is located in a single fire-separation area, all Class I and Class II liquids must be stored in approved storage cabinets or approved safety cans. Ten gallons of Class I and Class II liquids, combined, in approved safety can, is the maximum allowable outside of approved storage cabinets. Five gallons (19.0 Liters) of Class IIIA liquids is the maximum allowable outside of approved storage cabinets or safety cans
4. For single fire-separation areas, 10 gallons (38 Liters) of Class I and Class II liquids, combined, is the maximum quantity allowable outside of approved storage cabinets or approved safety cans
5. For single fire-separation areas, 25 gallons (95 Liters) of Class I and Class II liquids, combined, is the maximum allowable quantity outside of approved storage cabinets
6. For single fire-separation areas, 60 gallons (228 Liters) of Class IIIA liquids is the maximum allowable outside of approved storage cabinets

12.6.3 Chlorinated Hydrocarbons

12.6.3.1 Scope

The chlorinated hydrocarbons as a whole have many industrial as well as laboratory uses. Examples are chloroform, dichloroethane, and carbon tetrachloride.

12.6.3.2 Hazards

12.6.3.2.1 Most of these compounds have an anesthetic (narcotic) effect, causing workers to feel intoxicated, become unconscious, or even die if the amount of inhaled vapor is excessive e.g. in a confined space. Individuals working around moving machinery can be subject to accidents when their judgment and coordination are impaired by the anesthetic effects of inhaled solvents. Usually, it is the anesthetic effect that is responsible for sudden unconsciousness of persons exposed to solvents in tanks, pits, and other confined spaces.

12.6.2.3.2 Some, but not all, of the chlorinated hydrocarbons are strong poisons that damage the liver, kidneys, nervous system, and/or other parts of the body. This damage due to acute or chronic exposure may be permanent or even cause death, although recovery from lesser exposures does occur. Single exposures to higher concentrations of vapors, as well as repeated exposure to small concentrations can produce symptoms of poisoning. These symptoms most often come on gradually, with nausea, loss of appetite, vomiting, headaches, weakness, and mental confusion most often noted. Carbon tetrachloride is an example of a compound that is a strong poison.

12.6.2.3.3 All chlorinated hydrocarbons, on repeated contact with the skin, can cause rashes (dermatitis) because of their ability to remove the protective fats and oils from the skin. A few of these solvents readily permeate protective gloves and are known to be capable of entering the body through contact with the skin. In addition, many of these compounds are highly irritating to the membranes around the eyes and in the nose, throat, and lungs. An example of a chlorinated hydrocarbon that has irritant properties is chloroform.

12.6.2.3.4 Some compounds are suspected human carcinogens, such as carbon tetrachloride and chloroform. In studies on laboratory animals, several chlorinated hydrocarbons have been linked to the onset of the production of cancerous cells. Examples of these types of compounds are ethylene dichloride, perchloroethylene, and trichloroethylene. At present, there is no direct evidence associating these compounds with an increased risk of cancer in humans.

12.6.2.3.5 When heated, these compounds can decompose, forming highly toxic vapors of phosgene, hydrochloric acid, and chlorine. Most of the chlorinated hydrocarbons are nonflammable; however, there are exceptions. Table 11-1 lists important characteristics of some of the common chlorinated hydrocarbon solvents. Because of their inherent properties, these compounds are harmful to varying degrees. For questions concerning the hazards of a specific compound, contact EHS.

Table 12-1 Chlorinated Hydrocarbon Data

Common name	Chemical name	TLV (ppm)[a]	Volatility[b] (mm Hg)	Flammability
Acetylene dichloride	1,2-dichloroethylene	200	200	Moderate
Carbon tetrachloride	Tetrachloromethane	5	115	Nonflammable
Chloroform	Trichloromethane	10	200	Nonflammable
Ethylene dichloride	1,2-dichloroethane	10	80	Moderate
Methyl chloroform	1,1,1-trichloroethane	350	132	Nonflammable
Methylene chloride	Dichloromethane	100	435	Nonflammable
Perchloroethylene	Tetrachloroethylene	50	18	Nonflammable
Tetrachloroethane	1,1,2,1-tetrachloroethane	1	8	Nonflammable
Trichloroethane	1,1,2-trichloroethane	10	25	Nonflammable
Trichloroethylene	Trichloroethylene	50	76	Nonflammable

[a] The threshold limit value (TLV)[27] is expressed as parts of pure solvent vapors per million parts (ppm) of air.

[b] The vapor pressure at 77°F (25°C).

[27] OSHA Chemical Sampling Information: https://www.osha.gov/dts/chemicalsampling/toc/toc_chemsamp.html

12.6.3.3 Precautions

12.6.3.3.1 The above table includes information on the TLV[28], the volatility, and the flammability of the compounds listed. These three characteristics always must be taken into careful consideration in selecting a compound in order to minimize the health hazards connected with its use. If there is a possibility of skin or eye contact, wear the appropriate protection equipment. Gloves made of impervious material should be worn for hand protection.

12.6.3.3.2 For high vapor concentrations, control by local exhaust ventilation or chemical fume hoods is necessary. Contact EHS for an assessment of the airborne concentration. Chlorinated hydrocarbons should be stored in cool, dry, and well-ventilated areas. Containers should be checked for leaks because metal corrosion can occur from hydrochloric acid produced by the decomposition of the solvent. Decomposition may occur under conditions of high temperature, exposure to moisture, and exposure to ultraviolet light.

12.6.3.3.3 Compounds, both in the original containers and in containers used by faculty or staff, must be labeled so that the potentially injurious substances are plainly identified.

12.7 Ionizing Radiation

12.7.1 Ionizing radiation is electromagnetic radiation (x-ray or gamma-ray photons) or particulate radiation (alpha particles, beta particles, electrons, and neutrons) capable of producing ions either primarily or secondarily when passing through matter. The handling of ionizing radiation sources and use of machines must be performed in strict compliance with NYS state-mandated procedures to ensure employee and environmental protection.

12.7.2 The sources of ionizing radiation at SUNY Geneseo are outlined on the college’s radiologic license, which is available through the designated Radiation Safety Officer and EHS.

12.8 Electrical Safety Hazards

12.8.1 Electrical safety hazards are common in the laboratory environment. All laboratory personnel must be familiar with electrical hazard precautions even if they do not presently work directly with electrified materials. Electrical safety actions are easily overlooked and may result in serious injury or death without necessary protection and good practices.

12.8.2 Make sure electrical systems are properly guarded, posted, and grounded. Electrical safety can usually best be ensured by "designing-in" appropriate protections as a procedure or protocol is first proposed. The most hazardous electrical situation comes from the risk of direct contact with exposed electrical circuitry. Trouble shooting, maintenance, and test activities often accentuate electrical risk. Follow Safe Work Practices (see Section 5.2) when performing these tasks.

12.8.3 Label all high voltage sources appropriately. Do not leave electrical circuitry un-insulated, exposed, and/or unattended. Prior to performing maintenance or other work on equipment, any moving parts or energy source, such as electrical, thermal, or gravitational must be locked out and tagged out. Lock Out/Tag Out is a safety procedure to ensure dangerous machines are properly shut off and not able to be started up again prior to the completion of maintenance or servicing work. See the SUNY Geneseo EHS website for more information: http://www.geneseo.edu/ehs/lockout_tagout

[28] Threshold Limit Value (TLV) is discussed further in Section 7.1

Section Thirteen

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Appendix One

SUNY GENESEO Accident Report form

https://www.geneseo.edu/sites/default/files/sites/hr/Accident%20Report%20Form.pdf

GENESEO
ACCIDENT REPORT FORM
(OTHER THAN MOTOR VEHICLE ACCIDENTS)

Part 1: General Information to be completed by or on behalf of the injured/ill party:

NYS ARS Incident # (call 1-888-800-0029): ______________________________

Name of Injured/Ill Party: ______________________________

Date of Birth: ____/____/______ Date of hire: ____/____/______ Gender: ☐Female ☐Male

Home Address: ______________________________

Home phone: ________________ Cell phone: ________________ Work phone: ________________

What is the injured/ill party's status: ☐Faculty/Staff ☐Student Employee ☐Student ☐Visitor

☐Vendor ☐Other (specify) ________________________

Job title: ______________________________ Bargaining unit: ______________________________

Campus work location: ________________________ Office/Department Name: ________________________

Normal work hours: ______________ Time shift began: ______________ Pass days: ______________

Employee remained on duty after accident/injury? ☐Yes ☐No

Date of first full day of absence: __________________ Has employee returned to work? ☐Yes ☐No

If yes, date: __________________________ Does the employee have restricted duties? ☐Yes ☐No

Reporter of Accident: ☐Injured/Ill Party ☐Faculty/Staff ☐Other (specify) ____________________

Part 2: Accident Information to be completed by or on behalf of injured/ill party:

Date of report: ____/____/____ Date of accident: ____/____/____ Time of accident: ____________

Location of occurrence: ______________________________

Was the accident: ☐Job related ☐Academic ☐Other ______________________________

Was the injured/ill party in an area they were authorized to be in? ☐Yes ☐No ☐Unknown

GENESEO

GENESEO

ACCIDENT REPORT FORM

(OTHER THAN MOTOR VEHICLE ACCIDENTS)

Describe the injury or illness. Include a description of the exact body part(s) and location(s) affected, i.e. right, left, upper, middle, lower:

____

____

____

____

What was the employee doing just before the incident occurred? Describe the activity, as well as any tools, equipment (including personal protective equipment), or material(s) the employee was using. Be specific (attach additional pages if necessary): ____________________________

____

____

____

____

What happened? How did the accident or exposure occur? (attach additional pages if necessary):

____

____

____

____

____

What object or substance directly harmed the individual? *Examples: concrete floor, radial arm saw, chlorine.* In case of strains - identify the object that caused strain. *Examples: lifting, pulling, etc.*

____

____

____

____

Did the injured/ill party require medical attention? ☐Yes ☐No If yes, when: ____________

Was medical assistance rendered? ☐Yes ☐No If yes, by whom?

☐First aid by staff ☐Lauderdale Health Center staff ☐Hospital

☐GFR ☐Other __________ ☐Ambulance: ____________________

Name & address of hospital (if applicable):

____

Name & address of attending physician (if applicable):

____

Appendix Two

Chemical Storage/Incompatible Reactions

Chemical Storage Classes

Storage of reactive chemicals by class (rather than alphabetically) ensures that individual chemicals receive the proper storage measures warranted by their reactivity. There are many different appropriate chemical class storage group philosophies and methods used across academic, research and industrial laboratories; and it's important to select and implement a method that works for: 1) the number and character of chemicals used and stored in a laboratory, 2) the physical storage space and cabinetry options possible, and 3) maximizing the safety and security of all occupants. For additional information, contact EHS.

Incompatibilities between classes can be anticipated and protected against. Alphabetizing within a group, once a storage group method which identifies and segregates storage hazards is acceptable. An added benefit to selecting and implementing a type of storage is that knowledge of a chemical's reactivity is respected inside the laboratory or storeroom. Once a chemical's reactive class is recognized, carry-over of this information to everyday laboratory exposure increases safety awareness.

Acids

Segregate acids from active metals such as sodium, potassium, magnesium, etc.

Segregate oxidizing acids from organic acids, flammable and combustible materials.

Segregate acids from chemicals which could generate toxic or flammable gases upon contact, such as sodium cyanide, iron sulfide, calcium carbide, etc. Segregate acids from bases.

Examples: Nitric acid, Sulfuric acid, Hydrofluoric acid

Bases

Segregate bases from acids, metals, explosives, organic peroxides and easily ignitable materials. Segregate strong bases (e.g., Sodium hydroxide) from chlorinated hydrocarbons (e.g. Freon).

Examples: Ammonium hydroxide, Sodium hydroxide,

Flammables

Store in approved safety cans or cabinets.

Segregate from oxidizing acids and oxidizers.

Keep away from any source of ignition: heat, sparks, or open flames.

Examples: Acetone, Diethyl ether, Toluene

Oxidizers

Store in a cool, dry place.

Keep away from combustible and flammable materials.

Keep away from reducing agents such as Zinc, alkali metals, and Formic acid.

Examples: Bromine, Chromic acid, Hydrogen peroxide, Sodium chlorite

Water Reactive Chemicals

Store in a cool, dry place away from any water source.

Examples: Sulfuric Acid, Benzoyl peroxide, Sodium metal (elemental)

Light Sensitive Chemicals

Store in amber bottles in a cool, dry, dark place.

Examples: Ammonium dichromate, Hydrogen peroxide, Silver nitrate

Peroxidizable Chemicals

Store in airtight containers in a dark, cool, and dry place.

Label containers with receiving, opening, and disposal dates.

Test for the presence of peroxides every 6 months or as indicated by the manufacturer.

Examples: Diethyl Ether, Tetrahydrofuran, Isopropyl ether

Acutely Toxic Chemicals – (p-Listed Chemicals)

Store according to the nature of the chemical, using appropriate security where necessary.

Examples: Arsenic compounds, Cyanide salts, Methylhydrazine, Nitroglycerin

Explosives or Other Highly Unstable Materials

Store separately from all other materials according to the nature of the chemical, using appropriate security where necessary.

Store in a cool, dry place. Keep away from any high energy sources, including heat, sparks, open flames, and physical shock hazards.

Label containers with receiving, opening, and disposal dates.

Contact EHS prior to purchasing and storage on campus.

Examples: Benzoyl Peroxide, Dinitrophenol, Nitroglycerin, Picric acid (>90% dry)

Avoiding Laboratory Accidents Resulting From Chemical Incompatibilities[29]

1. Know the properties of the chemicals used

   The chemical classes discussed previously and the chemical incompatibilities discussed on the following pages are by no means exhaustive. As result, it is crucial for laboratory personnel to thoroughly research the properties of the chemicals they are using. Safety Data Sheets (SDSs) all have sections on chemical incompatibility. SDS should serve as a primary resource for information on avoiding contact with incompatible compounds. A more detailed reference is the *Handbook of Reactive Chemical Hazards*[30].

2. Avoid mixing incompatible waste materials

   A number of serious laboratory accidents, including incidences which resulted in a death have occurred at the University of Washington in the 1970's, the University of California at Los Angeles (UCLA) in 2008, and the Texas Tech University in 2010, when incompatible waste materials were co-mingled in hazardous waste containers. Waste may only be co-mingled at SUNY Geneseo if waste meets both of the following: 1) The total volume in a container must be under one gallon and 2) the waste stream constituents are considered compatible when co-mingled. Otherwise, segregate waste streams by hazard class as thoroughly as possible, but at least minimally as described above in Chemical Storage Classes.

[29] "Safety in Academic Chemistry Laboratories", American Chemical Society. 2014

[30] Bretherick's Handbook of Reactive Chemical Hazards, seventh edition, P. G. Urben (Ed.). 2007

3. Store incompatible chemicals separately

A common problem in college laboratories which could lead to mixing of incompatible chemicals is long-term chemical laboratory and storeroom storage. The most serious concerns includes the storage of acids (especially oxidizing acids) with flammable solvents. Contact of a concentrated oxidizing acid with a flammable solvent would likely result in a fire or an explosion (for example, mixing concentrated nitric acid with acetone or storing concentrated nitric acid with concentrated (glacial) acetic acid). This is not an unlikely scenario in the event of an earthquake.

Storage of chemicals in simple alphabetical order on shelves often results in incompatible chemicals being stored together. For example, alphabetical arrangement could result in hydrogen peroxide (a strong oxidizer) being stored next to hydrazine (a very strong reducer). Prevention of run-away reactions from recurring in the event of container failure is crucial to personnel and facility safety. Store chemicals in an identified hazard class storage group, utilizing both secondary containment and physical separation of chemicals according to differential hazard classes as best as is prudent. Physically separating chemicals through the use of multiple chemical storage cabinets create an added layer of protection to prevent unintended mixing of chemicals and/or vapors in the event of container failure.

Table A2-1 Examples of Incompatible Chemicals[31]

Chemical	Is Incompatible With
Acetic Acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetone	Concentrated nitric and sulfuric acid
Alkali and alkaline earth metals (such as powdered aluminum or magnesium, calcium, lithium, sodium, potassium)	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens
Carbon tetrachloride	Sodium
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Hydrocarbons (such as butane, propane, benzene)	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
Hydrofluoric acid (anhydrous)	Ammonia (aqueous or anhydrous)
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, combustible materials
Nitrates	Sulfuric acid
Nitric acid (concentrated)	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, copper, brass, any heavy metals
Oxygen	Oils, grease, hydrogen, flammable liquids, solids or gases
Sulfuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate (similar compounds of group 1a metals, such as sodium, lithium)

[31] "Safe Chemical Storage: A Pound of Prevention is Worth a Ton of Trouble" by David Pipitone and Donald Hedberg, Journal of Chemical Education, Volume 59, Number 5, May 1982 and "Fire Protection Guide on Hazardous Materials," NFPA, 1978.

Appendix Three

Glove Selection/Use Matrix, Guidelines for PPE

The Right Glove for the Job

The first step in choosing the right glove is determining the primary concern. Does the user need protection from hazardous chemicals? Is dexterity crucial to the work engaged? Is product protection of utmost importance?

Different glove materials offer different kinds of protection. Neoprene provides chemical/oil resistance while Nitrile adds abrasion resistance to that protection. Vinyl gives economical flexibility as a natural rubber alternative. Natural rubber latex offers inherent elasticity and resiliency, plus the dexterity needed in food processing or pharmaceutical manufacturing.

Because a material's suitability may be affected by either degradation or permeation, both of these factors must be considered when selecting appropriate gloves. Degradation is the reduction in one or more of the physical properties of a material due to chemical contact. Exposed gloves may swell, get harder or softer, stiffen or weaken, or become brittle. Permeation is the passage of a chemical through the material even if the material is not susceptible to chemical degradation. Permeation can occur even if there is no visible damage to the gloves being worn. Since there is usually no indication that a glove has been permeated, the person wearing gloves to handle hazardous chemicals can get a false sense of security.

The selection of appropriate gloves and other pieces of Personal Protective Equipment (PPE) is generally done after consulting one or more chemical degradation guides, and more detailed information can be found at ANSI/ISEA 105-2011. This CHP appendix specifically focuses on three guides:

Guide #1the physical properties of several materials.
Guide #2the degradation properties of several materials.
Guide #3the permeation properties of several materials.

The following definitions refer to various glove-related terms used in the guides:

Natural Rubber: A material (also called latex) which is inherently elastic and resilient, and resistant to acids, alkalies, salts and ketones. Natural rubber gloves are suited for food processing, electronics assembly, and laboratory chemical handling (although it is not suitable for some corrosive or organic solvents – please refer to the glove chart in this Appendix chapter and/or the manufacturer for additional information or limitations.)

Neoprene: A synthetic rubber developed as an oil-resistant substitute for natural rubber. It also resists a broad range of chemicals. Neoprene gloves are used in petrochemical, degreasing and refining applications, and when handling acids, caustics, alcohols, and solvents.

Nitrile: A synthetic rubber with superior puncture and abrasion resistance in addition to chemical protection. Nitrile gloves are suited for stripping and degreasing, as well as acid etching, and chemical washing. Nitrile gloves offer better protection against some organic solvents than Latex, however please refer to the glove chart in this Appendix chapter and/or the manufacturer for additional information or limitations.

PVC: Also known as polyvinyl chloride or vinyl, PVC is a plastic material that resists acids and alcohols, but not petroleum products. Vinyl gloves are used for intricate assembly work, food processing, laboratory, research, and pharmaceutical venues.

Viton: A specially fluoroelastomer which has excellent resistance to oils, fuels, lubricants, most mineral acids, hydraulic fluids, and aliphatic and aromatic hydrocarbons.

CPE: This chlorinated polyethylene has increased resistance to oil, ozone, heat, and chemicals. It also provides low permeability to gases.

Supported: A supported glove has a fabric liner that is coated with a polymer. The liner is generally knit, and can be palm-coated or fully coated. Supported gloves deliver more durable hand protection.

Unsupported: Refers to gloves produced by dipping a glove form directly into a compound, yielding a glove that is 100% compound. Unsupported gloves offer better tactile sensitivity and dexterity.

Powdered: Refers to a thin coating of (what is most commonly) cornstarch which may be placed inside the glove to make donning and removal from the hand easier.

Further information may be found in the Chemical Resistance Guide published by Ansell. This information is summarized below:

Table A3-1 Glove Chart

Type	Advantages	Disadvantages	Use Against
Natural rubber	Low cost, good physical properties, dexterity	Poor vs. oils, greases, organics. Frequently imported; may be poor quality	Bases, alcohols, dilute water solutions; fair for aldehydes, ketones
Natural rubber blends	Low cost, dexterity, better chemical resistance than natural rubber vs. some chemicals	Physical properties frequently inferior to natural rubber	Same as natural rubber
Polyvinyl chloride (PVC)	Low to medium cost, very good physical properties, medium chemical resistance	Plasticizers can be stripped; frequently imported; may be poor quality	Strong acids and bases, salts, other water solutions, alcohols
Neoprene	Medium cost, medium chemical resistance, medium physical properties	Often thicker than Latex or Nitrile and may be perceived by some to reduce dexterity	Oxidizing acids, anilines, phenol, glycol ethers

Type	Advantages	Disadvantages	Use Against
Nitrile	Low cost, excellent physical properties, dexterity	Poor for benzene, methylene chloride, trichloroethylene, many ketones	Oils, greases, aliphatic chemicals, xylene, perchloroethylene, trichloroethane; fair for toluene
Butyl	Specialty glove, polar organics	Expensive, poor for hydrocarbons, chlorinated solvents	Glycol ethers, ketones, esters
Polyvinyl alcohol (PVA)	Specialty glove, resists broad range of organics, good physical properties	Very expensive, water sensitive, poor for low molecular weight alcohols	Aliphatics, aromatics, chlorinated solvents, ketones (except acetone), esters, ethers
Type	**Advantages**	**Disadvantages**	**Use Against**
Fluoro- elastomer (Viton*) ™	Specialty glove, organic solvents	Extremely expensive, poor physical properties, poor vs. some ketones, esters, amines	Aromatics, chlorinated solvents, also aliphatics and alcohols
Norfoil (Silver Shield)	Excellent chemical resistance	Poor fit, easily punctures, poor grip, stiff	Use for Hazmat work

*Trademark of DuPont Dow Elastomers

Table A3-2 Glove Type and Chemical Resistance[32]

	VG= Very Good	G= Good	F=Fair	P=Poor (not recommended)
Chemical	**Neoprene**	**Natural Latex or Rubber**	**Butyl**	**Nitrile**
*Acetaldehyde	VG	G	VG	G
Acetic acid	VG	VG	VG	VG
*Acetone	G	VG	VG	P
Ammonium hydroxide	VG	VG	VG	VG
*Amyl acetate	F	P	F	P

[32] Chemical Resistance Guide: http://www.ansellpro.com/download/Ansell_7thEditionChemicalResistanceGuide.pdf

	VG= Very Good	G= Good	F=Fair	P=Poor (not recommended)
Chemical	**Neoprene**	**Natural Latex or Rubber**	**Butyl**	**Nitrile**
Aniline	G	F	F	P
*Benzaldehyde	F	F	G	G
*Benzene	F	F	F	P
Butyl acetate	G	F	F	P
Butyl alcohol	VG	VG	VG	VG
Carbon disulfide	F	F	F	F
*Carbon tetrachloride	F	P	P	G
Castor oil	F	P	F	VG
*Chlorobenzene	F	P	F	P
*Chloroform	G	P	P	P
Chloronaphthalene	F	P	F	F
Chromic Acid (50%)	F	P	F	F
Citric acid (10%)	VG	VG	VG	VG
Cyclohexanol	G	F	G	VG
*Dibutyl phthalate	G	P	G	G
Diesel fuel	G	P	P	VG
Diisobutyl ketone	P	F	G	P
Dimethylformamide	F	F	G	G
Dioctyl phthalate	G	P	F	VG
Dioxane	VG	G	G	G
Epoxy resins, dry	VG	VG	VG	VG
*Ethyl acetate	G	F	G	F
Ethyl alcohol	VG	VG	VG	VG
Ethyl ether	VG	G	VG	G

	VG= Very Good	G= Good	F=Fair	P=Poor (not recommended)
Chemical	**Neoprene**	**Natural Latex or Rubber**	**Butyl**	**Nitrile**
*Ethylene dichloride	F	P	F	P
Ethylene glycol	VG	VG	VG	VG
Formaldehyde	VG	VG	VG	VG
Formic acid	VG	VG	VG	VG
Freon 11	G	P	F	G
Freon 12	G	P	F	G
Freon 21	G	P	F	G
Freon 22	G	P	F	G
*Furfural	G	G	G	G
Gasoline, leaded	G	P	F	VG
Gasoline, unleaded	G	P	F	VG
Glycerine	VG	VG	VG	VG
Hexane	F	P	P	G
Hydrochloric acid	VG	G	G	G
Hydrofluoric acid (48%)	VG	G	G	G
Hydrogen peroxide (30%)	G	G	G	G
Hydroquinone	G	G	G	F
Isooctane	F	P	P	VG
Isopropyl alcohol	VG	VG	VG	VG
Kerosene	VG	F	F	VG
Ketones	G	VG	VG	P
Lacquer thinners	G	F	F	P
Lactic acid (85%)	VG	VG	VG	VG

	VG= Very Good	G= Good	F=Fair	P=Poor (not recommended)
Chemical	**Neoprene**	**Natural Latex or Rubber**	**Butyl**	**Nitrile**
Lauric acid (36%)	VG	F	VG	VG
Lineoleic acid	VG	P	F	G
Linseed oil	VG	P	F	VG
Maleic acid	VG	VG	VG	VG
Methyl alcohol	VG	VG	VG	VG
Methylamine	F	F	G	G
Methyl bromide	G	F	G	F
*Methyl chloride	P	P	P	P
*Methyl ethyl ketone	G	G	VG	P
*Methyl isobutyl ketone	F	F	VG	P
Methyl methacrylate	G	G	VG	F
Monoethanolamine	VG	G	VG	VG
Morpholine	VG	VG	VG	G
Naphthalene	G	F	F	G
Naphthas, aliphatic	VG	F	F	VG
Naphthas, aromatic	G	P	P	G
*Nitric acid	G	F	F	F
Nitromethane (95.5%)	F	P	F	F
Nitropropane (95.5%)	F	P	F	F
Octyl alcohol	VG	VG	VG	VG
Oleic acid	VG	F	G	VG
Oxalic acid	VG	VG	VG	VG

	VG= Very Good	G= Good	F=Fair	P=Poor (not recommended)
Chemical	**Neoprene**	**Natural Latex or Rubber**	**Butyl**	**Nitrile**
Palmitic acid	VG	VG	VG	VG
Perchloric acid (60%)	VG	F	G	G
Perchloroethylene	F	P	P	G
Petroleum distillates (naphtha)	G	P	P	VG
Phenol	VG	F	G	F
Phosphoric acid	VG	G	VG	VG
Potassium hydroxide	VG	VG	VG	VG
Propyl acetate	G	F	G	F
Propyl alcohol	VG	VG	VG	VG
Propyl alcohol (iso)	VG	VG	VG	VG
Sodium hydroxide	VG	VG	VG	VG
Stryene (100%)	P	P	P	F
Sulfuric acid	G	G	G	G
Tannic acid (65%)	VG	VG	VG	VG
Tetrahydrofuran	P	F	F	F
*Toluene	F	P	P	F
Toluene diisocyanate	F	G	G	F
*Trichloroethylene	F	F	P	G
Triethanolamine	VG	G	G	VG
Tung oil	VG	P	F	VG
Turpentine	G	F	F	VG
*Xylene	P	P	P	F

Personal Protective Equipment Program Policy

The use of Personal Protective Equipment at SUNY Geneseo Laboratories

SUNY Geneseo strives to create a safe and healthy work environment for all members of the campus community. Laboratories present special hazards to the laboratory personnel, necessitating the application of engineering controls, administrative controls, and the use of personal protective equipment to protect against workplace hazards. The use of personal protective equipment (PPE) is an integral part of minimizing hazards, but should only be considered after all other controls have been exercised.

The purpose of the PPE Program is to protect employees from risk of personal injury or death by creating a barrier against workplace hazards. The PPE program addresses eye, face, head, foot, and hand protection.

As an employer, SUNY Geneseo is responsible for performing hazard assessments and providing personal protective equipment to faculty, staff, and student employees engaged in potentially hazardous activities as per OSHA Standard 1910.132. The Environmental Health & Safety Office (EHS) implements the campus-wide PPE Program.

Faculty members are responsible for conducting hazard assessments for the materials they use in student laboratories, selecting the appropriate PPE, and training students about protecting themselves. This information should be incorporated into the individual laboratory exercises.

SUNY Geneseo's PPE Program includes:

1. A written policy and procedure on PPE distribution, use, and maintenance
2. Guidelines for performing hazard assessments and selection of PPE
3. Employee training

These documents are available from EHS.

Appendix Four

Safety Data Sheet Quick Reference Guide

Introduction to Safety Data Sheets

Material Safety Data Sheets and Safety Data Sheets are guidelines on the safe use, handling, and storage of chemicals. The Occupational Safety & Health Administration (OSHA) requires manufacturers to provide a Safety Data Sheet (SDS) with each chemical product that they distribute. Once the SDS became the hazard communication standard in 2012 to align with the Global Harmonized System of Classification and Labeling of Chemicals (GHS), MSDS became obsolete. Both SDS/MSDS identify the manufacturer of the chemical, general product information, physical characteristics of the chemical, instructions for safe handling and use of the material, fire and emergency response procedures, reaction hazards, toxicity and health data, exposure limits, and other information on the chemical or product. The SDS/MSDS specific to the product that you are working with should be carefully reviewed prior to handling that chemical.

Instructions on how to use and read SDS/MSDS can be found in this CHP in Section 7.3.

Safety Data Sheet Recordkeeping

SDS and MSDS for chemical inventory onsite must be maintained by College department laboratories at each respective location(s) of storage and use for hazardous chemicals. In the Integrated Science Center, these include each respective research and academic laboratory and/or stockroom(s) for their respective departments. Department Faculty, Principle Investigators, Laboratory Supervisors/Managers are responsible for organizing SDS, replacing old copies with the latest version, and sending a current version of each hazardous chemical used, located, or stored to the EHS Department. Accompanying any new SDS submitted to EHS should be indication of the building and room number where the chemical is stored. Laboratories must not dispose of obsolete copies of SDS/MSDS due to manufacturer revision updates to SDS or removal of the chemical from local inventory. Obsolete copies must be submitted to EHS for long-term records, as federal law requires SDS/MSDS records to be kept for 30 years from receipt.

SDS and MSDS are also available from a number of online sources, though if the SDS/MSDS cannot be found online, the manufacturer or distributer should be contacted to obtain a copy. In the event that a manufacturer does not provide a copy, a written request to the manufacturer should be sent via certified mail with a copy of the request to the local OSHA office. Additional questions should be addressed to EHS.

SDS Physical Accessibility

Emergency responders must be able to readily access SDS information for on-site chemical inventory in the event of an emergency.

If at all possible paper copies of the SDS are preferable for each chemical in inventory. At minimum, electronic copies of the SDS/MSDS must be stored locally on the hard drive (not on campus network or through online access) of a non-password protected computer located in the laboratory where chemical inventory is stored. Ensuring accurate and up-to-date submission to EHS all current and obsolete SDS/MSDS is vital to keeping a dedicated campus safety data sheet database required for current or historical review. This database can be accessed by contacting EHS at x5663.

Properties of a SDS

The GHS formatted SDS has 16 sections (source: OSHA SDS Quick Card). The OSHA-mandated SDS information is as follows[33]:

1. Section 1, Identification includes product identifier; manufacturer or distributor name, address, phone number; emergency phone number; recommended use; restrictions on use.
2. Section 2, Hazard(s) identification includes all hazards regarding the chemical; required label elements.
3. Section 3, Composition/information on ingredients includes information on chemical ingredients; trade secret claims.
4. Section 4, First-aid measures includes important symptoms/ effects, acute, delayed; required treatment.
5. Section 5, Fire-fighting measures lists suitable extinguishing techniques, equipment; chemical hazards from fire.
6. Section 6, Accidental release measures lists emergency procedures; protective equipment; proper methods of containment and cleanup.
7. Section 7, Handling and storage lists precautions for safe handling and storage, including incompatibilities.
8. Section 8, Exposure controls/personal protection lists OSHA’s Permissible Exposure Limits (PELs); Threshold Limit Values (TLVs); appropriate engineering controls; personal protective equipment (PPE).
9. Section 9, Physical and chemical properties list chemical characteristics.
10. Section 10, Stability and reactivity lists chemical stability and possibility of hazardous reactions.
11. Section 11, Toxicological information includes routes of exposure; related symptoms, acute and chronic effects; numerical measures of toxicity.
12. Section 12, Ecological information
13. Section 13, Disposal considerations
14. Section 14, Transport information
15. Section 15, Regulatory information
16. Section 16, Other information, includes the date of preparation or last revision.

[33] Note: Due to other agencies regulating this information, OSHA does not enforce Sections 12 through 15 (29 CFR 1910.1200(g)(2)).

Appendix Five

General Information Regarding Reproductive Hazards

Reproductive Hazards in the Laboratory[34]

Basic laboratory chemical hygiene practices (such as wearing protective gloves and washing hands frequently) are always important when working with hazardous materials. These practices are even more important for persons who work in laboratories while they are pregnant or are reproductively able to become pregnant. Campus laboratories typically contain a number of dangerous chemicals, some of which may harm the reproductive system or pose a hazard to a developing fetus if exposure is not adequately controlled.

Standard Precautions

Persons who are pregnant or who are able to become pregnant should adhere to the following standard exposure-control practices whenever they are working or engaging in a campus laboratory. These same precautions will help prevent chemical exposures that may affect the male reproductive system and will help prevent contaminants being brought home on clothing.

1. Prevent accidental chemical ingestion or contamination by practicing basic hygiene in the laboratory. Never apply cosmetics, consume food or drink, or make other hand-to-mouth contact in the laboratory. Always wash your hands with soap and water after handling chemicals and when leaving the laboratory.
2. Always handle volatile chemicals at least six inches behind the sash inside a properly operating chemical fume hood, with the sash drawn down between you and the material.
3. Wear appropriate personal protective equipment including a laboratory coat, closed-toe shoes, disposable impermeable gloves, and safety glasses for physical hazards (or chemical-splash resistant goggles when using chemicals). The specific protective equipment worn should be tailored to the task that is being performed. For example, face shields, rubber aprons, and heavy-duty gloves should be used for strong corrosives. For assistance in selecting the proper personal protective equipment, refer to the appropriate Safety Data Sheet / Material Safety Data Sheet, or contact EHS at x5663.
4. Review again or take a fresh look at the safety precautions detailed in the laboratory procedures, SOPs, or other safety information provided by the leading faculty member/ supervisor.
5. Students who are pregnant are strongly encouraged to fill out the Student Pregnancy Advisement Form for each laboratory course, laboratory research course, or laboratory in which the student is employed and submit the signed and completed form to the faculty/laboratory supervisor in charge of the laboratory. The Student Pregnancy

[34] While both the understanding of and terminology defining biological sex, gender identity, and gender expression continues to evolve, the legislative language used by OSHA to define and refer to reproductive toxins has not. In order to be more inclusive, terminology used by OSHA specifying ‘women’ or ‘females’ and ‘men’ or ‘males’ have been modified in this CHP to specify ‘persons or ’, unless context involves information otherwise unambiguously specific to male or female reproductive systems.

Advisement Form for acknowledgment of laboratory exposure may be found at the following Geneseo EHS webpage: https://www.geneseo.edu/ehs/forms

Special Precautions

Pregnant laboratory personnel and students should discuss both the work they perform and the hazardous materials to which they are exposed with their personal physician or medical health care professional to determine what, if any, work modifications and/or restrictions are needed. In some cases, certain chemicals may need to be substituted for other reagents or certain activities modified or discontinued for the duration of the pregnancy. Any modifications and/or restrictions recommended by a personal physician or medical health care professional should be discussed with the faculty member/laboratory supervisor immediately, and for additional reported to EHS at x5663.

Specific federal and state regulations apply to pregnant personnel's exposure to radiation. If working with radiation-producing machines or radioactive materials, the Radiation Safety Officer (x5286) can provide additional information.

Remember, it is **always** important to adhere to proper laboratory safety practices to prevent unsafe chemical exposures. For personnel who may become pregnant, adherence to proper laboratory practices and techniques are particularly important because fetal damage from chemical exposure may occur prior to realizing there is an active pregnancy.

Rights of Pregnant Persons in the Workplace

The Federal Pregnancy Discrimination Act[35] prevents SUNY Geneseo from compelling a person to disclose their pregnancy. If a person willingly informs the college of their pregnancy, then additional assessments, precautions, or other accommodations should be discussed with their faculty/laboratory supervisor.

Departments, faculty, and/or laboratory supervisors shall determine the extent to which a pregnant lab worker or lab student can be excused from lab requirements or what accommodations can be made. In all cases, a pregnant person should discuss their laboratory environment and offer specific information about potential exposures with their personal physician or medical care professional.

Additionally, pregnant lab students or personnel may:

1. Request a hazard assessment with EHS to understand potential exposures and protective measures which should be utilized
2. Request from the department an altered assignment within the lab either through a change in lab duties, a reduced time-frame within the lab, or a change in location*
3. Request a delay in entry into the academic program requiring the laboratory work* *or*
4. Continue to work in a laboratory by utilizing the standard safety precautions which have been developed for the laboratory

**Please note that requests for altered schedules might not be able to be honored.*

[35] United States Equal Opportunity Employment Commission Federal Pregnancy Discrimination Act https://www.eeoc.gov/eeoc/publications/fs-preg.cfm

Appendix Six

How to Label and Collect Waste: Waste Classification

1. A material becomes "Waste" when the individual generator determines that it is no longer useful and should be discarded. A material is "hazardous chemical waste" if it listed in the Federal Regulations (40CFR, Subpart D) or it meets the definition of one of the following:

   I. **Ignitability** - Ignitable wastes can create fires under certain conditions, are spontaneously combustible, or have flash points < 60 °C (140 °F). Examples include waste oils and used solvents.

   II. **Corrosivity** - Corrosive wastes are acids or bases (pH <4 or >10) that are capable of corroding metal containers, such as storage tanks, drums, and barrels. Battery acid is an example (solids are not included).

   III. **Reactivity** - Reactive wastes are unstable under "normal" conditions. Explosives, unstable chemicals, respond violently to air or water. Examples include lithium-sulfur batteries and explosives.

   IV. **Toxicity** - Toxic wastes are harmful or fatal when ingested or absorbed (e.g., containing mercury, lead, etc.). When toxic wastes are land disposed, contaminated liquid may leach from the waste and pollute ground water.

2. Hazardous chemicals can be treated to reduce the hazard or the quantity of waste in the laboratory if the treatment procedure is included in the experimental protocol. Refer to the supervising Faculty/PI/Laboratory Supervisor for additional information.

3. Empty compressed gas cylinders should be returned to the manufacturer or distributor whenever possible. Non-returnable cylinders should be labeled as hazardous waste and collected through EHS.

4. "Mixed Waste" (hazardous chemicals) should be collected through EHS.

5. For “Radioactive Waste”, EHS should be contacted in advance to advise proper procedure.

6. Unused uncontaminated pure chemicals may also be collected for disposal, however contact EHS first before collecting. EHS offers a “campus share” program that may be able to donate the unwanted chemical to another lab or another department.

7. Chemical substances whose identity is unknown will be picked up by EHS if submitted as hazardous chemical waste; however, this method is strongly discouraged. In such

cases, use "unknown" for the chemical description on the disposal tag. Contact EHS for more information.

8. For additional information about hazardous or non-hazardous chemicals, contact EHS at x5663.

Classification and Segregation of Hazardous Chemical Waste

1. Hazardous chemical waste is categorized into the following hazard classes:
   - **halogenated solvents**
   - **non-halogenated solvents**
   - **acids** (inorganic or organic)*
   - **bases** (inorganic or organic)
   - **heavy metals** (silver, cadmium, lead, mercury, etc.)
   - **poisons** (inorganic or organic)
   - **reactives** (cyanides, sulfides, water reactive chemicals, peroxides, etc.)

   **in large quantities (>4L) mixing organic and inorganic acids may not be advisable (i.e. Nitric acid with Acetic acid), please contact EH&S with any questions.*

   **If there are small amounts of concentrated acids and bases, it would not be advisable to mix them together as this would create a strong exothermic reaction.*

2. If the bucket is over 3.8L, or if the waste is strongly incompatible, different waste classes must not be mixed. If the waste bucket is smaller than 3.8L, then mixing waste may be acceptable, however contact EHS with questions before attempting. Do not combine inorganic heavy metal compounds and organic waste solvents.
   - e.g., a mixture of water, dilute acetic acid, and sodium bicarbonate with hazardous chemical waste, because doing so then requires that the entire container of otherwise non-hazardous waste be treated as hazardous waste.

3. **Dry material** (paper, rag, towels, gloves, Kim-Wipes, etc.) that is contaminated with flammable or extremely toxic chemicals may have to be treated as hazardous chemical waste, and segregated in "**Laboratory Trash**". Contact EHS to determine if the laboratory trash must be collected due to mixed hazardous contents.
4. **Sharps** (needles, razor blades, etc.) must be placed in a "puncture resistant" container or a plastic/metal container labeled sharps. Never fill greater than ¾ full. Do not ever stick your hands into a sharps container. Sharps must be considered Regulated Medical Waste, and are disposed of utilizing a waste agency contractor not directly affiliated with the college. Contact EHS for more information about proper disposal methods when collecting sharps and when you wish to dispose of the container.

Containment and Storage of Hazardous Chemical Waste

1. Individual waste generators (teaching and research laboratories) must ensure hazardous chemical wastes are accumulated in safe, transportable containers and are stored properly

in designated Waste Storage Areas in secondary containment to prevent human exposure or environmental release of the waste materials.

2. Containers must be closed or sealed to prevent leakage.
3. Waste generators must use waste containers that are compatible with the chemical contents (i.e., do not use metal containers for corrosive waste or plastic containers for organic solvents). Containers must be in good condition and not leak. All containers must have suitable screw caps or other means of secure closure.
4. Never overfill hazardous waste containers. Expansion and excess weight can lead to spills, explosions, and extensive environmental exposure.
    - Containers should not be filled above the shoulder of the container.
    - Containers of solids must not be filled beyond their weight and volume capacity.
    - Closed head cans (5 gallons or less) should have at least two inches of head space between the liquid level and the head of the container.
5. All waste collection containers must be kept closed, except when adding or removing material

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Labels and Labeling

1. The original chemical label on containers used for waste accumulation must be destroyed or defaced.
2. College policy requires that waste containers be labeled with the accumulation start date, content identity, and the words "Hazardous Waste" **when the chemical waste is first added.**
3. Associate the unique identification number found on the **Hazardous Waste Tag** (available from the EHS) to each new waste container and **Hazardous Waste Log** when the first chemical is added.

Print the information on the tag legibly.

Do not use formulas, always write out chemical names.

Disposal

1. It is illegal to dispose of hazardous waste in any of the following ways:
    - Disposal down the drain
    - Intentional/unintentional evaporation in a fume hood
    - Disposal in the regular trash
    - Disposal in the environment
2. Empty chemical containers may be disposed with other non-hazardous trash, provided that the following requirements are satisfied. EPA regulations stipulate **an empty chemical container** must:
    - not contain free liquid or solid residue,
    - be triple rinsed,
    - have the label removed or defaced (when reusing, not for regular disposal),

- have the lid or cap removed

3. It is not necessary to break empty glass or metal containers when placing them in a trash receptacle.
4. Containers with Hazardous Waste must be submitted to EHS using either the Hazardous Waste Tags or using the SUNY Geneseo online form. See below for more information.
    A. EHS will not pick up submitted waste containers with improper caps, leaks, outside contamination, or improper labeling or non-matching identification numbers.

Reporting Waste for EHS Pick-up and Removal

1. <u>Paper Hazardous Waste Tag Submission</u> –

    For reporting waste containers for EHS pick-up using *paper tags*, see **Appendix Seven - LABELING AND COLLECTING WASTE, CAMPUS GUIDELINES for PAPER TAGS** to properly prepare a waste container, complete the associated Hazardous Waste Log, and submit the container to EHS using the Hazardous Waste Tag.

2. <u>Online Webform Submission</u> –

    For reporting waste containers for EHS pick-up using the *online webform*, see **Appendix Eight - LABELING AND COLLECTING WASTE, CAMPUS GUIDELINES for ONLINE SUBMISSION** to properly prepare a waste container, complete the associated Hazardous Waste Log, and submit the container using the SUNY Geneseo online form.

Appendix Seven

Labeling and Collecting Waste: Campus Guidelines with Paper Tags

For online hazardous waste submission to EHS, please see Appendix Eight: **Labeling and Collecting Waste: Campus Guidelines for Online Waste Submission.**

TO PREP OR MANAGE HAZARDOUS WASTE YOU MAY NEED TO BE FORMALLY TRAINED AND HAVE DOCUMENTED TRAINING IN SUNY GENESEO EHS RECORDS. PLEASE CONSULT EHS FOR FURTHER INFORMATION BEFORE GENERATING HAZARDOUS WASTE CONTAINERS.

Step 1 - Picking the appropriate waste container

Avoid mixing hazard classes whenever possible. More information can be found in **Appendix Six - How to Label and Collect Waste: Waste Classification**. Ideally, the following types of hazard classes should be segregated:

- Halogenated solvents (flammable)
- Non-halogenated solvents (flammable)
- Organic acids (corrosive)
- Inorganic acids (corrosive)
- Bases (corrosive)
- Solids (filtrates, mixtures, or other materials with chemical contamination
- Materials containing heavy metals
- Cyanides and sulfides
- Reactives (explosive or peroxide forming compounds, etc.)
- Non-hazardous waste (paint, oil, aerosols, photo waste, etc.)
- Regulated medical waste (sharps, bio-contaminated materials)

Further Container Selection Guidelines:

- Use a separate container for each hazard class.
- Containers should be compatible with the waste being stored in them.
- Lids/caps must be tightly closed when not being filled.
- Provide secondary containment which can contain a spill in case of container failure.
- Never accumulate more than 55 total gallons of waste.
- AVOID placing paper, stir bars, and other solid debris in liquid waste containers.
- Record a unique ID number that is not duplicated to associate with the container.
  - Any ID number is fine, so long as it is not duplicated on another waste bucket by the same lab at any time, or by any other research group in the same room.
- Maintain the **Hazardous Waste Log** associated with the Unique ID# for the container, keeping the log updated of all constituents (name, quantity, concentration) placed in the waste container.
- Further instructions are listed in the steps below.

Step 2 - Prepping a Waste Container

- You will need the following to prepare a new waste container:
    - **Yellow and pink paper contact paper 'Hazardous Waste Tag'**
    - **'Hazardous Waste Log' Sheet**[36]
    - **Yellow 'Hazardous Waste' Sticker Labels**
    - *Empty container with a screw-cap lid.*
    - *White paper label*

  The PI/Advisor or Lab Manager can obtain contact paper Hazardous Waste Tags, and Yellow Hazardous Waste Labels from Darlene Necaster through campus mail, e-mail her at necaster@geneseo.edu to request them. The Hazardous Waste Log sheet may be found online.

- Obtain a "**Hazardous Waste Tag**" (it is made of yellow and pink contact paper) from EHS. Each tag will have a unique ID # written on it. Assign this unique number to your container using a separate label (write it on the container) and a new "**Hazardous Waste Log**" Sheet.

- Obtain a closeable *bottle or container with a screw-cap lid*. The container will need to be made of the proper material to store the waste intended to fill it without deteriorating, usually glass, HDPE plastic, or metal. If the container was formerly a chemical bottle and is being recycled into a waste container, ensure that it has been cleaned out of any material that may react with intended wastes. Remove the outer label, or deface the label thoroughly to ensure the bottle cannot be confused with what it originally contained.
    - i.e. Do not use metal waste containers to store acid/base wastes, or glass waste bottles to store fluorinated acids or strong bases.

- On the container, using a separate *white paper label*, write identifying information that notates the name of the lab or professor, the building and the room number the bottle is going to be located in, and the unique identification number found on the "**Hazardous Waste Tag"**. A description identifying the type of waste should also be noted on the bottle (i.e. Mixed Waste, Acid Waste, Organic Waste, Halogenated Waste, etc. Other descriptions are possible).

- On the "**Hazardous Waste Log**" sheet, enter the following information before beginning to add waste to the bottle:
    - At the top of the sheet:
        - Building Name
        - Room # (where the bottle will be housed, filled, and stored)
    - At the bottom of the sheet:
        - Hazardous Waste Tag Unique ID # ***VERY IMPORTANT***

[36] SUNY Geneseo Hazardous Waste Log may be found at the following web address: https://www.geneseo.edu/sites/default/files/sites/ehs/EHS_Hazardous_Waste_Log.pdf

- You will also need to fill out information on the "**Hazardous Waste Tag**".
  - On the Hazardous Waste Tag, immediately complete the following information:
    - Matter phase (solid, liquid or gas – multiple phases can be checked if mixed phase)
    - Container size (best to record in mL or liters)
    - Your Name (legibly)
    - Building and Room Number (This is the room the bucket will be stored in)
    - Your office contact phone number.

Step 3 - Storing a Waste Container

- While in use, the container must be kept in secondary containment with easy access so that those using it can add the waste safely and easily. Always close the container when not in use, placing the lid back in place.
  - If a container is bulging after being capped, STOP adding waste to it, and call the Faculty/PI/Lab Manager and/or EHS immediately for further advice. Do not try to uncap the bucket without advice.
- Make sure precisely what and how much of each chemical being disposed of is recorded on the "**Hazardous Waste Log**" as the container is filled. It is very important to structure a way to accurately determine what is going into them and what the masses/volumes are of waste filling the containers. Accuracy is key; it will make it easier to complete the necessary info when the container is full.
  - The data which must be completed for each container in the "**Hazardous Waste Log**" is:
    - **Date generated** (every time something new is added, it must be dated when it was added)
    - **Chemical Composition -** (State law requires that full names and concentrations are written out)
      - (i.e. Hydrochloric acid, 6M; or Ethanol/Water, 50%; or Nickel(ethylenediamine)chloride 3% solution)
      - ***Do not*** write formulas, such as HCl; or EtOH/H_2O; or Ni(en)Cl,)
    - **Quantity** – written with units (mL, L, or grams)
    - The name of the person documenting the waste put in the container (only has to be written once if the person disposing into the container is the same, ditto marks are fine for the rest. If more than one user, all users must be identified).
    - The telephone # of the recorder
- When not in use, whether the waste container is full or not, the waste container must be placed in a designated Hazardous Waste Storage area in the room. Do not move the container to another room even for temporary storage. It must stay in the same room. The Hazardous Waste Storage Area should provide secondary containment.
- A container may be used until the container is no more than ⅞ full. Always ensure there is an air space to accommodate for potential expansion (at least 2 inches [5 centimeters]).

- Whether or not to comingle (or mix together) different types of wastes depends on the capacity of the waste container being used. Please refer to Appendix Six - How to Label and Collect Waste: Waste Classification for more information. If the container is over 3.8L, or if the waste is strongly incompatible, different waste classes must not be comingled. If the waste container is smaller than 3.8L, then mixing waste may be acceptable. Contact EHS with any questions.
- Keep the "**Hazardous Waste Log**" and "**Hazardous Waste Tag**" in an accessible place near the Waste Storage area. A 3-ring binder works well. *Do not* store the Hazardous Waste Log inside the Hazardous Waste Storage Area container.

Step 4 - Submitting a Full Container

- Once the waste container is full or is ready for submission for removal, refer to the "Hazardous Waste Log" associated with the container.
- Add the sum of all similar contents and concentrations on the same line. Do not add the chemicals with different concentrations even if they are the same (For example, all sodium chloride, 10% entries can be added together. All sodium chloride, 25% solutions must be added as a separate entry).
- The volume in the container should match the total sum of the volume written on the log sheet. If it does not, refer to your lab and chemicals and volumes used. Confer with colleagues if necessary. Then, proceed to write down all chemicals and quantities in the lines provided on the yellow/pink "**Hazardous Waste Tag**" (writing transfers through the sheets) to match the "**Hazardous Waste Log**". You may need to write smaller to fit more lines than the 7 provided.
    - If there are more chemicals to report than there is room for on the carbon copy tags, you will have to attach as many sheets as you need to the tag to effectively convey all the contents, associated concentrations and appropriate masses or volumes. Please consider submitting the waste container online using the process in Appendix Eight for online waste submission.
- If there is more than one container to submit for request for removal, repeat this procedure for all Waste Logs.
- Fill out the remainder of the yellow/pink Hazardous Waste Tag:
    - Under the "Check if applicable" portion of the tag:
        - Check an "x" on descriptors that are appropriate to the waste in the container.
            - For example, if the hazardous waste is toxic, check off the blank space adjacent to "toxic".
        - If an abundance of acid or base is present making the waste in the container have a pH of below 5.5 or above 8, mark an "x" next to "pH."
- Ensure the tag(s) are signed and dated.
- It is recommended to keep copies of completed documents for reference, in case of emergency or loss in the mail.

Step 5 - Paper Form Submission

- Once the desired copies are made, carefully separate each yellow "**Hazardous Waste Tag**" slip from the pink slip that is attached behind it.
- Affix the corresponding pink slip vertically on the side of the appropriate container (tape both the top and bottom to ensure that it holds). Be certain to not cover up the ID # on the bottle.
- After this has been completed for all waste containers, staple the original Hazardous Waste Log(s) and their accompanying yellow slips.
- Place them in a campus mail envelope and address the envelope to:

EHS
Darlene Necaster
Clark 121

- Place the original documents in out-going campus mail.
- The hazardous waste container with a paper Hazardous Waste Tag is now submitted to EHS for pick-up and collection.

Appendix Eight

Labeling and Collecting Waste: Campus Guidelines with for Online Waste Submission

TO PREP OR MANAGE HAZARDOUS WASTE YOU MAY NEED TO BE FORMALLY TRAINED AND HAVE DOCUMENTED TRAINING IN SUNY GENESEO EHS RECORDS. PLEASE CONSULT EHS FOR FURTHER INFORMATION BEFORE GENERATING HAZARDOUS WASTE CONTAINERS.

Step 1 - Picking the appropriate waste container

Avoid mixing hazard classes whenever possible. More information can be found in **Appendix Seven - How to Label and Collect Waste: Waste Classification**. Ideally, the following types of hazard classes should be segregated:

- Halogenated solvents (flammable)
- Non-halogenated solvents (flammable)
- Organic acids (corrosive)
- Inorganic acids (corrosive)
- Bases (corrosive)
- Solids (filtrates, mixtures, or other materials with chemical contamination)
- Materials containing heavy metals
- Cyanides and sulfides
- Reactives (explosive or peroxide forming compounds, etc.)
- Non-hazardous waste (paint, oil, aerosols, photo waste, etc.)
- Regulated medical waste (sharps, bio-contaminated materials)

Further Container Selection Guidelines:

- Use a separate container for each hazard class.
- Containers should be compatible with the waste being stored in them.
- Lids/caps must be tightly closed when not being filled.
- Provide secondary containment which can contain a spill in case of container failure.
- Never accumulate more than 55 total gallons of waste.
- AVOID placing paper, stir bars, and other solid debris in liquid waste containers.
- Record a unique ID number to associate with the container.
    - Any ID number is fine, so long as it is not duplicated on another waste container by the same lab at any time, or by any other research group in the same room.
- Maintain the **Hazardous Waste Log** associated with the Unique ID# for the container, keeping the log updated of all constituents (name, quantity, concentration) placed in the waste container.
- Further instructions are listed in the steps detailed in this appendix.

Step 2 - Prepping a Waste Container:

- The following materials are needed to prepare a new waste container:
  - **'Hazardous Waste Log' sheet**[37]
  - **Yellow 'Hazardous Waste' Sticker Labels**
  - *Empty container with a screw-top lid.*
  - *White paper label*
- **Yellow Hazardous Waste sticker labels** can be obtained by emailing a request to Darlene Necaster at EHS, necaster@geneseo.edu
- Assign a Unique Number to the container using a separate label (or write it on the container) and a new "**Hazardous Waste Log**" sheet. Make sure this number has not been used by the research group before, and make sure it does not duplicate any number used by any research group sharing the room.
- Obtain a *closeable bottle or container with a lid*. The bottle will need to be made of the proper compatible material* to store the waste intended to fill it without deteriorating (i.e. glass, HDPE plastic, or metal). If the bottle was formerly a chemical bottle and is being recycled into a waste bottle, ensure that it has been cleaned out of any material that may react with intended wastes. Remove the outer label, or deface the label thoroughly to ensure the bottle cannot be confused with what it used to hold.

  **Do not use metal waste bottles to store acid/base wastes, or glass waste bottles to store fluorinated acids or strong bases.*
- On the container, using a separate *white paper label*, write identifying information which notates the name of the lab or professor, the room number the bottle is going to be located in, and the unique identification number you determined. A description identifying the type of waste should also be noted on the bottle (i.e. Mixed Waste, Acid Waste, Organic Waste, Halogenated Waste, etc. Other descriptions are possible).
- On the "**Hazardous Waste Log**" sheet, enter the following information before beginning to add waste to the bottle:
  - At the top of the sheet:
    - Building Name
    - Room # (where the bottle will be housed and filled)
    - Name of Lead Faculty or Staff Member
    - Container Size
    - An office contact phone number
- At the bottom of the sheet:

[37] SUNY Geneseo Hazardous Waste Log may be found at the following web address: https://www.geneseo.edu/sites/default/files/sites/ehs/EHS_Hazardous_Waste_Log.pdf

- The Unique ID # ***VERY IMPORTANT** *

  ***NOTE**: The yellow and pink "Hazardous Waste Tag" carbon copy is no longer needed for online waste submission only.*

- While in use, the container should be kept in secondary containment with easy access so that those using it can add the waste safely and easily. Always close the container when not in use, placing the lid back in place.
  - **CAUTION!** If you find the container bulging after being capped, STOP adding waste to it, and call the supervising PI/Faculty/lab manager and/or EHS immediately for further advice. Do not try to uncap the container without advice.
- Make sure that what and how much of each chemical being disposed of is recorded on the Hazardous Waste Log as the container is filled. It is very important to structure a way to accurately determine what is going into them and what the masses/volumes are of waste filling the containers. Accuracy is key and it will make it easier to complete the necessary info when the container is full.
  - The data needed for the "**Hazardous Waste Log**" sheet are:
    - **Date generated** (every time something new is added, it must be dated when it was added)
    - **Chemical Composition** - (State & Federal law requires that full names and concentrations are written out)
      - (i.e. Hydrochloric acid, 6M; or Ethanol/Water, 50%; or Nickel(ethylenediamine)chloride solution)
    - ***Do not*** write formulas, such as HCl; or EtOH/H_2O; or Ni(en)Cl)
    - **Quantity** – volume or mass units described as mL, L, or grams
    - The name of the recorder (only has to be written once if the person disposing into the container is the same, ditto marks are fine for the rest. If more than one user, all users must be identified).
- When not in use, whether the waste container is full or not, the waste container should be placed in a designated *Waste Storage Area* in the room. Do not move the container to another room. It must stay in the same room. The *Waste Storage Area* must be secondarily contained.
- The container must have at least 2 inches (5 cm) of airspace left when considered full to accommodate for potential expansion. Do not fill the waste container to the very top. Do not overfill the container to create a spill.
- Whether or not to mix different types of wastes depends on the capacity of the waste container being used *and* the reactivity compatibility of the component waste chemicals added. If the container is over 3.8L, or if the co-mingled waste would be strongly incompatible, different waste classes must not be mixed. If the waste container is smaller than 3.8L, then mixing waste may be acceptable under certain circumstances. Contact EHS with questions.

Keep the "**Hazardous Waste Log**" and "**Hazardous Waste Tag**" in an accessible place near the *Waste Storage Area*. A 3-ring binder works well.

Step 3 - Storing a Waste Container:

When not in use, waste container(s) must be stored in secondary containment (dishpan, trays, NOT CARDBOARD) which will not be quickly degraded or corroded by the waste contained therein. Waste containers must be segregated by chemical compatibility. The location of storage must be labeled with an easily recognized and visible signage, i.e. "Hazardous Waste Satellite Accumulation Area" or simply, "Waste Storage Area". The specific area in the room where storage occurs is considered to be a Resource Conservation and Recovery Act (RCRA) Satellite Accumulation Area (SAA) and storage there is subject to a specific set of requirements, including secondary containment and segregation by compatibility class.

The Hazardous Waste Logs associated with the waste containers must be easily accessible and labeled, but not be able to be damaged by the contents of the waste container if they leak or fail. This is often accomplished with a 3-ring binder which has been labeled, i.e. "For Hazardous Waste." Neutralization logs are also often kept in this 3-ring binder for convenience.

Once a waste is generated, it must be placed in a container which is kept closed (except when filling) and labeled. The closed, labeled containers must be stored in the room in which the waste was generated, waste containers cannot be moved into another room, even if used by the same person/group/lab. Waste generated must be documented on the Hazardous Waste Log during the same working shift of the waste generator (the person disposing of material into the waste container).

It is the responsibility of the generating department to ensure its personnel are aware of the regulations and prohibitions regarding the management of RCRA Hazardous Wastes. It is the responsibility of the generating professor, laboratory supervisor, or other campus individual to ensure the waste is properly classified and managed.

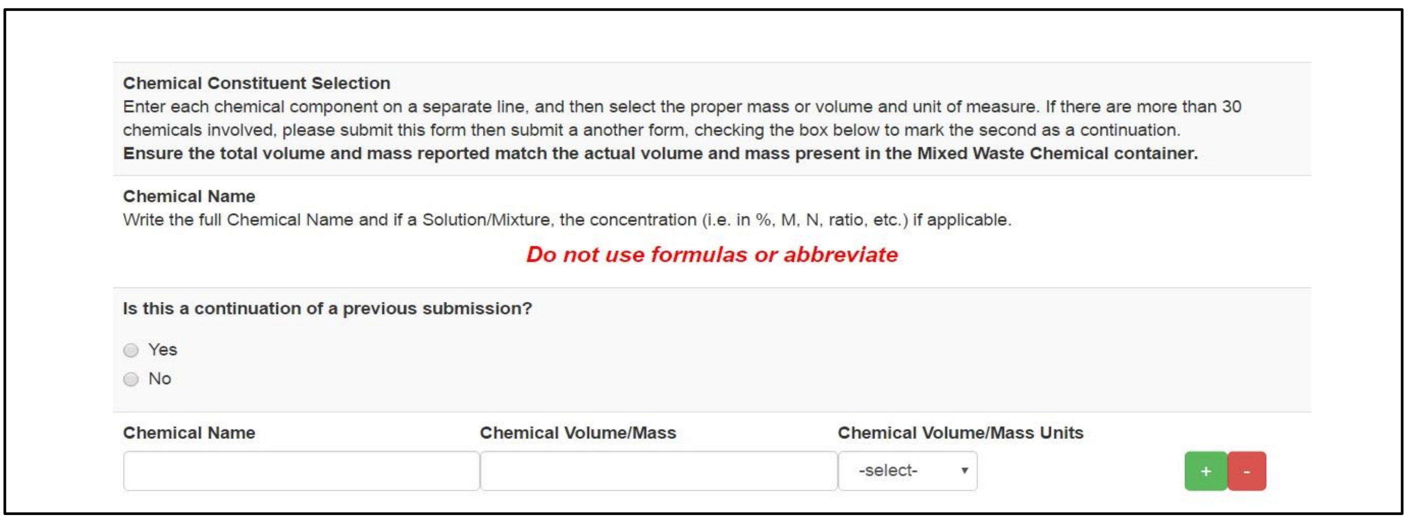
Step 4 - Submitting a Full Waste Container:

- Once the waste container is full, refer to the “Hazardous Waste Log” that the lab has been keeping.
- Add the sum of all similar contents and concentrations on the same line.
    - Do not add the chemicals with the different concentrations even if they are the same (For example, all sodium chloride, 10% entries are lumped together. All sodium chloride, 25% solutions are added together separately).
- The volume in the container should match the total sum of the volume written on the log sheet. If it does not, refer to your lab and expected chemicals and volumes used. Confer with colleagues if necessary.
- Make sure the **Unique ID #** on the Hazardous Waste Log and the **bucket number** match.
- If there is more than one container to complete, repeat this procedure for all Waste Logs.
- Take a general pH reading of the bucket. Refer to the Faculty/PI/Lab Manager for assistance with recording a pH range. Record on the log if the bucket is acid, neutral, basic, or midrange.
- Be sure to sign and date each of the Hazardous Waste Logs somewhere, even if on the back.

Step 5 - Online Waste Submission

- Go to the Mixed Chemical Waste form: https://www.geneseo.edu/is/wasteforms/mixed-waste.php?
- Log in with your Geneseo username and password, your contact name and email address will be auto-filled in the appropriate fields on the webform based on your Geneseo credentials.
- In the Building field, select the campus building where the waste is stored.
- In the Room # field, type in the room number in which the waste is stored. Be sure to include room letter(s) if appropriate.
- In the Container # field, enter the unique container number given to the container when it was prepped to contain hazardous chemical waste.
- In the Container # Confirmation field, re-enter the unique number to confirm.
- In the Container Size field, select the appropriate volume of the container used. If the size is not available in the drop down, select the **OTHER** option and describe the *container volume* using a numerical value and appropriate units (e.g. L, mL, gal).
- In the Totaled Amount in Container field, write in the total volume or mass of constituent material present in the container. Label the numerical value with appropriate units.
- In the Physical State field, select the appropriate field, solid, liquid, gas, or mixed phase. If the container contains both liquid and solid, select **mixed phase**. Unless the hazardous chemical waste contains documented waste gas(ses) in the hazardous waste log – do not select mixed phase for gas/liquid or gas/solid mixtures due to the presence of air.
- In the pH Range field, select the appropriate pH of the major constituents of the container from the drop down. The exact pH does not have to be recorded, the dropdown offers selection across various ranges.
- Under the "Check if applicable" portion of the webform, check all descriptions as appropriate.
    - i.e. Hazardous Waste generally tends to be "toxic" and an "irritant."

Figure A8-1. The following is an image of the Chemical Constituent Selection portion of the webform. Refer to the steps listed next to complete this section for waste submission.



Chemical Constituent Selection
Enter each chemical component on a separate line, and then select the proper mass or volume and unit of measure. If there are more than 30 chemicals involved, please submit this form then submit a another form, checking the box below to mark the second as a continuation.
Ensure the total volume and mass reported match the actual volume and mass present in the Mixed Waste Chemical container.

Chemical Name
Write the full Chemical Name and if a Solution/Mixture, the concentration (i.e. in %, M, N, ratio, etc.) if applicable.

Do not use formulas or abbreviate

Is this a continuation of a previous submission?

Yes
No

Chemical Name	Chemical Volume/Mass	Chemical Volume/Mass Units	
		-select-	+ -

- To begin recording chemical components of the waste container, first read the directions on the webform. Once you begin filling in the text boxes, the information must be supplied in the following manner, please see the photo above for clarification:
- If this is the first time you are attempting to submit this particular container, in the "Is this a continuation of a previous submission?" selection box, select "No".
    - If this is not the first time you are attempting to submit this container, and you are resubmitting due to needing to add additional chemical constituent lines please see the "**Addendum A: Submitting More than One Webform for the Same Container**" section. If due to an error in original submission please see the "**Addendum B: Mistakes or Need to Resubmit a Waste Container**" section, described later in this document.
- In the first text box, for each unique chemical/solution/chemical mixture (and chemical concentration if it is a solution or chemical mixture), enter the full name of the chemical. Include the concentration and the solvent, if the solvent is not water.
    - *Do not* record complicated chemical mixtures on a single field line if you cannot accurately specify *each* concentration of *each* constituent portion of the mixture for EHS to clearly understand. Simplicity is key. Use separate field lines for each component.
- ***Do not use formulas or abbreviate chemical names! Don't forget to list appropriate concentrations, and what the solvent is, if appropriate.***
- Each of the following options are appropriate when recording the following example waste material:
    - potassium chloride, 5%, in methanol
    - potassium chloride, 1M in methanol
    - potassium chloride, 3.5g in methanol
- In the second text box, type the number associated with the volume or mass of the chemical/solution/mixture (material). Do not use units in this textbox, units are added in the adjacent dropdown box. It is best practice to add a 0 in front of a decimal point.
    - 0.1 ✓
    - **not** .1 ✗
- In the dropdown box, select the appropriate units for the material. If the appropriate unit is not available, click "Other" and type in the appropriate standard unit of measurement.
- Click  the button to add additional lines as needed. The form limit is 30 lines. If more than 30 lines are needed, you will need to submit a second webform. See "Submitting more than one webform for the same container" section below.
- Click the "Submit Form" button at the bottom of the webform page.
- Check your SUNY Geneseo email account, as indicated in the confirmation, to retrieve your 12 digit confirmation number for each container submission
- Legibly write down the full 12 digit confirmation number in two places, on the original Hazardous Waste Log and directly on the Waste Container (directly using a sharpie or on a label and affix that label to the Waste Container).
    - Confirmation #:XXXXXXXXXXXX

- Print out at least two copies of the Confirmation Email. This is the Confirmation Email Sheet.
- ***MAKE SURE*** the **Unique Container ID#** on the Confirmation Email Sheet and the newly printed **CONFIRMATION#** on the associated Waste Container match!
- Staple one of the printed copies of the Confirmation Email Sheet to the original Hazardous Waste Log. Place this set of Confirmation Email Sheet and original Hazardous Waste Log in the Waste Log 3-Ring binder to produce if requested.

Step 6 - Paper Documents:

- Roll up a printed copy of all Confirmation Email Sheet(s) associated with the container and slide it into the area between the bottle and the handle, or securely tape the confirmation sheet(s) on the container if there is nowhere to slide the sheet.
    - Make sure the Email Confirmation Sheet does not obscure the unique identification number or the confirmation number printed on the container.
- Make sure the submitted waste container stays with the lid firmly secured in a clearly labeled waste storage area in secondary containment.
- The hazardous waste container is now submitted to EHS for pick-up and collection. There is no need to mail any documents.

Addendum A: Submitting More than One Webform for the Same Container

Usually due to needing to record more than 30 chemical constituents

There may be circumstances when you need to list more chemical constituents in a waste container than the 30 lines the webform allows for recording. If this is the case, you will need to submit more than one webform. (These steps do not include instructions for resubmission due to a mistake or error in the first submission, for directions on how to resubmit a previously online submitted waste container in that event, please see **Addendum B: Mistakes or Needing to Resubmit a Waste Container**.) For submitting more than one form to accurately record all chemical constituents on the online waste webform, this may be done using the following steps:

- If this is the *not* first time you are attempting to submit this particular container, due to needing to add additional chemical constituent lines, open a new webform and fill out all appropriate information except the chemical constituent information exactly the same as the previous submission for the bucket with the same ID #.
        - *If it is a resubmission of a waste bucket because of a mistake, please see the* "Mistakes or needing to resubmit a waste container" *section at the end of this document.*
    - Once you arrive at the **Chemical Constituent Selection** portion in the webform, in the "Is this a continuation of a previous submission?" selection box, select "Yes". Fill out the additional chemical contents not yet listed in the previous form. Do not duplicate contents in this second submission, the purpose of this second form is to just list chemicals you did not have room to add in the first attempt.

- In the "**Other comments**" section text box, describe the reason for the additional form so it is not mistaken as a unique and different container.
  - On the first line, write "Additional submission due to needing more lines to list chemical constituents."
  - Make sure you reference the Confirmation Number from the first Email Confirmation Sheet to alert EHS to the duplication.

- *If it is a resubmission due to other circumstances, explain issues as required. Always reference any confirmation numbers associated with the container if there are multiple submissions for the same container. Please see the "Addendum B: Mistakes or Need to Resubmit a Waste Container" section for more information.*

Addendum B: Mistakes or Need to Resubmit a Waste Bucket?

If an error has occurred and you need to resubmit a container because of a mistake on a previous online submission or for some other reason, be sure to do the following:

- Fill out the webform again as appropriate for all categories, ensuring data is correct.
- Check **YES** on the "Is this a continuation of a previous submission" question
  - *If it is a resubmission of a waste bucket because of a mistake*:
  - In the "Other comments" on the first line, write "***Resubmission due to error***."
  - Then, describe the problem, and **CLEARLY** indicate that this submission replaces the previous submission.
  - Make sure you reference the Confirmation Number from the error email to alert EHS to the duplication.
- *If it is a resubmission due to other circumstances* (i.e. needed more lines for chemical constituents):
  - In the "Other comments" on the first line, write "Resubmission due to [DESCRIBE REASON HERE]."
  - Make sure to reference and write down the Confirmation Number from the confirmation email containing the error in the **Other Comments** section textbox to alert EHS to the duplication.

If you have any questions please contact EHS at x5663

Appendix Nine

Laboratory Decommissioning Checklist

GENESEO | DEPARTMENT OF **Environmental Health & Safety**

LABORATORY DECOMMISSIONING CHECKLIST

Please check refrigerators, freezers, fume hoods, bench tops, storage cabinets, closet spaces and shared storage areas for waste and hazardous materials	**PLEASE INDICATE DATE COMPLETED**
<u>**PRELIMINARY INSPECTION AND CONSULTATION**</u>	
At least <u>one month prior</u> to close-out, contacted all appropriate offices (described below)to request a preliminary consultation and inspection to determine the necessary steps to take prior to cleaning out the laboratory:	
If applicable, contacted the *Radiation Safety Officer* <u>first</u> to clear the area of radiological hazards.	
Contacted *EHS* at x5663 for instructions on how to remove hazardous waste and to ensure the area is clear of chemicals and chemical hazards.	
<u>**CHEMICALS (SOLIDS, LIQUIDS, GASES)**</u>	
✓ Checked laboratory and other occupied rooms for consumables, usable chemicals, and hazardous waste and/or materials.	
✓ Labeled all containers (bottles, beakers, flasks, test tubes, vials, etc.) with chemical contents using full chemical names (no formulas or abbreviations).	
✓ Segregated incompatible materials and chemicals.	
✓ Identified any usable materials/chemicals to be moved or transferred.	
✓ If attempting to donate unwanted chemicals to other SUNY Geneseo departments/laboratories, determined if chemicals are suitable for donation by reviewing the following link: https://www.geneseo.edu/chemistry/mixed-and-individual-waste-forms#IndividualChemical	
✓ Submitted all to EHS unwanted and unclaimed chemicals for donation through the *Unwanted Chemical Exchange* webform found at: https://www.geneseo.edu/is/wasteforms/unwanted-exchange.php	
✓ Securely closed all containers to prevent and avoid leaks or spills.	
✓ Stored flammable liquid containers in flammable storage cabinets until removal.	
✓ If directly transferring chemicals to another lab without using the exchange webform, prepared inventory and moved chemicals to (*please print and list all locations/ownership transfers, complete additional sheets and attach if necessary*): Name(s) ______________________________ Locations: Building(s) & Room(s)______________________________	
✓ Followed procedures in the hazardous materials transportation program for materials to be moved.	
✓ If transporting chemicals to another lab, prepared inventory and informed department chair that inventory will be transported to a facility outside Geneseo. Packaging of the containers, shipment and documentation must be in accordance with DOT regulations.	
✓ For proper disposal of regulated medical waste, contacted the Departmental Chair.	

GENESEO | DEPARTMENT OF Environmental Health & Safety

LABORATORY DECOMMISSIONING CHECKLIST

COMPRESSED GASES:	PLEASE INDICATE DATE COMPLETED
✓ Identified compressed gas cylinders and ensured they are labeled with contents.	
✓ Removed pressure regulators on cylinders and replaced protective valve caps.	
✓ Returned cylinders to the gas supplier(s).	
FUME HOODS, EQUIPMENT, GENERAL SAFETY/SECURITY	
✓ Wiped down, disinfected, and decontaminated fume hoods, bench tops, and shelves as well as equipment or furniture to be left in the lab.	
✓ Checked all shared areas, freezers, incubators, cold rooms for hazardous materials/ waste.	
HAZARDOUS WASTE	
✓ Identify and label all waste containers (bottles, beakers, flasks, test tubes, vials, etc.) with the chemical contents using full chemical names. Place hazardous waste stickers on the containers, then complete the hazardous waste tag or submit hazardous waste online using the *Mixed Waste* webform. Go to https://www.geneseo.edu/chemistry/mixed-and-individual-waste-forms#MixedChemWaste for the webform and complete the on-line form. Make sure the form is securely taped the waste container, and the emailed confirmation number is transcribed to the container after webform submission. o *If submitting hazardous waste tags, contact EHS at x5812 for pick up. If submitting the Mixed Waste webform, no call is necessary.*	
✓ Collected all sharps, needles, razor blades, and surgical blades for proper disposal in an appropriate and properly-labeled red sharps container. For more information about appropriate disposal procedure, please review https://www.geneseo.edu/ehs/regulated-medical-waste for more information about appropriate disposal procedures.	
✓ Collected broken glass and other glass waste in a labeled, sturdy container for disposal. Glass waste contaminated with bio-hazardous material may need to be disposed of as regulated medical waste.	
FINAL CLEARANCE INSPECTION	
✓ Contacted EHS x5663 to request a final clearance inspection prior to custodial maintenance.	

I certify that I have followed standard operating procedures established for the transfer or disposal of hazardous material from my laboratory(s) and for the proper decontamination and/or decommissioning of all equipment in my laboratory(s) used to store or process hazardous materials.

Name:____________________ Signature:____________________ Date:__________

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Appendix Ten

Laboratory Hazard Analysis Form

Name of Process: ____

Chemical Name(s) and associated CAS#:____
____
____

Identify (if any) environmental conditions (*temperature*, *pressure*, *anaerobic*, *etc*.):
____
____

Describe General Procedure:
____
____
____
____

List Physical/Health Hazards: Engineering Controls:
____
____
____

Administrative Practices (Including storage and waste procedures):
____
____
____

Personal Protective Equipment (PPE) requirements:
____
____

All laboratory work require general safety training. List additional training required for this lab hazard analysis:
____
____
____

Additional Comments:

Faculty/PI/or
Lab Manager Name: (print) ____

Signature: ____**Date:**______________

Building: _______________________________________ **Room #**: _______________

Student Researcher Name(s) * (printed)**:**

1. ____________________________ Signature:___________________________ Date:___________

2. ____________________________ Signature:___________________________ Date:___________

3. ____________________________ Signature:___________________________ Date:___________

4. ____________________________ Signature:___________________________ Date:___________

5. ____________________________ Signature:___________________________ Date:___________

6. ____________________________ Signature:___________________________ Date:___________

7. ____________________________ Signature:___________________________ Date:___________

8. ____________________________ Signature:___________________________ Date:___________

9. ____________________________ Signature:___________________________ Date:___________

10. ___________________________ Signature:___________________________ Date:___________

**If more than 10 Student Researchers, list below and collect signatures. Attached additional pages if necessary.*

Appendix Eleven

GENESEO
DEPARTMENT OF
Environmental Health & Safety

Example Laboratory Safety Checklist for Research Students/Student Employee

Name of Student Researcher___________________________________ **Date**_____________ **Bldg**.__________ **Rm**. #_________

Faculty Member ____________________________ or **Lab Supervisor**_________________________________

Please check off each of the following procedures once they have been reviewed with this research student/student employee prior to working in the laboratory.

1. _______ Faculty/Lab Supervisor discussed the protocol(s)/research conducted in the laboratory.
2. _______ Faculty/Lab Supervisor discussed the hazardous components of the research or protocol:
   a.______ chemical
   b.______ biological
   c.______ physical
3. _______ Student received instruction on known symptoms associated with exposure to highly toxic chemicals or infectious agents used in the laboratory, if applicable.
4. _______ Faculty/Lab Supervisor discussed that a student has the right to inform health care providers of the hazardous substances used in the laboratory.
5. _______ Faculty/Lab Supervisor reviewed the laboratory Chemical Hygiene Plan, Laboratory Hazardous Analysis and/or safety operating procedures with the student.
6. _______ Faculty/Lab Supervisor identified the location of laboratory space-specific Safety Data Sheets to the student and demonstrated method(s) of access.
7. _______ Hazard assessment information concerning Personal Protective Equipment required in laboratory have been reviewed, and the supervisor and student have both signed off on the Laboratory Analysis Form.
8. _______ Does the student need a respirator? If yes, arrange for exposure evaluation through EHS, including training and fit testing.
9. _______ All Emergency Equipment locations/procedures been identified to the student.
   a._______ Emergency Shower
   b._______ Emergency Eyewash
   c._______ Fire Alarm Pull Station
   d._______ Fire Extinguisher
   e._______ Spill Kit
   f._______ Telephone (dialing campus police at x5222 or 9-1-1)

10. _______ Faculty/Lab Supervisor reviewed with the employee/student the laboratory signage system as indicated on the door(s) to the laboratory(s) used.

11. _______ Basic laboratory safety requirements been explained & reinforced.

12. _______ Student has signed the appropriate Laboratory Training documents required for laboratory access.

All laboratory research students and student employees must

Know the hazards

Understand the hazards

Have skills to engage safe practices

Student's Name Printed______________________________ Signed_______________________________ Date______________

Faculty Member Printed___________________________ Signed________________________________ Date______________

Or

Laboratory Supervisor Printed_________________________ Signed_____________________________ Date______________

Appendix Twelve

Peroxidizables Quick-Reference

Many liquid organic chemicals may undergo auto-oxidation in the presence of oxygen and may form dangerous concentrations of peroxide compound contaminants during storage. These peroxide contaminants may be sensitive to shock, heat, or friction to varying degrees. Light may catalyze this reaction in some compounds. Additionally, group 1A alkali metals and their amide derivatives can develop a peroxide or super-oxide outer layer that can be catastrophically shock sensitive. If a laboratory or storeroom contains any the peroxidizable chemicals listed in List A, B or C of this appendix, those chemicals must each be regularly evaluated to ensure dangerous levels of peroxide contaminants are not concentrating in storage bottles or containers. Implementing a continuous surveillance schedule of peroxidizable chemicals as described in this document is crucial for the safety of laboratory personnel.

As an initial step in determining the age and use of peroxide-forming chemicals in their containers, it is vital to write the date on each container when it is received to a lab and additionally write the date the container is first opened. As an additional precaution, EHS at SUNY Geneseo offers Peroxide-Former Identification tags which may be slipped over the neck of any container of a peroxide-forming chemical, either upon receipt to the laboratory or during regular inventory of chemical assets in a laboratory for any legacy containers found (after peroxide-testing and finding peroxidizable concentrations within an acceptable limit, if the container was previously opened). Contact EHS for more information and for the Peroxide-Former Identification tags.

Lists A, B and C of Potential Peroxide Forming Chemicals in part 6 of this Appendix are categorized by the rate at which the chemicals must be tested to maximize safety. The list of chemicals referenced is not all inclusive to known and otherwise previously uncharacterized peroxide-forming compounds.

Procedures

Evaluation of Peroxide-Forming Chemicals

Peroxide-forming liquid chemicals which have not been tested for peroxides within recommended time intervals must be evaluated as follows:

1. **Visual Inspection**

   Visually inspect all peroxide-forming chemicals before any further evaluation. Containers which exhibit any unusual visual characteristics should be assumed to contain dangerous levels of peroxides. Ensure any suspect containers are not disturbed and notify EHS immediately. Additionally, contact the supervising Faculty/PI/Laboratory Supervisor. EHS will assist in the evaluation of chemicals. When in doubt about the safety of handling a chemical container, immediately notify EHS.

Liquid Chemicals (many ethers, tetrohydrofuran)

Visual cues for peroxidation:

A. Crystallization (around the cap or in the liquid)
B. Visible discoloration
C. Liquid stratification

***Note**: A flash light or other light source can be used to increase the visibility of the interior of amber bottles.*

Chemicals which have never been opened may not have to be tested for peroxides on the schedule listed later in this appendix. When uncertain, contact the Faculty/PI/Laboratory Supervisor for more information and/or contact EHS for more information.

Organic solvents stored and purchased in steel containers prevent the visual inspection of the liquid for peroxides. Ethyl ether (also known as Diethyl ether) is a common example. Large containers, including solvent drums of 5 gallons (19 Liters) or larger also prevent the visual inspection of the liquid contents for peroxides. In the absence of being able to inspect the contents of metal containers and large drums visually, containers whose age and use history are unknown should be assumed to contain dangerous levels of peroxides and should not be disturbed. Notify EHS immediately to initiate further assessment procedures or disposal.

Solid Chemicals (potassium metal, potassium amide, sodium amide)

Visual cues for peroxidation:

A. Dulling of the metal through a discoloration and/or formation of a surface crust (for example, potassium metal forms a yellow or orange superoxide at the surface)

Note: Evaluation of alkali metals and their amides is based on visual criteria only. These substances react strongly with both water and oxygen, and standard peroxide test strips should not be used.

Liquid and solid chemicals meeting the above listed criteria are considered to be high-risk and must be addressed carefully. Notify EHS prior to any further handling and movement. Only chemicals and their containers which pass visual inspection should be further evaluated for peroxide-forming chemicals by the following listed method(s).

2. Opening Container

Only chemical containers which meet the characterization criteria listed below should be opened and tested for peroxides. Chemicals which do not meet one or more of these criteria should be considered to be high-risk and should not be disturbed. Notify EHS prior to any further handling and movement.

A. The chemical's identity is known
B. The chemical's age is known (since manufacture and receipt)
C. Evaporation of the chemical through the container is thought to be less than 10% of the total volume
    a. If the volume evaporated is unknown, assume that high concentrations of peroxide contaminants may be present

Note: Never try to force open a rusted or stuck cap on a container of a peroxide-forming chemical.

Additionally, the following classification-specific time criteria for opened and unopened containers must be met:

List A Chemicals

A. Opened chemicals not used in the past 3 months must be less than 6 months old
B. Unopened chemicals from the manufacturer must be less than 2 years old
    a. If unsure if the container is unopened, assume the container has been opened

List B and List C Chemicals

A. Opened chemicals not used in the past 12 months must be less than 5 years old
B. Unopened chemicals from the manufacturer must be less than 10 years old
    a. If unsure if the container is unopened, assume the container has been opened

Chemicals not meeting the minimum characterization and time criteria for opening and testing must be considered to be high risk and should be addressed carefully. Notify EHS prior to any further handling and movement. If visual irregularities in the chemical container or contents are discovered after opening the container as describe in the Visual Inspection section, assume that dangerous levels of peroxide contaminants are present. Gently cover the container to minimize evaporation, limit handling and movement, and notify EHS immediately.

Safety Precautions

Students should not handle outdated peroxide-forming chemicals; if outdated containers are found, notify the Faculty/PI/Laboratory Supervisor immediately. Personnel handling containers of outdated peroxide-forming chemicals must wear the following PPE at minimum: chemical goggles and a face shield, heavy gloves, and a buttoned lab coat. Hearing protection (plugs or muffs) and a rubber apron are also recommended.

Suspect chemical containers must be individually transferred to a laboratory hood containing no other chemical containers. A blast shield and secondary containment must be used when opening and manipulating containers for the purpose of testing peroxide levels. Do not attempt to force open a stuck cap on a container. When practical, utilize tongs or other forms of remote handling when manipulating the chemical container. Furthermore, verify that an operable safety shower/eyewash and appropriately classed fire extinguisher is readily accessible. Never work alone, ensure at least one other person is present in the room who is not directly involved in handling of the chemicals.

3. Peroxide Testing

For chemicals that have been determined to be safe to open, measure the peroxide concentration using commercial peroxide test strips. Wet chemical peroxide detection methods are possible; however, commercial test strips may be gentler, easier, faster, and have greater sensitivity and accuracy. The Faculty/PI/Laboratory Supervisor may offer additional laboratory-specific information. Laboratory personnel are responsible for performing peroxide testing of chemicals present in their laboratories and storage areas.

A. EM Quant Peroxide test strips manufactured by EM Science (E. Merck) are available from many vendors (such as ThermoFisher Scientific and VWR)
B. There are many available peroxide concentration ranges available in various commercial testing strips. Ensure the peroxide test strips used are testing the appropriate peroxide detection range for the chemical
    a. Chemicals containing peroxide levels which exceed the test strip detection range may be diluted with a miscible, peroxide-free, solvent.

4. Dispose of Chemical or Decontaminate Peroxides

Chemicals with a peroxide concentration of less than 30 ppm can be disposed of through standard EHS Hazardous Waste Disposal procedures (see Appendix Seven for submission with paper tags and Appendix Eight for online webform submission). Laboratory personnel are responsible for decontaminating chemicals containing greater than 30 ppm peroxides prior to EHS request for standard Hazardous Waste Disposal. EHS may assist with questions regarding the peroxide decontamination process. Departments or laboratories requesting disposal of peroxide-forming chemicals with peroxide concentrations higher than 30 ppm may bear the fees incurred by contracted hazardous waste disposal agencies due to the special hazardous waste disposal considerations.

A. Peroxide-forming chemicals from List A, B and C with a peroxide contaminant concentration of greater than 800 ppm are considered high-risk hazardous waste, requiring disposal and should not be disturbed. Notify EHS immediately and limit any further handling.
B. Peroxide-forming chemicals from List A or List C with a peroxide concentration greater than 100 ppm but less than 800 ppm must be disposed of as high-risk hazardous waste. Notify EHS immediately and limit any further handling.
C. Peroxide-forming chemicals from List B in a specific container with a peroxide concentration of less than 800 ppm, may be decontaminated for continued use and/or storage upon the approval of the responsible Faculty/PI/Laboratory Supervisor.
    a. In some instances, peroxides may be removed by chemical neutralization methods[38] or column separation[39]
D. Peroxide-forming chemicals with an initial peroxide contaminant concentration of less than 800 ppm must be decontaminated to reduce the concentration to less than 30 ppm before routine hazardous waste disposal (verify final peroxide concentration using testing strips or other valid method). Notify EHS of initial treatment and the subsequent peroxide concentration when submitting request for

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[38] Review of Safety Guidelines for Peroxidizable Chemical Compounds. Kelly, R. J. Chemical Health and Safety. American Chemical Society. 1996, 3(5), 28-36

[39] Control of Peroxidizable Compounds. Jackson, H., McCormack, W., Rondestvedt, C., Smeltz, K., Viele, I. Journal of Chemical Education. 1970, 47(3), A175-88

waste removal. Methods to decontaminate peroxide contaminants of peroxide-forming compounds are listed below.

<u>Preparation of Peroxide Formers for Disposal</u>

Water-Insoluble Peroxide Decontamination

Water-insoluble peroxide formers (organic ethers, hydrocarbons, etc.) may be decontaminated by gently mixing with a concentrated aqueous ferrous sulfate solution. To make the ferrous sulfate solution, dilute 6 ml of concentrated sulfuric acid with 11 ml of water, then dissolve 6 g of ferrous sulfate ($FeSO_4 \bullet 7H_2O$). This volume of ferrous sulfate solution is sufficient to decontaminate one liter of the peroxide-forming chemical. Mix the ferrous sulfate solution with the peroxide forming chemical. Reduction of the peroxides generally takes only a few minutes of mixing. Re-test the peroxide forming chemical after decontamination to verify that the peroxide concentration is less than 30 ppm. Once the concentration of peroxide contaminants have fallen below 30 ppm, document the chemical for EHS Hazardous Waste Disposal using the SOP described in Appendix Seven for paper tags and Appendix Eight for the SUNY Geneseo online webform; additionally report final peroxide concentration in the comments section available for either waste documentation method.

Water-Soluble Peroxide Decontamination

An alumina column may used as the standard procedure to decontaminate water-soluble peroxide formers with peroxide concentrations of less than 800 ppb[40]. Prior to attempting an alumina column, ensure the Faculty/PI/Laboratory Supervisor is familiar with and approves the procedure. In certain instances, EHS may suggest other methods. Once the concentration of peroxide contaminants fall below 30 ppb, prepare for chemical disposal using the SOP for EHS Hazardous Waste Disposal described in Appendix Seven for paper tags and Appendix Eight for the SUNY Geneseo online webform; additionally report final peroxide concentration in the comments section available for either waste documentation method.

5. Safe Storage and Use of Peroxide-Forming Chemicals

Maintenance of peroxide-forming chemicals requires implementation of the following procedures:

A. Identify potential peroxide-forming chemicals utilizing Lists A, B, and C listed later in this appendix. Prudent practice dictates that laboratories minimize their inventory of peroxide-forming chemicals.

B. Label each container with the date it is received and the date it is opened.

C. Store peroxide-forming chemicals in tightly sealed containers to minimize introduction of air. An inert gas such as nitrogen or argon can be introduced into the container as an inert blanket to minimize available oxygen (inhibited vinyl monomers, List C chemicals, are the exception to this recommendation).

[40] “Review of Safety Guidelines for Peroxidizable Chemical Compounds.” Kelly, R. J. Chemical Health and Safety. American Chemical Society. 1996, 3(5), 28-36 and “Control of Peroxidizable Compounds.” Jackson, H., McCormack, W., Rondestvedt, C., Smeltz, K., Viele, I. Journal of Chemical Education. 1970, 47(3), A175-88

D. Ultraviolet light can initiate auto-oxidation; therefore, it is best to store peroxide forming chemicals in containers that exclude light.

E. Test for peroxides at least as often as recommended in the example lists. Unopened chemicals from the manufacturer must be tested upon reaching the manufacturer's expiration date, or 18 months, whichever comes first. Chemicals with a peroxide concentration of greater than 100 ppm must be decontaminated or disposed of through EH&S after treatment to reduce peroxides to less than 30 ppm.

F. Inspect containers of peroxide-forming chemicals frequently, looking for signs of precipitation, stratification of liquid, crystal formation, or other irregularities. The presence of any of these signs indicates a potential shock sensitive container – do not move the container and contact EH&S as soon as possible.

G. Test for peroxides prior to distilling peroxide-forming chemicals (or prior to other concentration procedures), as this is when explosions commonly occur. It is recommended that 10 to 20% residual bottoms be left during distillation. Additionally, a non-volatile organic liquid, such as mineral oil, can be added to minimize concentration of any peroxides.

H. Chemical manufacturers often add trace quantities of free radical scavengers (for example, 100 ppm hydroquinone) to inhibit the formation of peroxides. These inhibitors become depleted as peroxides are formed. Additionally, distillation separates the inhibitor from the peroxide-forming chemical. Distilled chemicals and chemicals retained for extended periods should be checked for inhibitor concentration, and inhibitor added if the concentration is below the manufacturer's specifications (contact the manufacturer for recommendations).

6. Potential Peroxide-Forming Compounds

The following lists of Potential Peroxide Forming Chemicals are categorized by the rate at which the chemicals must be tested to maximize safety[41]. The list of chemicals referenced is not all inclusive to known and otherwise previously uncharacterized peroxide-forming compounds.

List A:

These chemicals form explosive levels of peroxides without concentration. Discard or test for peroxides every 3 months after open date.

Chemical Name	CAS Number	Chemical Name	CAS Number
Divinyl acetylene	821-08-9	Diisopropyl ether	108-20-3
Potassium metal $_{(s)}$	7440-09-7	Potassium amide	17242-52-3
Sodium amide	7782-92-5	Vinylidine chloride	75-35-4

[41] 29 CFR 1910.1450, OSHA Standard, Occupational Exposure to Hazardous Chemicals in Laboratories

List B:

These chemicals produce some peroxides when stored and there is increased risk of explosive peroxide contaminants building up when concentration occurs. Do not distill or evaporate the compounds described in this list without first testing for the presence of peroxides using peroxide test strips or other qualified means. Dispose of the chemicals as hazardous waste or test for peroxides at least every 12 months after open date. Some of these chemicals (e.g. some secondary alcohols) may form peroxides more slowly than others, but all should be treated as List B peroxide formers.

Chemical Name	CAS Number	Chemical Name	CAS Number
Acetaldehyde	75-07-0	Furan	110-00-9
Benzyl alcohol	100-51-6	Heptanol	589-55-9
2-Butanol (2-Butyl alchohol) (sec-Butyl alcohol)	78-92-2	2-Hexanol	626-93-7
Cumene	98-82-8	Methylacetylene	74-99-7
Cyclohexanol	108-93-0	3-Methyl-1-butanol (Isoamyl alcohol) (Isopentanol)	123-51-3
2-Cyclohexen-1-ol	822-67-3	Methylcyclopentane	96-37-7
Cyclohexene	110-83-8	Methyl isobutyl ketone	108-10-1
Cyclooctene	931-88-4	4-Methyl-2-pentanol	108-11-2
Cyclopentene	142-29-0	2-Pentanol	6032-29-7
Decahydronaphthalene	91-17-8	4-Penten-1-ol	821-09-0
Diacetylene	460-12-8	1-Phenylethanol	98-85-1
Dicyclopentadiene	77-73-6	2-Phenylethanol	60-12-8
1,1-Diethoxyethane (Diethyl acetal)	105-57-7	2-Propanol (Isopropyl alcohol)	67-63-0
Diethyl ether (Ethyl Ether) (Ether)	60-29-7	Tetrahydrofuran	109-99-9
1,4-Dioxane	123-91-1	Tetrahydronaphthalene	119-64-2
Diethylene glycol dimethyl ether	111-96-6	Dioxanes	
Ethylene glycol dimethyl ether	110-71-4	Other secondary alcohols	
Furan	110-00-9	Vinyl ethers	

List C:

These chemicals form peroxides which initiate spontaneous, rapid, and exothermic polymerization. Uninhibited chemicals are not to be stored longer than 24 hours.

Liquids at Room Temperature and Pressure

Discard or test for peroxides within 12 months after open date.

Chemical Name	CAS Number	Chemical Name	CAS Number
2-Chloro-1,3-butadiene (2-Chloroprene)	126-99-8	Vinyl acetate	108-05-4
Styrene	100-42-5	Vinyl pyridine	1337-81-1

Gases at Room Temperature and Pressure

If transferred to a secondary container, discard within 12 months after transfer date.

Chemical Name	CAS Number	Chemical Name	CAS Number
Butadiene	106-99-0	Vinyl acetylene	689-97-4
Chlorotrifluoroethylene	79-38-9	Vinyl chloride	75-01-4
Tetrafluoroethylene	116-14-3		

Appendix Thirteen

Glossary of Acronyms

-A-

ACGIH – American Conference of Government Industrial Hygienists, a professional organization which focuses on advancing worker protection through occupational and environmental health.

ANSI – American National Standards Institute – a private non-profit organization which oversees the development of and accredits consensus standards for products, processes and systems for the safe practices and procedures for industry.

ASHRAE – American Society of Heating, Refrigerating and Air Conditioning Engineers - a professional association which promotes building systems, energy efficiency, indoor air quality, refrigeration, and sustainability within the industry.

ASME – American Society of Mechanical Engineering, a professional association which promotes codes and standards for multidisciplinary engineering and allied sciences.

ASTM – American Section of the International Association for Testing Materials, International, a standards organization which develops technical standards for many services, including chemical standards.

-C-

CAS Number – Chemical Abstracts Service Number (also known as the CAS registry number, or just CAS), is a unique number given to every distinct chemical known and described in scientific literature.

CHP – Chemical Hygiene Plan, is a written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace and meets the requirements of OSHA 29 CFR 1910.1450.

CHO – Chemical Hygiene Officer, as defined by OSHA 29 CFR 1910.1450(b) is an employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. This definition is not intended to place limitations on the position description or job classification that the designated individual shall hold within the employer's organizational structure.

-D-

DEC – Department of Environmental Conservation. The New York State DEC is the state's environmental protection and regulatory agency.

-E-

EHS – Environmental Health and Safety Department at SUNY Geneseo.

EPA – Environmental Protection Agency (sometimes abbreviated as USEPA), is a United States federal agency created to protect human health and environment through developing and enforcing regulations in concert with laws passed by Congress.

-G-

GHS – Globally Harmonized System of Classification and Labeling of Chemicals, created in 1992 by the United Nations to define and classify the hazards of chemical products, and communicate health and safety information on labels and safety data sheets. With a goal to create the same set of rules internationally for classifying hazards, develop labeling, and for the production of safety data sheets. GHS is a 'non-binding' system of hazard communication, only rules adopted by the United States legislation are enforceable.

-H-

HCS – Hazard Communication Standard, the OSHA mandate, 29 CFR 1910.1200, stating that companies producing and using hazardous materials must provide employees with information and training on the proper handling and use of these materials.

HEPA – High Efficiency Particulate Air, a designation for an air filter which must be capable of removing at least 99.97% of particles as small as 0.3µm in size.

HMIS – Hazardous Material Information System, a hazard rating system of color standards and numerical codes used for identification of hazards for chemicals handled in the workplace. The coloring and numerical range is similar to the NFPA system, but the numerical coding of each chemical can be different due to the NFPA system assuming a fire is present.

-I-

IARC – International Agency for Research on Cancer, an intergovernmental agency tasked by the World Health Organization of the United Nations to conduct and coordinate research into the causes and occurrence of cancer worldwide. IARC publishes "Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man," one of the publications used to determine the cancer risk of a chemical.

ILDH – Immediately Dangerous to Life or Health

ISEA – International Safety Equipment Association

IUPAC – International Union of Pure and Applied Chemistry

-L-

LC_{50} – The concentration of a substance in air that will kill half (50%) of the exposed test animals. A measure of acute toxicity.

LD_{50} – The dose of a substance that will kill half (50%) of the treated test animals when given as a single dose. A measure of acute toxicity.

LEL or **LFL** – Lower Explosive Limit or Lower Flammable Limit. The lowest vapor concentration at which a liquid will burn or explode.

LFPM – Linear Feet Per Minute – a calculation of a volume of air moving across a surface.

LI – Laboratory Instructor, a title as defined by any of SUNY Geneseo's constituent academic departments. May refer to faculty, staff or employed student teaching assistant in a laboratory.

LSC – Laboratory Safety Committee for SUNY Geneseo, a committee commissioned by the college president, consisting of representative members of laboratory sciences at the college.

-M-

MSDS – Material Safety Data Sheet, an obsolete and unregulated form used to describe and label substances used in the workplace. See SDS.

-N-

NFPA – National Fire Protection Association, a United States trade association that creates and standards and codes used for identification of hazardous material response and firefighting. The coloring and numerical range is similar to the HMIS system, but the numerical coding of each chemical can be different due to the NFPA system assuming a fire is present.

NIOSH – National Institute for Occupational Safety and Health. This agency of the Public Health Service, U.S. Department of Health and Human Services (DHHS), tests and certifies respiratory devices, recommends occupational exposure limits, and assist OSHA by conducting research and investigations.

NTP – National Toxicology Program, a federal program though the Department of Health and Human Services which coordinates, evaluations and reports on the toxicology of chemical agents in the environment.

NYSDEC – New York State Department of Environmental Conservation – a state department which enforces New York State environmental laws and regulations while also guiding and regulating the improvement, conservation, and protection of the natural resources of the state.

-O-

OSHA – Occupational Safety and Health Administration, a federal agency of the United States Department of Labor. Established in 1970 to enforce safe and healthful working conditions.

-P-

PEL – Permissible Exposure Limit, the enforceable regulatory limit in the United States for exposure of a chemical substance or physical agent (such a noise) to an employee in the workplace air. Units are often given as a time-weighted average (TWA), but can include short-term exposure limits or ceiling limits. This limit must not be exceeded or engineering controls or PPE is needed to protect the worker.

PESH – Public Employee Safety and Health Bureau, a federal agency established to enforce safety and health standards under the United States Occupation Safety and Health Act.

PI – Principle Investigator, a title defined by SUNY Geneseo. Usually the lead faculty or professional staff member for a research laboratory.

PPE – Personal Protective Equipment

PVC – Plastic in which polyvinyl chloride is a major constituent.

-R-

RCRA – Resource Conservation and Recovery Act, the EPA law 40 CFR 238-282 which creates the framework for the proper management of hazardous and non-hazardous solid waste. The law describes the waste management program mandated by Congress that gave EPA authority to develop the RCRA program.

RSO – Radiation Safety Officer, a title defined by SUNY Geneseo. The individual designated by SUNY Geneseo's Radiation Safety Committee as the contact individual for issues regarding Hazardous Radiation Sources.

-S-

SABA – Supplied Air Breathing Apparatus

SCBA – Self-Contained Breathing Apparatus

SDS – Safety Data Sheet (renamed by OSHA from the formerly named Material Safety Data Sheet [MSDS] beginning in 2013], a regulated and standardized form used to establish and inform the user of the physio-chemical, health, and/or environmental risk in a workplace setting.

SOP – Standard Operating Procedure is a step by step instruction authored to inform personnel how to engage routine operations and activities in the workplace.

STEL – Short Term Exposure Limit is the maximum concentration allowed in a continuous, 15-minute exposure. There may be no more than four such exposures each day with at least one hour between exposures. The daily TWA cannot be exceeded, however.

-T-

TLV – Threshold Limit Value, the level of exposure a person is believed to be exposed to chronically over a period of a lifetime without adverse effects. This term is used specifically by the American Conference of Governmental Industrial Hygienists based on toxicology studies and specific chemical values are updated as determined necessary.

TLV-C – Threshold Limit Value-Ceiling, the maximum concentration of a toxic substance for which exposure is allowed. This limit is not to be exceeded, even momentarily. The TWA must still be observed.

TWA – Time weighted average in reference to permissible exposure limits (PEL).

TVL TWA – Threshold Limit Value Time Weighted Average, the time weighted average concentration for a conventional 8 hour workday/40 hour per work week established by ACGIH. While updated frequently, these values are not legally enforceable. (See PEL)

-U-

UEL or **UFL** – Upper Explosive Limit/ Upper Flammable Limit. The highest vapor concentration at which a liquid will burn or explode.

Appendix Fourteen

Glossary of Useful Terms

-A-

Action Level – means a concentration designated in 29 CFR part 1910 for a specific substance, calculated as an eight (8)-hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

Acute effect – Symptom of exposure to a hazardous material that soon appears after a short-term exposure, which quickly can lead to health-related crisis.

Acute exposure – A single, brief exposure to a large dose of a toxic substance. Adverse health effects are evident soon after exposure.

Acutely Hazardous – Agents or chemicals which cause acute effect on health upon exposure, and/or are listed in EPA "P-Listed Chemicals" as defined by EPA 40CFR Section 261.33, NFPA Blue/Health numeric hazard rating of 4, and/or HMIS Blue/Health numeric hazard rating of 4.

Acute Hazardous Waste – "P-List" waste chemicals as defined by EPA 40CFR Section 261.33, which are either 100% pure, commercial grade, technical grade, or the only active ingredient of a listed product.

Acute Toxicity – Adverse biological effects of a single dose of a toxic agent.

Aerosol – A suspension of fine solid or liquid particles in air (e.g., paint spray, mist, fog).

Anesthetic – A chemical that causes drowsiness. Large doses of anesthetic chemicals can cause unconsciousness, coma, and death.

Asphyxiant – A chemical vapor or gas that replaces air and can, thereby, cause death by suffocation. Asphyxiants are especially hazardous in confined spaces.

Auto-Ignition Temperature – The temperature at which ignition occurs without an ignition source and the material continues to burn without further heat input.

-C-

Carcinogen – A chemical or physical agent that is known to cause cancer in humans or is thought possibly to cause cancer, based on evidence from experimental animals.

Cardiac – Term used to refer to the heart.

cc - Cubic centimeter. A metric-system volume measurement equal to a milliliter (ml). One quart is about 946 cc (946 ml). Intentionally lower case.

Ceiling Limit – The maximum allowable exposure limit for an airborne chemical, which is not to be exceeded even momentarily. See also PEL and TLV.

Central Nervous System – The part of the body made up of the brain, spinal cord, and nerves.

Chemical Family – Chemicals with similar structural characteristics are grouped into a chemical family (e.g., ketones, alcohols, hydrocarbons).

Chemical Hygiene Officer (CHO) – An employee title defined by OSHA 29 CFR 1910.1540(b) who is designated by the employer, and who is qualified by training or experience to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan.

Chemical Hygiene Plan (CHP) – A written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment, and work practices which are capable of protecting employees from the health hazards presented by hazardous chemicals used in the particular workplace and meets the requirements of the OSHA Standard on Hazardous Chemicals in the Laboratories (29 CFR 1910.1450).

Chronic Exposure – Repeated exposure or contact with a toxic substance over a long period. Adverse biological effects from chronic exposure develop slowly, last a long time, and frequently recur.

Chronic Effect – Symptom of exposure to a hazardous material that develops slowly after many exposures or that recurs often.

Chronic Toxicity – Adverse biological effect of repeated doses or long-term exposure to a toxic agent.

Combustible – Able to catch on fire and burn. Combustible substances are harder to ignite than flammable substances. A liquid that will burn is called a "combustible liquid." Non-liquid substances that will burn, such as wood and paper, are called "ordinary combustibles." NYS Fire Code defines a combustible liquid as having a flashpoint at or above 100 degrees F. (See Flammable).

Combustible Gas – Defined as: (i) A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70^{o}F (21.1^{o}C); or (ii) A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130^{o}F (54.4^{o}C) regardless of the pressure at 70 ^{o}F (21.1^{o}C); or (iii) A liquid having a vapor pressure exceeding 40 psi at 100 ^{o}F (37.8^{o}C) as determined by ASTM D-323-72.

Concentration – The relative amount of a given substance present when mixed with one or more substances. Concentration is often expressed as molarity (M), parts per million (ppm), percent, or weight per unit volume, e.g., milligrams/cubic meter (mg/m^3).

Corrosive – A chemical that causes visible destruction of, or irreversible changes in living tissue by chemical action at the site of contact, or that has a sever corrosion rate on structural materials.

- D -

Decomposition – The breakdown of a material into a simpler compound by chemical reaction, decay, heat, or other process.

Density – The mass of a substance (e.g solid or liquid) per unit volume. The density of a substance is usually compared to water, which has a density of 1 at STP. Substances that float on water have densities of less than 1; substances that sink in water have densities greater than 1.

Dermal – Term used to refer to skin.

Dermatitis – An inflammation of the skin, which can be caused by irritation (chemical, physical, or mechanical) or allergic reaction.

Designated Area – An area which may be used for work with "select carcinogens," reproductive toxins or substances which have a high degree of acute toxicity. A designated area may be the entire laboratory, an area of a laboratory, or a device such as a laboratory hood.

Dose – The amount of a substance received during exposure.

- E -

Epidemiology – The branch of medical science that deals with the incidence, distribution, and control of disease in a population.

Explosive – means a chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

- F -

Flammable – A flammable substance is one that will catch on fire easily and burn rapidly under ordinary conditions, when exposed to an ignition source; for example, liquids with a flash point below 100^{o}F and solids that ignite readily.

Flashpoint – means the minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite.

Formula – The molecular composition of a chemical compound written in scientific symbols. Water is H_2O; hydrochloric acid is HCl.

- G -

g/kg – Grams per Kilogram. A term used in experimental testing to indicate the dose of a test substance, in grams, given for each kilogram of the test subject's body weight. Intentionally lower case.

- H -

Hazard warning – The words, pictures, and symbols, or combination thereof, that appear on a label and indicate the hazards of the substance in the container.

Hazardous material/chemical – A chemical or mixture of chemicals that can produce adverse physical effects (e.g., fire, explosion) or health effects (e.g., dermatitis, cancer).

Health hazards – Substances for which there is evidence, from at least one scientific study, that acute or chronic health effects may occur in exposed persons. These chemicals include carcinogens, toxic agents, reproductive toxins (mutagens and teratogens), irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents that damage the lungs, skin, eyes, or mucous membranes.

Hematopoietic system – The blood-forming organs of the body, including bone marrow and the spleen.

Hepatotoxin – A chemical that can cause liver damage (e.g., carbon tetrachloride).

- I -

Ignition Source – An ignition source can be heat, sparks, or flame which may ignite a combustible or flammable substance.

Ingestion – Taking a material into the body through the mouth and swallowing it.

Inhalation – Taking a material in the form of a vapor, gas, dust, fume, or mist into the body by breathing it.

Inhibitor – A chemical added to a substance to prevent the occurrence of an undesirable chemical reaction.

Irritant – A substance that may not be corrosive, but that can with direct contact, cause a reversible effect on the skin, eyes, or respiratory system.

- L -

Laboratory Instructor (LI) – A title as defined by any of SUNY Geneseo's constituent academic departments. May refer to faculty, staff or employed student teaching assistant(s) in a laboratory.

Laboratory Safety Committee (LSC) – A committee commissioned by the college president of SUNY Geneseo, consisting of representative members of laboratory sciences at the college.

Laboratory Hood – means a device located in a laboratory, enclosure on five sides with a moveable sash or fixed partial enclosed on the remaining side; constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory; and allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms. Often referred to as a fume hood.

Lacrimation – Abnormal or excessive production of tears as a result of exposure of an irritant to the eyes.

Lacrimator – A substance that irritates the eyes and generates a tear production response.

LC_{50} – Lethal Concentration 50. The concentration of a substance in air that kills half (50%) of the exposed test animals in at least one published study. A measure of acute toxicity.

LD_{50} – Lethal Dose 50. The dose of a substance that kills half (50%) of the treated test animals when given as a single dose in at least one published study. A measure of acute toxicity.

Lock Out/Tag Out – A safety procedure which is used both in industry and research settings to ensure dangerous machines are properly shut off and not able to be started up again prior to the completion of maintenance or servicing work.

Local exhaust - A ventilation method for removing contaminated air at the point where the contaminants are generated (e.g., a fume hood).

Lower Explosive Limit *or* Lower Flammable Limit – The lowest vapor concentration at which a liquid will burn or explode.

- M -

m^3 – Cubic meter. A volume measurement in the metric system. One m^3 is about 35.3 cubic feet or 1.3 cubic yards. Intentionally lower case.

Mechanical exhaust – A powered device, e.g., a motor-driven fan, that removes contaminants from a work area or enclosure.

mg/kg – Milligrams per kilogram. A term used in experimental testing to indicate the dose of a test substance, in milligrams, that was given for each kilogram of body weight of the test animal. Intentionally lower case.

mg/m^3 – Milligrams per cubic meter. A way of expressing the concentration of dusts, gases, aerosols, or mists in the air. Intentionally lower case.

Mist – A suspension in air of finely divided particles of liquid.

Mucous membranes – A protective lining of cells found, for example, in the mouth, throat, nose, and other parts of the respiratory system.

Mutagen – A substance capable of causing damage to genes and chromosomes, particularly those of sperm or egg cells, resulting in mutations.

Mutation – A genetic alteration that can be inherited, thus affecting future generations.

- N -

Narcosis – A state of deep unconsciousness caused by the influence of a drug or other chemical.

Nephrotoxin – A chemical that causes kidney damage (e.g., uranium).

Neurotoxin – A chemical whose primary toxic effect is on the nervous system (e.g., carbon disulfide).

- O -

Odor threshold – The lowest concentration of a substance's vapor, in air, that a person can detect by smell. Odor thresholds are highly variable, depending on the individual and the nature of the substance.

Olfactory – Term used to refer to the sense of smell.

Oral – Term used to refer to the mouth.

Organic peroxide – Very hazardous and shock sensitive compounds that present serious fire and explosion hazards. A type of oxidizer that is very useful because of its reactive properties, considered by law (OSHA) to be a physical hazard. Common examples are: benzyl peroxide, peracetic acid, and methyl ethyl ketone peroxide.

Oxidation – A reaction in which a substance gives up electrons, often when combining with oxygen to cause a chemical change. When a rapid reaction, oxidation may lead to fire or when slow, to rust.

Oxidizer – A material that causes the ignition of combustible materials without an external source of ignition. When mixed with combustible materials, an oxidizer increases the rate of burning of these materials when the mixtures are ignited. Oxidizers usually contain their own oxygen, and can, therefore, burn in an oxygen-free atmosphere. They are usually very unstable or reactive, and pose serious fire hazards.

- P -

Permissible Exposure Limit (PEL) – Defined by OSHA is an enforceable regulatory limit on the amount and concentration of a substance in the workplace air. This limit must not be exceeded or engineering controls or PPE is needed to protect the worker.

pH – A measure of how acidic or basic (caustic) a substance is on a scale of with a range of about 0 (very acidic) to about 14 (very basic); pH 7 indicates that the substance is neutral. Ranges of pH can go somewhat below 0 on the scale to somewhat above 14.

Physical hazard – A substance that is a combustible liquid, a compressed gas, an organic peroxide, an oxidizer, or any substance that is otherwise explosive, flammable, pyrophoric, unstable (reactive), or water-reactive.

P-List Chemical – Pure and commercial-grade chemicals that are defined by EPA 40 CFR Section 261.33 which have been designated as waste to be disposed. These chemicals are described by the EPA, must be unused prior to designation for disposal, and in the form of a commercial chemical product.

Polymerization – A chemical reaction in which individual molecules combine to form a single large molecule (a polymer). Hazardous polymerization is an uncontrolled reaction releasing large amounts of energy (heat).

ppb – Parts per billion. A term used to express very small concentrations of a given substance present in a mixture. Often used as a unit to measure the parts (by volume) of a gas or vapor in a billion parts of air. Intentionally lower case.

ppm – Parts per million. A term used to express very small concentrations of a given substance present in a mixture. Often used as a unit to measure the parts (by volume) of a gas or vapor in a million parts of air. Intentionally lower case.

Principle Investigator (PI) – A title defined by SUNY Geneseo. Usually the lead faculty or professional staff member for a laboratory.

Pulmonary – Term used to refer to the lungs.

Pyrophoric – A chemical that can catch on fire spontaneously in air at or below $130^{o}F$.

- R -

Reactivity – A term used to describe the ease with which a chemical can undergo change, usually by reacting with another substance or by breaking down. Highly reactive substance may explode.

Reduction – A chemical reaction in which electrons are gained and lowers the oxidation state of the element or molecule.

Reproductive toxins – Chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

Respiratory protective equipment – Air cleaning or air supply respirators that protect against toxic materials in the air.

Route of entry – The way a toxic substance enters the body. For example, absorption through the skin, inhalation, ingestion, or injection. May also be called mode of entry.

- S –

Select carcinogen – Any substances which meets one of the following criteria:

(i) It is regulated by OSHA as a carcinogen; or
(ii) It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or
(iii) It is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest editions); or
(iv) It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals.

Sensitizer – A substance that can cause an allergic reaction, which usually appears after repeated exposure.

Solubility in Water – A term used to indicate the amount, in percent (%) of a substance that will dissolve in water. Solubility information is important for determining spill-cleanup and firefighting procedures.

Solvent – A liquid that dissolves other substances. Some common solvents are water, alcohol, and mineral spirits.

Short Term Exposure Limit (STEL) – The maximum concentration allowed in a continuous, 15-minute exposure. There may be no more than four such exposures each day and there must be at least one hour between exposures. The daily TWA exposure for a substance however, cannot be exceeded.

Standard Temperature and Pressure (STP) – A standard unit corresponding to 273 K (0° Celsius) and 1 atmosphere (atm) of pressure. STP is often used for measuring gas density and volume.

Suspect carcinogen – A substance that might cause cancer in humans but has not yet been proven to do so.

Synonym – Another name by which a chemical is known. For example, synonyms for methyl alcohol are methanol and wood alcohol.

Systemic poison – A substance that has a toxic effect upon several organ systems of the body.

- T -

Target organ effects – Effects on specific organs of the body caused by exposure to one or more hazardous chemicals.

Threshold Limit Value (TLV) – The airborne concentration of a substance below which no adverse health effects should occur. TLVs, established by the American Conference of Governmental Industrial Hygienists (ACGIH), are voluntary limits expressed in three ways (STEL, TLV-C, TWA). While updated frequently, these values are not legally enforceable.

Threshold Limit Value-Ceiling (TLV-C) – The maximum concentration of a toxic substance for which exposure is allowed. This limit is not to be exceeded, even momentarily. The TWA must still be observed.

Threshold Limit Value Time Weighted Average (TLV TWA) – The time weighted average concentration for a conventional 8 hour workday/40 hour per work week established by ACGIH. While updated frequently, these values are not legally enforceable. (See PEL)

Time Weighted Average (TWA) – The exposure limit averaged over a normal 8-hour workday or 40-hour work week.

Toxic substance – A substance which causes harmful biological effects after either short-term or long-term exposure.

Toxicity – All of the adverse biological effects resulting from exposure to a harmful substance.

- U -

Upper Explosive Limit/ Upper Flammable Limit (UEL or UFL) – The highest vapor concentration at which a liquid will burn or explode.

Unstable – A chemical is unstable if it tends to decompose or undergo other undesirable chemical changes during normal handling or storage.

- V -

Vapor – The gas given off by a liquid or solid at room temperature.

Ventilation – Term used to describe the method by which inside air is circulated.

Viscosity – A term used to describe the rate at which a liquid flows or pours. A very viscous liquid, like molasses, flows slowly.

Volatile – A term used for liquids that evaporate at room temperature. Very volatile liquids, such as ethyl ether or gasoline, form vapors (evaporate) quickly and are breathing hazards.

- W-

Water-Reactive – A chemical that reacts with water to release a flammable or toxic gas.