University of New Hampshire

Chemical Hygiene Plan

Revised:
2015

EMERGENCY CONTACT INFORMATION

	CELL PHONE	OFFICE PHONE
Laboratory Safety Officer *Primary Emergency Coordinator*	(603) 534-9872	(603) 862-5038
Hazardous Waste Manager *Alternate Emergency Coordinator*	(603) 534-9873	(603) 862-3526
Director of EHS *Alternate Emergency Coordinator*	(603) 534-9871	(603) 862-4041
Radiation Safety Officer	(603) 312-2500	(603) 862-3607
Biological Safety / Security Officer	(603) 475-7543	(603) 862-0197
Hazardous Waste Coordinator	(603) 534-6010	(603) 862-0683
Occupational Safety Coordinator		(603) 862-4761
Chemical Inventory Coordinator		(603) 862-1510
Facilities Control Center		(603) 862-1437
Environmental Health and Safety		(603) 862-4041
Fire/Police Dispatch		911
Emergency Medical Services (EMS), Hospital, etc.		911
Local Emergency Response Team		911
State of New Hampshire - Department of Environmental Services		(603) 271-2942

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FOREWORD

The **Chemical Hygiene Plan** is intended to comply with the following federal, state, and local regulations:

- USNH USY VI.F.3. "University System Policy on Environmental Health and Safety"
- USNH VI.F.1.3. "Board of Trustee Policy on Environmental Health and Safety"
- New Hampshire RSA 277-A "Worker's Right to Know Law"
- New Hampshire Lab 1403.36 "Hazardous and Toxic Substances"
- 29 CFR 1910.1450 "Occupational Exposures to Hazardous Chemicals in Laboratories"
- 29 CFR 1910.1200 "Hazard Communication"
- National Fire Protection Association Requirements
- Durham Ordinances

The **Chemical Hygiene Plan** should not be considered the only reference for health and safety concerns. However, this document does provide a compilation of suggested work practices, protocols and systems to work safely in University of New Hampshire laboratories. In addition, the Office of Environmental Health and Safety is always available to address health and safety concerns. This document will be evaluated and updated at least every two years by the Chemical Safety Committee. This document also contains several appendices with essential information for laboratory personnel. The Office of Environmental Health and Safety will evaluate and update the appendices on a routine basis.

At the time of publishing, the Chemical Safety Committee was composed of the following individuals:

CHEMICAL SAFETY COMMITTEE
Clyde Denis
Kyung Jae Jeong
Andy Glode
Scott Greenwood
Tom Harris
Linda Kalnejais
Lee Jahnke
Sarah Prescott
Bradford Manning
Marty McCrone
Janet Poff
Cindi Rohwer
Karen Jensen
Cheryl Whistler

Link to Chemical Safety Committee

The Chemical Safety Committee would like to thank the University of Massachusetts for allowing us to use their template for this health and safety manual.

Chapter 1 – Chemical Hygiene Plan

Section 1: Introduction

Section 2: Administrative Responsibilities

Department Chairs
Departmental Health & Safety Coordinator
Faculty Members
Employees and Students
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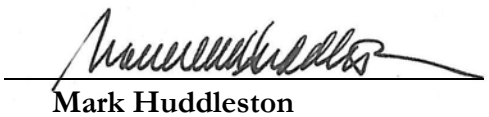
Section 1: Introduction

It is the policy of UNH to maintain a safe environment for its students, academic appointees, staff, and visitors in an atmosphere that encourages employees, students, and other campus members to communicate occupational safety and environmental health matters without fear of reprisal. The University will promote comprehensive biological and chemical safety programs based on applicable health and safety standards promulgated by federal and state agencies, including the OSHA regulation, 29 CFR 1910.1450, titled, "*Occupational Exposures to Hazardous Chemicals in Laboratories*," as well as published standards of nationally recognized professional health and safety groups.

The Office of Environmental Health and Safety (OEHS) and the various campus safety committees help to assure that campus policies and state and federal mandates are followed. OEHS and the safety committees have written the Chemical Hygiene Plan to define administrative responsibilities, accepted safety guidelines and standards, proper laboratory facilities, safety equipment, emergency procedures, medical surveillance, exposure monitoring, training and recordkeeping requirements.

The purpose of the Chemical Hygiene Plan is to provide a framework for recognizing, evaluating, and controlling hazards associated with laboratory operations. Departments may choose to go "above and beyond" this document and implement additional health and safety protocols. Implementation of the Chemical Hygiene Plan depends on the cooperation of department chairs, faculty, laboratory staff, students, OEHS staff and members of safety committees. The responsibility for safety and health must be shared by all and we must work towards meeting the standards set forth in this Chemical Hygiene Plan with the common goal of promoting a healthy and safe environment for all employees and students. We recognize that in some situations, proper facilities and equipment are not available for conducting projects. When this is the case, faculty members should consult with your *Departmental Safety Committee Representative* and OEHS for assistance in evaluating hazards and finding ways to conduct work in a safe and healthy manner.



Mark Huddleston
President

Section 2: Administrative Responsibilities

Each individual faculty member is responsible for implementing all University health and safety policies in his/her laboratory. The Dean of each college will implement University health and safety policies. The Department Chair will ensure compliance with existing health and safety policies by designating a *Departmental Safety Committee Representative*. OEHS is available to provide additional oversight, training, consultation, and technical assistance. Specific responsibilities are outlined below.

Responsibilities of Department Chairs and Directors

Department Chairs and Directors are responsible for the overall operations of their programs. Department Chairs and Directors shall also:

1. Disseminate and inform faculty and staff of University health and safety policies.
2. Designate a *Departmental Safety Committee Representative*.
3. Ensure faculty and staff have updated their emergency contact lists and communicated that information to the Office of Environmental Health and Safety (OEHS).

Responsibilities of the Departmental Safety Committee Representative

The Departmental Safety Committee Representative is appointed by lead administrator (i.e., Vice President, Dean, Director) for the division or college and is made up of faculty representatives. The Departmental Safety Committee Representative shall also:

1. Assist each faculty member in implementing University safety and health policies.
2. Communicate information on health and safety policies to faculty and staff.

Responsibilities of Faculty Members

Faculty members are responsible for the day-to-day health and safety management of their laboratories and ensuring compliance with federal, state, and local laws. Faculty members shall also:

1. Develop and implement Standard Operating Procedures (SOPs) that include health and safety considerations for work involving the use of hazardous materials.
2. Develop and implement applicable health and safety policies for the laboratory.
3. Develop written safety procedures applicable to their research and teaching activities.
4. Mandate laboratory practices and engineering controls that reduce the potential for exposure to hazards.
5. Inform all laboratory staff and students of the potential hazards associated with laboratory operations. Discuss the hazardous properties associated with chemicals in the laboratory (e.g., reproductive toxin, carcinogen, mutagen, poison, flammable, peroxidizable, explosive).

6. Inform laboratory personnel of the proper procedures for dealing with accidents and spills.
7. Ensure employees and students are trained as required by the **State of New Hampshire RSA 277-A** "Right to Know" regulation, the **OSHA Right-to-Know Law,** and University of New Hampshire health and safety policies.
8. Supervise laboratory personnel to ensure that safe practices and engineering controls are employed.
9. Instruct laboratory personnel on the location and use of safety equipment in the facility.
10. Designate at least one person to serve as a safety contact in your absence.
11. Post telephone numbers for all emergency response and safety contacts in a noticeable area in the laboratory, preferably near a telephone. Ensure the posting is updated during sabbaticals or other absences.
12. Keep emergency telephone call-back lists up-to-date.
13. Report accidents and any other safety problems to the *Departmental Safety Committee Representative* and Office of Environmental Health and Safety (OEHS).
14. Conduct periodic safety inspections and ensure problems are remedied.
15. Address issues identified by the Laboratory Safety Survey (see **Appendix C**).
16. Ensure that lab members understand how to access Safety Data Sheets (SDSs). OEHS provides online SDSs at https://cems.unh.edu.

Responsibilities of Employees, Students, and Visitors

All personnel who use, store, and handle hazardous materials are required to abide by the minimum requirements set forth in the UNH Chemical Hygiene Plan as well as any requirements specific to their school, department, or division. Employees, students, and visitors shall also:

1. Follow all safety and health procedures specified in the Chemical Hygiene Plan and by the faculty member in the laboratory.
2. Complete required health and safety training sessions.
3. Report accidents, unhealthy and unsafe conditions to the faculty supervisor, *Departmental Safety Committee Representative* and/or OEHS.
4. Notify the faculty supervisor of any health conditions that could lead to serious health situations in the laboratory.

Responsibilities of Maintenance Workers and Contractors

All personnel who access laboratories which contain hazardous chemicals are required to abide by the minimum requirements set forth in the UNH Chemical Hygiene Plan with regard to appropriate clothing and PPE as well as any other requirements specific to the particular laboratory they are entering. Maintenance workers and contractors must at a minimum:

1. Complete safety awareness training appropriate to the laboratory they are entering including chemical safety awareness training, biosafety awareness training, and/or radiation awareness training.
2. Comply with provisions of the UNH Hazard Communication Standard.

Responsibilities of the Office of Environmental Health & Safety (OEHS)

OEHS is responsible for ensuring the effectiveness and evaluation of the UNH Chemical Hygiene Plan. OEHS provides support and technical assistance in the safe use, storage, and disposal of hazardous materials at UNH. OEHS shall also:

1. Provide technical guidance on matters of laboratory safety.
2. Inspect laboratories to assure compliance with safety and health guidelines and regulations and to assist with remediation of safety issues.
3. Investigate accidents and recommend action to reduce the potential for recurrence.
4. Coordinate clean-up operations in the event of a large chemical or biological spill or if a spill reaches the environment.
5. Develop and conduct training programs in laboratory safety.
6. Work with state and local officials on matters of codes and enforcement.
7. Assist laboratory personnel with evaluating, preventing, and controlling hazards.
8. Oversee the adoption and implementation of all University health and safety policies.
9. Maintain training and audit documentation.

Section 3: Safety Committees

UNH has established the Radiation Safety Committee (RSC) and Institutional Biosafety Committee (IBC) according to government mandates. UNH has also established a Chemical Safety Committee (CSC) and an Occupational Safety Committee (OSC). These committees are standing committees under the University Environmental Health and Safety Committee (UEHSC). The members of these safety committees are appointed by the Senior Vice Provost for Research to improve conditions specific to this University. It shall be the responsibility of these committees to establish safety and health policies in accordance with federal, state, and local regulations and evaluate research being conducted on the UNH campus for safety and health considerations. In addition, departments should form safety committees to review and address safety issues specific to their areas.

Consistent with USNH Board of Trustees guidance and particular regulations which may apply, standing committees such as the Chemical Safety Committee exist within the UEHSC structure to develop specific policies and procedures related to hazardous materials and hazardous operations. Although university wide in the scope of its activities, service of individuals appointed to the UEHSC does not change established line authorities and reporting responsibilities. Standing committees that are assigned safety responsibilities at UNH are responsible for reviewing issues and recommending specific operational programs and practices within their areas of expertise. The UEHSC, based on thorough consideration of the collected technical input and administrative advice submitted by the standing committees, officially formulates policy and recommends actions for approval by the President. The body of approved UEHSC policies constitutes the University standard for safe facilities, operations and practices at UNH. The UEHSC can review procedures, programs and protocols approved by the standing committees

and vote to override the committees' action. However, the UEHSC cannot approve procedures, programs or protocols that have been rejected by the standing committees.

Section 4: Laboratory Construction and Renovation Projects

All design, construction, and modification of laboratory facilities must be reviewed by the UNH Facilities and OEHS, whether executed by an outside contractor or internal personnel. In order to ensure the safety of new and renovated laboratories, specific design and construction features are required by state and federal codes.

Section 5: Americans with Disabilities Act / Reasonable Accommodations

The Americans with Disabilities Act (ADA) requires the University of New Hampshire to make reasonable accommodations for students, staff, and faculty with disabilities as defined by the ADA. If you are a student with a disability and wish to discuss academic accommodations, contact Disability Services for Students, room 201, Smith Hall, or at 603-862-2607 (V/TTY). If you are a staff or faculty member with a disability and wish to discuss reasonable accommodations, contact the ADA Compliance Officer in Affirmative Action and Equity, room 305, Thompson Hall or at 603-862-2930 (V/TTY).

Chapter 2 – Laboratory Safety Practices

Section 1: General Laboratory Safety Procedures

Section 2: Food and Beverages in the Laboratory

Section 3: Security

Section 4: Working Alone in the Laboratory

Section 5: Laboratory Safety Inspections

Section 1: General Laboratory Safety Procedures

Each laboratory will have its own safety requirements. The following are minimum general safety practices which must be followed in all laboratories on campus:

1. Know the hazardous properties of the materials you are working with (e.g., chemical, biological, electrical, radioactive): Refer to the written laboratory protocols and review the Safety Data Sheets (SDS) for chemicals which are available in UNHCEMS. Consider the toxicity of materials, the health and safety hazards of each procedure, the knowledge and experience of laboratory personnel and the safety equipment that is available.
2. Know the location of safety equipment and emergency and exit procedures.
3. Always wear appropriate clothing (e.g., pants, shirts, closed toe shoes) and personal protective equipment (e.g., safety glasses, lab coats, gloves) in the laboratory. Open sandals, clogs, crocs, and similar footwear are prohibited; shorts and skirts are not recommended.
4. Remove personal protective equipment (PPE) before leaving the laboratory, some exceptions apply. See Ch. 6, Section 5, "Protective Clothing Outside the Laboratory".
5. If hazardous operations are conducted in the laboratory, arrangements should be made to have another person present. See Ch. 2, Section 4, "Working Alone in the Laboratory," for additional information.
6. Use a properly operating fume hood when working with hazardous chemicals.
7. Do not eat, smoke, drink, prepare food, or apply cosmetics in the laboratory.
8. Keep work areas clean and uncluttered at all times.
9. No horseplay is allowed in laboratories. Activities that can startle or distract someone working with hazardous materials can lead to unnecessary risk.
10. Do not leave reactions unattended without conducting a risk assessment. Contact OEHS for more information.
11. Unauthorized individuals are prohibited from entering the laboratory.
12. Persons under 14 years of age are prohibited from entering certain high-hazard/high-risk areas (e.g., laboratories with hazardous chemicals, infectious organisms, or rooms with hydraulic equipment, lasers or radioactive material). Exceptions to this policy require prior written approval from OEHS. Additional information about children in high hazard areas can be found on the OEHS website at http://unh.edu/research/chemical-safety-plans-and-programs.
13. Employees under 18 years of age are subject to the New Hampshire Youth Employment Law (RSA 276-A). Contact Human Resources for more information.
14. Assistance animals or other vertebrate animals are only allowed in campus laboratories with written approval from the Institutional Animal Care and Use Committee and/or the Affirmative Action and Equity Office.
15. Refer to ***Safety in Academic Chemistry Labs*** (ISBN: 0841232598) in addition to this manual for other safety procedures to follow in the laboratory.
16. Proper operation of a centrifuge is essential in the laboratory. Accidents involving centrifugation can cause serious personal injury and damage to laboratory equipment. Centrifuge problems may arise from improper mechanical conditions, unbalanced rotors, hazardous materials, and operator error. The operator of a

centrifuge must have knowledge of the manufacturer's recommended instructions and the hazards associated with centrifuge use. An SOP should be developed for each centrifuge. See **Appendix H** for additional information.

17. Mechanical pipetting aids must be used. Mouth pipetting is prohibited.
18. Sharps containers are used for the disposal of hypodermic needles and syringes, razor blades and other sharp items. See **Appendix D** for additional information about sharps disposal.
19. "Glass Only" boxes are used for the disposal of "clean" broken glass only. When three-quarters full, the boxes should be properly sealed and disposed in a dumpster.

Section 2: Food and Beverages in the Laboratory

In order to reduce potential exposures and to ensure compliance with prudent laboratory operations, regulations, and other best management practices, UNH prohibits the storage and consumption of food and drink in all campus laboratories. The only exception is for food and beverages used in research and teaching projects. These materials must be labeled, "Not for Human Consumption."

In order to prevent potential exposure to hazardous materials:

- Do not eat, drink, smoke, chew gum, apply cosmetics, or take medicine in laboratories where hazardous materials are handled or stored.
- Do not store food, beverages, cups, or other drinking and eating utensils in areas where hazardous materials are handled or stored.
- Do not use glassware for laboratory operations to prepare or consume food or beverages.
- Do not use laboratory refrigerators, ice chests, cold rooms, and ovens for food storage or preparation.
- Do not use laboratory water sources or deionized laboratory water for drinking water.

Important: Food and beverages must never be stored in any laboratory refrigerator in which chemicals, biological, and radioactive materials are kept unless they are intended for research purposes only and have been labeled, "Not for Human Consumption."

Section 3: Security

Laboratory security is an integral part of an effective safety program. Follow these steps to ensure a secure working environment in your laboratory:

1. Keep laboratory doors closed and locked when unoccupied.
2. Keep stocks of organisms and hazardous chemicals locked when the laboratory is unoccupied.
3. Keep an accurate record of chemicals, stocks, cultures, project materials, growth media, and those items that support project activities.
4. Notify UNH police if materials are damaged or missing from laboratories.

5. Inspect all packages arriving into the laboratory.
6. When research is completed for the day, ensure that chemicals and biological materials have been stored properly and securely.
7. Ask strangers (someone you do not recognize as a co-worker or support staff person) to exit the room if they are not authorized to be there.
8. Discuss other security-specific requirements with your supervisor and colleagues.

Section 4: Working Alone in the Laboratory

All faculty, staff, students, and visitors working in a laboratory where hazardous conditions exist must have knowledge of the following:

- Emergency Contacts;
- Emergency Response Procedures;
- Evacuation Routes;
- Health and Safety Training Requirements;
- Personal Protective Equipment Requirements;
- Procedures to Report Unhealthy and Unsafe Conditions;
- Safety Policies and Procedures; and
- Spill Response Equipment and Procedures.

All personnel working **alone**‡ in a laboratory where hazardous conditions exist shall:

- Obtain written permission (e.g., e-mail, letter) from the Principal Investigator or Laboratory Supervisor to work alone in the laboratory; and
- Ensure that a means to contact emergency response personnel is available when working alone in the laboratory.

‡According to the National Safety Council, the term "alone" means that a person is beyond the visual or auditory range of any other individual for more than a few minutes at a time.

Section 5: Laboratory Safety Inspections

OEHS inspects laboratories at least once a year. The safety inspection includes an evaluation of the fume hood operation, laboratory techniques, emergency and safety equipment, chemical storage, electrical safety, and general housekeeping. Additional safety surveys are conducted when radioactive materials and biohazardous materials are in use and hazardous waste is stored.

Following the laboratory safety inspection, a report listing the safety concerns is sent to the faculty member responsible for the laboratory. The faculty member is responsible for correcting the issues as soon as possible and no later than the deadline provided by OEHS. If the faculty member fails to correct the hazard by the deadline, a second notice is sent to the department head and the ***Departmental Safety Committee***

Representative, with a copy to the faculty member. Follow-up inspections may be conducted to confirm resolution of safety issues.

In addition to these annual laboratory safety inspections, it is recommended that laboratory personnel update the chemical inventory and periodically conduct their own safety inspections on a regular basis. The American Chemical Society recommends that laboratories are inspected at intervals of no more than three months.

In cases where OEHS considers there to be conditions that are imminently hazardous to people or the environment, they may shut down laboratory or research operations until issues are fully evaluated and resolved.

Chapter 3 – Chemical Safety

Section 1: Chemical Hygiene in Laboratories

The use of hazardous chemicals is integral to the academic and research missions at the University of New Hampshire. In order to help ensure the protection of faculty, staff, students, and visitors in laboratories, the Occupational Safety and Health Administration (OSHA) promulgated 29 CFR 1910.1450, **Occupational Exposures to Hazardous Chemicals in Laboratories.** This regulation, also known as the OSHA Laboratory Standard, requires the development and implementation of a written Chemical Hygiene Plan that is "capable of protecting employees from health hazards associated with hazardous chemicals used in the laboratory." The UNH Chemical Hygiene Plan was developed and implemented to meet the requirements of this regulation and 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 campus laboratories.

In addition to the responsibilities listed in **Chapter 1**, each laboratory supervisor must ensure that all laboratory personnel under their direct supervision possess the requisite knowledge, training, and education to safely handle hazardous chemicals in the laboratory. All laboratory personnel are responsible for following appropriate work practices when using hazardous chemicals.

Section 2: Controlling Exposures to Chemical Hazards

Controlling exposures to chemical hazards and toxic substances is the fundamental method of protecting workers. A hierarchy of controls is used as a means of determining how to implement feasible and effective controls.

The hierarchy of controls (see Figure 1) for protecting laboratory workers from hazardous chemical in the laboratory is:

1. Reduction and substitution. Eliminate use of a hazardous chemical or substitute with a safer alternative.
2. Engineering controls. Examples include use of chemical fume hoods, glove box, or biosafety cabinet.
3. Administrative controls. Use of safe working procedures or processes.
4. Personal protective equipment (PPE). Lab coat, safety glasses, gloves, face shield, etc.

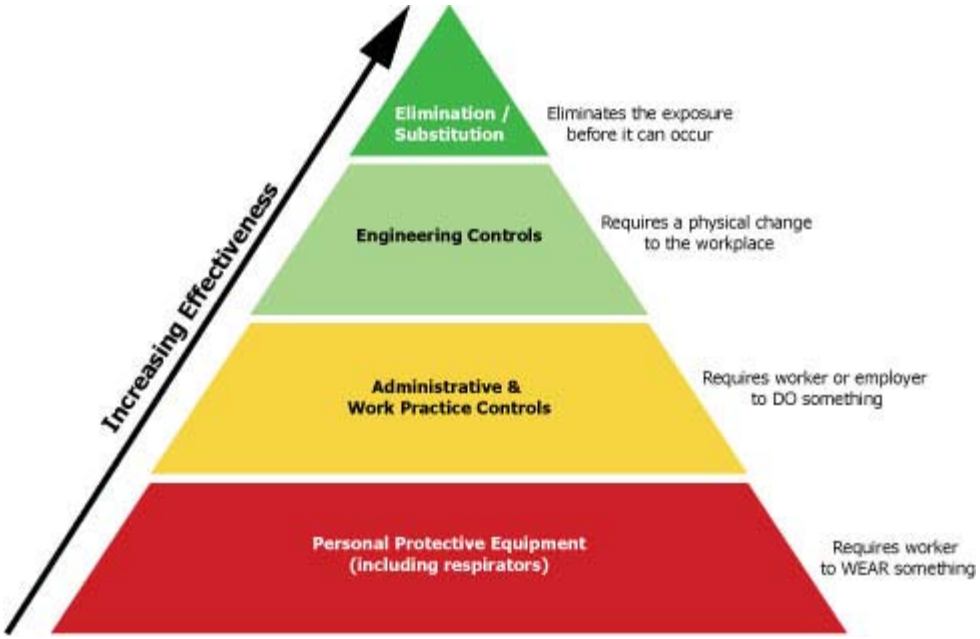


Figure 1. Hierarchy of Controls

This hierarchy is interpreted to mean that reduction/elimination of hazards is always more effective at protecting workers than engineering controls. Engineering controls are more effective at protecting workers than administrative controls. And, administrative controls are always more effective than PPE. It is important to note that personal protective equipment is the ***least effective means*** of protecting workers from chemical hazards. PPE should always be considered the last line of defense.

Section 3: Use of Hazardous Chemicals

Hazardous chemicals may only be used in laboratory and other facilities specifically intended for such use and designed with the appropriate infrastructure and engineering controls. This includes offices, dormitories, apartments, or other residential environments. Hazardous chemicals must never be used or stored in carpeted areas.

Hazardous chemicals may not be removed from UNH property without prior written approval by a Dean, Director, or other appropriate administrator.

Chemical exposures to laboratory personnel must not exceed the Permissible Exposure Limits (PELs) established by OSHA. Laboratory operations conducted in a properly operating fume hood, or similar containment device, are unlikely to result in excessive airborne exposures. The Office of Environmental Health and Safety should be consulted if:

- The chemical to be used can cause severe acute or lethal effects upon exposure by any route of entry to the quantities handled.
- The chemical has the potential to create an atmosphere that poses an immediate threat to life.
- The chemical is temperature or shock sensitive.

- The chemical has an unknown composition.
- The chemical may generate by-products that may overcome standard control measures or penetrate personal protective equipment to cause severe acute or lethal injuries.
- The laboratory operations produce conditions that may exceed OSHA PELs.

It is prudent to minimize all chemical exposures. Never deliberately taste or smell chemicals.

Section 4: Chemical Inventory

The OSHA Hazard Communication Standard and the Durham Fire Department requires the University to maintain an inventory (e.g., a comprehensive list) of hazardous chemicals. A hazardous chemical is defined as any liquid, solid, or gas that could present a physical or health hazard to an employee. All hazardous chemicals used at UNH must be registered through and inventory kept up-to-date in UNHCEMS™. The Durham Fire Department and other emergency responders use UNHCEMS™ when responding to an emergency.

Section 5: Safety Data Sheets

The Safety Data Sheet, or SDS, (formerly known as a Material Safety Data Sheet or MSDS) is a summary of safety information for a hazardous substance or material. OSHA requires manufacturers and importers of chemicals to create a SDS for these materials. Laboratory workers should read the SDS for each hazardous material they work with. SDSs must be readily accessible to employees; UNH provides SDSs online at https://cems.unh.edu.

Sections 1 through 8 contain general information about the chemical, identification, hazards, composition, safe handling practices, and emergency control measures (e.g., fire-fighting). This information should be helpful to those that need to get the information quickly.

Sections 9 through 11 and 16 contain other technical and scientific information, such as physical and chemical properties, stability and reactivity information, toxicological information, exposure control information, and other information including the date of preparation or last revision. The SDS must also state that no applicable information was found when the preparer does not find relevant information for any required element.

The SDS must also contain Sections 12 through 15, to be consistent with the UN Globally Harmonized System of Classification and Labeling of Chemicals (GHS). These sections contain information about ecological information, disposal considerations, transport information, and regulatory information.

More detail about the format of a SDS can be found at:
https://www.osha.gov/Publications/OSHA3514.html

Section 6: Labeling Chemicals

All containers must be dated and labeled with the full name of the chemical constituents and hazards, such as a NFPA rating for the chemical. It is recommended that the user's name also appear on the label. Labels on incoming containers must not be removed or defaced. Dating is especially important in the case of compounds which have a specified shelf life, such as those that will form peroxides (e.g., ethyl ether).

Identifying unknown materials for disposal is extremely costly. All laboratory personnel who are leaving the University are responsible for identifying and properly disposing of the chemical waste in their laboratory. Contact OEHS for additional information.

Chemical names must be spelled out on labels. Chemical formulas, acronyms, and abbreviations are not acceptable as the only identification of the contents of a container. Laboratory samples, including field specimens and newly synthesized compounds, must be identified as accurately as possible. For field specimens that include preservative, the preservative must be identified. In cases where the container is unable to be labeled, steps should be taken to ensure the contents can be identified (e.g., label the rack, box, or other outer container).

Section 7: Chemical Procurement and Distribution

Laboratory personnel should always plan experiments with safety in mind and substitute less hazardous chemicals in laboratory procedures whenever possible. Examples include substituting methyl tertiary-butyl ether (MTBE) for ethyl ether, toluene for benzene and dichloromethane for chloroform and carbon tetrachloride. Laboratory personnel should minimize the use of mercury in the laboratory and replace mercury-containing devices with non-mercury options whenever possible.

1. Before ordering new chemicals, check the chemical surplus list on the UNHCEMS™ website at https://cems.unh.edu to see if the chemical you need is available for free. Estimate the amount of chemical required for each experiment and order only what is necessary. Excess chemicals are very expensive to dispose of and can cause a hazard if stored too long.

2. Orders for all hazardous chemicals and regulated biological agents should be shipped to the **Chemical Transfer Station** using the instructions listed on the next page. The Chemistry Department has all orders shipped to the chemistry stockroom. Chemical ordering instructions are also available on the OEHS website at Chemical Ordering Instructions.

   Note: Packages weighing more than 75 pounds (34 kg) require special arrangements and must not be sent to the Chemical Transfer Station. Please call the Office of Environmental Health and Safety at 603-862-4041 for more information.

3. SDSs are available at https://cems.unh.edu or through the chemical vendor.

4. Keep your chemical inventory and your door Caution signs updated at https://cems.unh.edu.

5. Before opening a package containing hazardous substances, inspect the packaging carefully for any signs of breakage or leakage of material. If there are any signs of leakage, place package in chemical fume hood, protect from exposure and call OEHS for assistance.

Chemical Ordering Instructions
Fisher: http://www.fishersci.com (800) 766-7000
For chemical orders use a Fisher account number that ships to the Chemical Transfer Station, 11 Leavitt Lane. Account numbers that ship to the Chemical Transfer Station can be provided by your Business Service Center representative. Register to use an account number for online chemical orders by visiting the Fisher website. For each chemical order, enter in the attention line the building and room number to which you want the chemicals delivered.
Sigma-Aldrich: http://www.sigmaaldrich.com/pipeline (800) 325-3010
Register for an online chemical ordering account at Sigma Aldrich's Pipeline website with the registration code: USA_UNH (case sensitive). Orders with this account will be shipped to the Chemical Transfer Station, 11 Leavitt Lane. For each chemical order, enter in the attention line the building and room number to which you want the chemicals delivered.
VWR: http://www.vwr.com (800) 932-5000
For chemical orders use an account number that ships to the Chemical Transfer Station, 11 Leavitt Lane. Account numbers that ship to the Chemical Transfer Station can be provided by your Business Service Center representative. For each chemical order, enter in the attention line the building and room number to which you want the chemicals delivered.

For chemical orders made with all other suppliers:	
Shipping Instructions:	**For Chemistry Department only:**
1. Use this "ship-to" address: [Your Name] UNH Chemical Transfer Station 11 Leavitt Lane Durham, NH 03824	1. Use this "ship-to" address: [Your Name] Parsons Hall, Room 143 23 College Road Durham, NH 03824
2. Enter in the attention line the building and room where you want the chemicals delivered. **Note:** Online ordering is the preferred method because both you and EH&S receive a confirmation email. This will assist EH&S in scheduling deliveries.	2. Enter in the attention line the building and room where you want the chemicals delivered.
Reminder: Before you order, check the UNH Chemical Surplus List at the online inventory https://cems.unh.edu where the chemical may be available at NO COST.	
If you need a UNHCEMS™ account or have any questions on how to make chemical orders, call the Office of Environmental Health and Safety at 603-862-4041.	

Section 8: Housekeeping

Good housekeeping is mandatory in all laboratories using or storing hazardous chemicals. Ensure that all chemical spills are cleaned up promptly and safely. Dispose of old chemicals, mixtures, and solutions routinely (e.g., after each semester). Keep exit routes clear and never block access to emergency equipment (e.g., eyewash station, deluge shower, fire extinguisher). Keep clutter to a minimum in chemical fume hoods, safety cabinets, benches, tabletops, and on the floor. Ensure trash, broken glass, sharps, recyclables, and chemical wastes are properly disposed.

Section 9: Chemical Storage

The number and amounts of chemicals in laboratories should be reduced to the minimum necessary to meet research/teaching goals. Chemicals that are no longer useful should be systematically identified and disposed. Chemicals should be stored based on their compatibility; compatible chemicals can be stored alphabetically. Incompatible chemicals must be physically segregated during storage. Corrosives, flammable liquids, oxidizers, and highly reactive chemicals must be separated and stored properly to avoid an unwanted chemical reaction. Information on incompatible chemicals is available in **Appendix E** and available on the OEHS website at http://unh.edu/research/chemical-safety-plans-and-programs. Fume hoods should not be used for chemical storage.

Specially designed cabinets should be used to store hazardous chemicals. Hazardous chemicals should not be stored under sinks. Chemically-compatible bins should be used as secondary containment and to segregate incompatible materials. Proper chemical storage also includes the following:

- Storage areas should be well ventilated.
- Large containers of reagents should be stored on low shelving, preferably in trays to contain all leaks and spills.
- Chemicals should not be stored on the floor, on bench tops, or inside fume hoods.
- Inventories of storage areas should be conducted on an ongoing basis, and at least annually, and results should be included in UNHCEMS™.
- Odiferous chemicals should be stored inside vented cabinets.
- Flammable and combustible liquids requiring refrigeration must be stored in units designed for flammable material storage. Typical domestic refrigerators and freezers are not approved for flammable material storage and may result in fire and explosion hazards.

Section 10: Special Operating Procedures for Hazardous Chemicals

A. Corrosive Chemicals

Corrosive chemicals include strong acids and bases, dehydrating agents, nonmetal chlorides and halogens. These chemicals are acute health hazards and present

problems in handling and storage. In addition to general procedures for handling of chemicals detailed in this manual, the following procedures should be followed:

- Store in corrosives cabinets; these may be under a hood or a standalone cabinet.
- Gas cylinders (including lecture sized) should not be stored in the same cabinet with corrosive liquid, because of possible cylinder/valve damage.
- Properly segregate hazardous materials to prevent fire, explosion or toxic gas release. For example, segregate acids from bases and oxidizing acids from organic acids. Also, segregate nitric acid from other acids.
- Make sure containers and equipment, such as tubing used with corrosive materials, are compatible with those materials.
- Personal protective equipment is important for work with corrosives. Neoprene or rubber gloves, goggles and face shield, rubber apron, and rubber boots should be considered.
- Add acid to water, never water to acid.
- Wherever corrosives are used or stored, be sure there is a working, readily accessible eyewash and safety shower.
- Seek medical attention immediately in the event of a potentially injurious exposure.

B. Flammable Liquids

Flammable and combustible liquids are chemicals in a liquid state that can easily burn. They are classified, or grouped, as either flammable or combustible by their flashpoints. Flammable liquids will ignite (i.e., catch on fire) and burn easily at normal working temperatures. Combustible liquids have the ability to burn at temperatures that are usually above working temperatures. See Table 1 for the various flash and boiling points according to the NFPA.

Table 1. Flash/Boiling Points for NFPA Categories.

	Flash Point		Boiling Point	
TYPE	Fahrenheit	Celsius	Fahrenheit	Celsius
Class IA	< 73˚	< 22.8˚	< 100˚	< 37.8˚
Class IB	< 73˚	< 22.8˚	> 100˚	> 37.8˚
Class IC	73˚ - 100˚	22.8˚ - 37.8˚		
Class II	100˚ - 140˚	37.8˚ - 60˚		
Class IIIA	140˚ - 200˚	60˚ - 93.3˚		
Class IIIB	> 200˚	> 93.3˚		

Flammable and combustible liquids are present in almost every workplace. Fuels and many common products like solvents, thinners, cleaners, adhesives, paints, waxes and polishes may be flammable or combustible liquids.

It is important to remember that as a general rule, a fire typically requires:

- Fuel in solid, liquid, or gas form. Fuel in the gaseous state must be between upper and lower explosion limit to combust.
- Oxygen in the form of breathable air or other chemical sources such as oxidizers.
- A source of ignition, including heat, sparks, static discharge, and open flame.

In order to work safely with flammable liquids:

- Order only the amounts that are necessary.
- Remove all nearby sources of ignition.
- Heat flammable liquids with safe heating equipment (e.g., mantles) or explosion-safe equipment.
- When transferring flammable liquids using metal containers, ground both containers and bond the receiving container to the dispensing container. For bonding and grounding to be effective, a metal-to-metal connection must be maintained between the bonding and grounding cables and the containers.
- Though uncommon, some plastics require special grounding to prevent static charge; avoid use of these plastics. In cases where they are used, employ grounding techniques as prescribed by the manufacturer or contact OEHS for more information.
- Store flammable liquids in safety cans, flammable storage cabinets, or flammable storage refrigerators.
- Locate all distillation apparatus inside a functioning chemical fume hood.
- Do not leave solvent distillation processes unattended.
- Contact OEHS for an evaluation if intrinsically safe equipment might be required with your use of flammable materials.

C. Storage of Flammable Liquids

Limits for the storage of flammable solvents are based on fire hazards associated with each liquid. The following requirements must be followed:

- Flammable liquids stored in the laboratory should be kept to a minimum.
- Flammable liquids must not be stored next to sources of ignition or oxidizers.
- Storage of flammable liquids outside approved flammable storage cabinets and safety cans must not exceed 10 gallons per 100 square feet of laboratory space, including waste.
- Storage in flammable storage cabinets and approved safety cans must not exceed 20 gallons per 100 square feet of laboratory space.

There are maximum container size requirements for different classes of flammable liquids and limits for the maximum amounts stored in a laboratory. Some locations, such as laboratories in Parsons Hall, have flammable liquid storage limits posted on the door caution signs. Please contact OEHS for additional information.

D. Safety Cans

Safety cans must be approved by Underwriter Laboratory (UL) or Factory Mutual (FM) for flammable and (non-corrosive) combustible materials. They are made of 22-gauge steel and have a self-closing lid or quarter turn spigot.

E. Flammable Storage Cabinets

Flammable storage cabinets are designed to protect the contents of the cabinet from heat and flame in the event of a fire. According to the National Fire Protection Association (NFPA), flammable storage cabinets are not required to be ventilated. If there are ventilation openings in the cabinet, then: (1) The ventilation opening must be sealed with materials providing fire protection at least equivalent to that of the construction of the cabinet; or, (2) The cabinet must be vented outdoors using appropriate fire protection piping. Flammable storage cabinets should not be vented by removing bung caps or flame arrestors.

Follow these procedures when using or considering the use of flammable storage cabinets:

- Flammable storage cabinets should not be located near exits, electrical panels or sources of heat or ignition.
- Factory Mutual, Underwriter's Laboratory, or other qualified testing agencies, must list flammable storage cabinets.
- The flammable storage cabinet must be clearly labeled with a sign, which reads "FLAMMABLE – KEEP FIRE AWAY."
- Materials stored inside of the flammable storage cabinet should be compatible with the cabinet's design and construction.
- Corrosive materials should not be stored in a flammable storage cabinet due to possible corrosion of the cabinet and incompatibility with organic solvents.

F. Flammable Storage Refrigerators

According to Annex A of NFPA 45 – Standard on Fire Protection for Laboratories Using Chemicals:

> "The use of domestic refrigerators for the storage of typical laboratory solvents presents a significant hazard to the laboratory work area. Refrigerator temperatures are almost universally higher than the flash points of the flammable liquids most often stored in them. In addition to vapor accumulation, a domestic refrigerator contains readily available ignition sources, such as thermostats, light switches, and heater strips, all within or exposed to the refrigerated storage compartment. Furthermore, the compressor and its circuits are typically located at the bottom of the unit, where vapors from flammable liquid spills or leaks could easily accumulate."

Flammable storage refrigerators are specially designed to prevent internal explosions caused by flammable vapors being exposed to ignition sources (e.g., the temperature control switch or the light). In addition, explosion-proof refrigerators and freezers

have an explosion-proof interior and exterior. These refrigerators and freezers must meet UL, NFPA, and OSHA standards.

Due to these concerns, flammable liquids with a flash point below 100 degrees Fahrenheit are prohibited in household-type refrigerators at UNH. Flammable storage refrigerators are required for storage of any quantity of flammable liquids including solutions of solvents and storage of samples preserved in flammable liquids. If a properly rated refrigerator is not available, plan experiments accordingly to chill solvents ahead of time with ice or dry ice.

Explosion-proof refrigerators are designed to be used in locations where there may be a flammable environment. For normal laboratory operations, they can be used interchangeably with flammable storage refrigerators since they have no sources of ignition on the inside of the unit.

An explosion-proof refrigerator would be required in a location where all wiring was explosion-proof. There are a very limited number of locations on campus where this type of wiring is required.

In laboratories storing or using flammable liquids, refrigerators should be clearly marked to indicate whether it is safe for storage of flammable materials. Internal laboratory procedures must ensure that laboratory refrigerators are being properly used.

G. Compressed and Liquefied Gases

Compressed gases may present both physical and health hazards. Gases may be flammable, reactive, corrosive or toxic and these properties must be considered when developing experimental procedures and designing apparatus. In addition, compressed gases, when not handled properly or not contained in properly designed vessels, can be extremely hazardous with a high potential for explosion. All procedures and experimental apparatus used in the handling of extremely toxic gases and gases with a high potential for explosion should be approved by the UNH Chemical Safety Committee, prior to implementation.

Although each approved gas cylinder is designed, constructed, and tested to safely contain its contents, the following procedures should be taken in handling and storing of compressed gases.

All personnel who will be working in areas where compressed gases are used or stored must receive instructions from their supervisor regarding the safe handling of cylinders, emergency and evacuation procedures, the use of appropriate personal protective equipment, and those steps which may be necessary to be taken in the event of a leak or fire in or nearby the work area.

1. Gas Cylinder Storage and Labeling Requirements

a. When receiving a gas cylinder do not accept it until the following items are verified:

- The contents are identified either by labels or stencils;
- It contains the appropriate DOT label;
- It contains a valve protection cap (if so designed); and
- It is labeled with the current hydrostatic test date (if applicable).

b. Store gas cylinders in a well-ventilated area. All cylinders must be stored in a secured upright position to a sturdy permanent structure to prevent the cylinder from falling or being knocked over. Gas mixtures should be stored in accordance with their physical and chemical properties. Refer to the Safety Data Sheets for specific information. All gas cylinders should be secured individually.

c. All gas cylinders must be labeled as to their status: Full, In Use, or Empty. Store "empty" and "full" gas cylinders separately. Cylinders are considered "empty" if their pressure is less than 25 psig. All cylinders will be considered "full" that are not properly identified.

d. Place protective caps on those cylinders which are not in use.

e. Flammable gases must be kept separated from oxidizing gases. Oxygen containers should be separated from flammable gas by a minimum distance of 20-feet or a non-combustible barrier with a 1-hour fire rating.

f. Cylinders of gases having a Health Hazard rating of 3 or 4 (or 2 with no physiological warning properties) must be kept in a continuously mechanically ventilated hood or other continuously mechanically ventilated enclosure. There must be no more than three cylinders of gases with Health Hazard ratings of 3 or 4 per hood or other ventilated enclosure.

g. Cylinders containing gases that are corrosive to cylinders or cylinder valves or that may become unstable while stored in the cylinder shall have a maximum retention period of six months, unless a shorter period is otherwise specified by the manufacturer.

h. Do not store gas cylinders near elevators, ventilating systems, or other openings through which gas may spread to other parts of the building if a leak should occur. Do not store gas cylinders where there is a risk of having damage to the cylinder.

i. Cylinders in laboratory work areas containing oxygen, flammable gas, liquefied flammable gas, and with a Health Hazard rating of 3 or 4 shall comply with requirements in NFPA 45.

2. Gas Cylinder Handling Requirements

a. Cylinder valves should never be opened without a regulator or appropriate control valve specified by the manufacturer.

b. Always open cylinder valves slowly. Never force the valve open. If the valve cannot be opened by the wheel or small wrench provided, return the gas cylinder. To shut down a system, close the cylinder valve and relieve the pressure from the entire system through a hose that is not being used.

c. Never interchange regulators and hose lines among different types of gases. Cylinder regulators are specific to the use application, gas type and delivery pressure required.

d. Always turn off cylinders from the main stem valve (not the regulator). Turn off any cylinder slowly.

e. Suitable equipment must be available for moving cylinders and other portable containers. Hand trucks must be equipped with a clamp or chain to secure the container in place or they must be specifically designed for container handling. Never drag, roll, or slide a cylinder in an attempt to move it. Always remove regulator and place protective cap on a cylinder before attempting to move it.

f. Never drop cylinders, permit cylinders to strike each other, or strike cylinders with a metal instrument.

H. Peroxide Formers

A significant number of laboratory solvents can undergo autoxidation under normal storage conditions to form unstable and potentially dangerous peroxide by-products. This process is catalyzed by light and heat and occurs when susceptible materials are exposed to atmospheric oxygen.

To prevent accidents, peroxide forming compounds should be identified, dated upon opening, inventoried, and evaluated for safe use after three months. Do not store peroxide forming compounds in colorless glass bottles because the formation of peroxides is catalyzed by light. More information is available in the National Safety Council Publication, "Recognition and Handling of Peroxidizable Compounds." Questions regarding the use and storage of peroxidizable materials should be directed to OEHS.

Use these precautions when handling peroxide-forming agents:

1. Know the properties and hazards of the material you are using through adequate research and study, including reading the label and SDS.

2. When receiving a bottle of the material, write "Received on:" and the date on the label. Ensure that the chemical has been entered into UNHCEMS™ at https://cems.unh.edu.
3. When opening the bottle for the first time, write "Opened on:" and the date on the label.
4. Establish a laboratory routine to test all peroxide-forming chemicals on the first day of each month (or no later than every 3 months).
5. Do not purchase more of the chemical than can be reasonably used in a three month time period. Peroxides can build up over time as solvent evaporates and/or air seeps into the bottle.
6. If possible, purchase material that contains an appropriate peroxide inhibitor such as BHT (butylated hydroxyl toluene). If non-inhibited material must be stored, be sure to store the material under an inert atmosphere of nitrogen or argon and test it for peroxides at least once a month.
7. Do not distill, evaporate, or concentrate the material until it has been tested for the presence of peroxides. Peroxides are usually less volatile than their parent material and tend to concentrate upon distillation.
8. Do not store peroxide-forming materials in clear glass bottles (light can accelerate the chemical reactions that form peroxides). Always use an amber, but transparent bottle. Do not store the material in a metal can or other container which must be opened to see inside.
9. Do not store peroxide-forming chemicals near heat, sunlight, or ignition sources. Avoid places that undergo temperature variations which can cause the bottle to "breathe in" oxygen.
10. Do not purchase or use high-risk items such as di-isopropyl ether: use less hazardous alternatives.
11. NEVER touch or attempt to open a container of a peroxide-forming liquid if there are crystals around the cap and/or in the bottle. The vibration/friction of screwing the cap could detonate the bottle.

See the table below for examples of common peroxidizable compounds.

Table 2. Classes of Chemicals that can Form Peroxides Upon Aging*		
Class A – Chemical that form explosive levels of peroxides without concentration. (***Discard After Three Months)***	**Class B** – These chemicals present a peroxide hazard upon concentration (distillation or evaporation). A test for peroxide should be performed if concentration is intended or suspected. ***(Discard After One Year)***	**Class C** - Unsaturated monomers that may autopolymerize as a result of peroxide accumulation if inhibitors have been removed or are depleted. (***Discard After One Year)***
Isopropyl ether Butadine Chlorobutadiene (chloroprene) Potassium amide Potassium metal Sodium amide (sodamide) Tetrafluoroethylene Divinyl acetylene Vinylidene chloride	Acetal Cumene Cyclohexene Cyclooctene Cyclopentene Diaacetylene Dicyclopentadiene Diethylene glycol dimethyl ether (diglyme) Diethyl ether Dioxane (*p*-dioxane) Ethylene glycol dimethyl ether (glyme) Furan Methyl acetylene Methyl cyclopentane Methyl-isobutyl ketone Tetrahydrofuran Tetrahydronaphthalene Vinyl ethers	Acrylic acid Butadiene Chlorotrifluoroethylene Ethyl acrylate Methyl methacrylate Styrene Vinyl acetate Vinyl chloride Vinyl pyridine
* Lists are illustrative and not exhaustive. Reference: Prudent Practices in the Laboratory, "Handling and Management of Hazardous Chemicals," National Academy Press, 2011.		

I. Formaldehyde

Formaldehyde is a particularly hazardous substance that is used in several laboratories at UNH and is covered under a specific OSHA Standard 1910.1048. UNH must identify all laboratory activities that are above the OSHA Permissible Exposure Limit (PEL) or Short Term Exposure Limit (STEL) through initial air monitoring and provide training, medical surveillance, and engineering and work practice controls if levels warrant it.

Formaldehyde is an animal carcinogen and a suspect human carcinogen according to OSHA and IARC. It is also a sensitizer and can cause allergic skin reactions and asthma-like respiratory symptoms. It is an eye, nose, and throat irritant.

Formaldehyde procedures should be performed with ventilation such as a fume hood, slot hood, or vented downdraft table. All work should be done using gloves with adequate resistance to formaldehyde, such as disposable nitrile gloves.

With proper exhaust ventilation, laboratory personnel should not detect any odors from formaldehyde work nor experience any symptoms of exposure such as eye tearing or throat irritation. If you do, immediately contact OEHS at 603-862-4041 for an evaluation.

J. Hydrofluoric Acid

Hydrofluoric acid (HF) is a particularly hazardous substance, like many acids, but has added dangers that make it especially dangerous to work with. HF is less dissociated than most acids and deeply penetrates the skin. Symptoms of exposure may be delayed for up to 24 hours, even with dilute solutions. HF burns affect deep tissue layers, are extremely painful, and disfiguring. The highly reactive fluoride ion circulates throughout the body and can cause multiple organ toxicity, including heart arrhythmias and death, if not treated. Any suspected exposure to HF should be immediately flooded with water and decontaminated with calcium gluconate gel. Due to delayed symptoms of exposure, anyone with known or suspected exposure to HF must receive medical evaluation.

All employees are required to be trained before beginning work with HF. The training must cover safe use, personal protective equipment, and decontamination procedures. All laboratories using HF must have unexpired calcium gluconate decontamination gel on hand and appropriate decontamination equipment.

In addition, the following information regarding HF was provided by the Desert Research Institute's Environmental Health and Safety Office:

> Always wear gloves, a laboratory coat, and chemical safety goggles when working with any HF solution. Additionally, a face shield and rubber apron should be worn when handling solutions greater than 2% (1 molar), or if high splash potential exists. Not all gloves provide adequate protection against HF; high quality gloves made from butyl or neoprene rubber are recommended. Two pairs of gloves are recommended when working with concentrations exceeding 20% or when heavy exposure to gloves is expected. Always check gloves for leaks prior to use.
>
> The purpose for PPE is to shield the individual in the event of a release of vapor, a spill or other incident. PPE is not a substitute for safe work practices. Although accidents involving HF may not be totally eliminated, pre-planning will minimize the effects of such incidents. All laboratories that store or use HF should develop standard operating procedures that outline how to safely use HF, as well as how to respond to personnel contamination and HF spills. Use these general guidelines when developing a laboratory specific SOP:
>
> 1. Never use HF when working alone or after hours. HF may be used when working alone during normal working hours provided knowledgeable laboratory personnel have been alerted and at least one is in the general vicinity.
> 2. All laboratory personnel, not just those who will be using HF, must be informed of the dangers of this chemical and the emergency procedures necessary in case of an accident. A sign should be posted to alert people that work with HF is in progress.
> 3. All persons who will be using HF must be made aware of its properties and trained in proper procedures for use and disposal.

4. Laboratories which keep or use HF gas or concentrated solutions (>1% HF) should have emergency procedures in addition to a copy of the SDS.
5. Laboratories which keep or use HF gas or concentrated solutions (>1% HF) must have an operational safety shower and eyewash in their laboratory. Before beginning any procedure involving HF, make sure the access to the emergency shower and eyewash is unobstructed.
6. Only experienced persons familiar with its properties should handle the concentrated acid.
7. A small supply of calcium carbonate or calcium hydroxide for spills should also be kept near the hood where the work will be conducted. If a small quantity (100 ml or less) of dilute HF solution is spilled, clean it up by applying powdered calcium carbonate or calcium hydroxide, or use a commercial HF spill kit. Call OEHS to dispose of the waste. If a larger amount is spilled, or the acid is concentrated, contain the spill as best you can, evacuate the area, and call 911. Avoid exposure to the vapors.
8. Dispose of unwanted HF by completing a request for waste disposal and submitting it to OEHS.
9. Always use the appropriate personal protective equipment and engineering controls when working with HF or >1% HF solutions.
10. Any exposure to HF must be medically evaluated immediately.

Section 11: Intra-Facility Transportation of Chemicals

Secondary containment of chemicals is required when transporting bottles of chemicals outside the laboratory. Secondary containment is a durable container (e.g., "Rubber Maid" tote, plastic pail or bottle carrier) capable of containing the contents of the original container in the event of a spill. Secondary containers should be used when chemicals are carried through corridors, stairways, and inside elevators. Under no circumstances should anyone transport chemical containers in a passenger elevator without the use of secondary containers.

Section 12: Chemical Waste

Many of the waste chemicals resulting from laboratory experiments are hazardous and their generation, storage, and disposal must be given consideration in ***every*** experiment. Each laboratory must follow the procedures specified in the **UNH Hazardous Waste Management Plan**.

UNH has the following requirements for chemical waste containers:

- ***Labeling:*** The label must contain the information shown on the OEHS provided hazardous waste labels and be completely filled out.
- ***Packaging and storage:*** The chemical waste container must have a cap in place at all times, except when actively filling or discharging the container. Place the primary chemical container into a secondary container for additional protection.

Hazardous waste that is not properly packaged and labeled cannot be removed by OEHS.

A. Sharp Containers and Glass Only Boxes

Sharps containers are used for the disposal of hypodermic needles and syringes, razor blades and other sharp items. When three-quarters full, sharps containers should be sealed, labeled with the building/room number, placed into a biohazard bag, and then placed into a biological or infectious waste burn box. Call OEHS for disposal instructions. See **Appendix D** for additional information.

"Glass Only" boxes are used for the disposal of "clean" broken glass only. When three-quarters full, the boxes should be properly sealed, labeled with the building/room number and disposed in a dumpster. "Sharps Containers" and "Glass Only" boxes can be obtained from the chemical stockroom or departmental offices.

Section 13: Particularly Hazardous Substances

The OSHA Laboratory Standard mandates provisions for additional employee protection for work with particularly hazardous substances. Particularly hazardous substances are select carcinogens, reproductive toxins, and substances which have a high degree of acute toxicity, identified below in part A. Required procedures for working with particularly hazardous substances are listed below in part B.

A. Types of Particularly Hazardous Substances

1. Carcinogens

A carcinogen is a substance capable of causing cancer. Carcinogens are chronically toxic substances; that is, they cause damage after repeated or long-duration exposure, and their effects may become evident only after a long latency period.

A chemical is considered a carcinogen, for the purpose of the Chemical Hygiene Plan, if it is included in any of the following carcinogen lists below:

a. OSHA-regulated carcinogens as listed in Subpart Z of the OSHA standards. The current list of substances that OSHA regulates as carcinogens or potential carcinogens follows:

Asbestos	N-Nitrosodimethylamine
4-Nitrobiphenyl	Vinyl chloride
alpha-Naphthylamine	Inorganic arsenic
Methyl chloromethyl ether	Cadmium
3,3'-Dichlorobenzidine (and its salts)	Benzene
bis-Chloromethyl ether	Coke oven emissions
beta-Naphthylamine	1,2-dibromo-3-chloropropane

Benzidine	Acrylonitrile
4-Aminodiphenyl	Ethylene oxide
Ethyleneimine	Formaldehyde
beta-Propiolactone	Methylenedianiline
2-Acetylaminofluorene	1,3-Butadiene
4-Dimethylaminoazobenzene	Methylene Chloride
Chromium (VI)	

b. Under the category "known to be carcinogens" in the Annual Report of Carcinogens published by the National Toxicology Program (NTP) latest edition; or

c. Any of the following three classifications of the International Agency for Research on Cancer (IARC), latest edition:

1. Group 1, carcinogenic to humans;
2. Group 2A, probably carcinogenic to humans; or
3. Group 2B, possibly carcinogenic to humans.

Carcinogenicity of a chemical is identified in the chemical's SDS. Also, many chemicals with carcinogenicity hazards are identified in UNHCEMS.

1. Reproductive Toxins

Reproductive toxins are substances that have adverse effects on various aspects of reproduction, including fertility, gestation, lactation, and general reproductive performance. When a pregnant woman is exposed to a chemical, the fetus may be exposed as well because the placenta is an extremely poor barrier to chemicals. Reproductive toxins can affect both men and women. Male reproductive toxins can in some cases lead to sterility. Reproductive hazards of a chemical are identified in the chemical's SDS. Also, many chemicals with reproductive hazards are identified in UNHCEMS. See Chapter 6, Section 3 for more information on reproductive toxins.

2. Substances with a High Acute Toxicity

High acute toxicity includes any chemical that falls within any of the following OSHA-defined categories:

1. A chemical with a median lethal dose (LD50) of 50 mg or less per kg of body weight when administered orally to certain test populations;

2. A chemical with an LD50 of 200 mg less per kg of body weight when administered by continuous contact for 24 hours to certain test populations; or

3. A chemical with a median lethal concentration (LC50) in air of 200 parts per million (ppm) by volume or less of gas or vapor, or 2 mg per liter or less of mist, fume, or dust, when administered to certain test populations by continuous inhalation for one hour, provided such concentration and/or condition are likely to be encountered by humans when the chemical is used in any reasonably foreseeable manner.

B. Procedures for Working with Particularly Hazardous Substances

Those working with Particularly Hazardous Substances (PHSs) must comply with the following, where appropriate:

1. A "designated area" for work with PHSs must be established by the PI on the UNHCEMS door Caution Sign. A PI may further designated discrete areas within the laboratory to minimize the risk of exposure, such as an area of a benchtop or a laboratory hood;
2. Use appropriate containment devices such as fume hoods or glove boxes;
3. Utilize laboratory specific procedures as well as those specified in the UNH Hazardous Waste Management Plan for safe removal of contaminated waste; and
4. Establish written decontamination procedures.

Section 14: Controlled Substances

Those planning to work with controlled substances at UNH must adhere to requirements outlined in the UNH Controlled Substances Management Plan. Please contact the attending veterinarian at the Animal Resource Office for more information.

Section 15: Accepting Hazardous Materials

The Office of Environmental Health and Safety must approve all hazardous material transfers to UNH property. Faculty, staff, students, visitors, and guests are prohibited from accepting hazardous materials, including but not limited to chemicals, without first receiving approval from OEHS. Please contact OEHS for more information.

Chapter 4 – Laboratory Safety Training

Section 1: Laboratory Safety Training

Section 2: UNHCEMS Training Compliance Module

Section 1: Laboratory Safety Training

Faculty members are responsible for ensuring that their employees and students receive proper training as stipulated in the **UNH Chemical Hygiene Plan.**

B. Safety Training Offered by OEHS

Training may be required for faculty, staff, students, visitors, and other personnel depending on the nature of their work. To determine specific training requirements, see Environmental Health and Safety Training Programs for a description of each of the following courses and who is required to take it.

The most common training requirements for laboratory workers are listed below:

1. **Laboratory and Chemical Safety Training** – required for anyone working in a laboratory where hazardous chemical are used or stored. Available online via UNHCEMS.
2. **Cryogenic Liquid Safety Training** – required for anyone working with or dispensing liquid cryogens such as liquid nitrogen, liquid argon, liquid helium, etc. Available online via UNHCEMS.
3. **Fire Extinguisher Training** – recommended for users working with flammable solvents or other fire hazards.
4. **Hazardous Waste Handler Training** – required for anyone who handles, generates, or otherwise affects compliance of hazardous waste containers. Available online via UNHCEMS.
5. **Biosafety Training** – the type of biosafety training required, BSL-1 or BSL-2, is determined by the procedures performed and the types of organisms that are manipulated. Please contact the Biosafety Officer at 862-0197 for determination of type of training required.
6. **Bloodborne Pathogen Training** – required for anyone working with or potentially exposed to bloodborne pathogens. Available online via UNHCEMS.
7. **Hazardous Material Shipping Training** – required for anyone shipping hazardous materials in such as dry ice, specimens preserved in solvents, hazardous chemicals including newly synthesized chemicals. Contact the Laboratory Safety Officer at 862-5038 for more information.
8. **Radiation Safety Training** – training required for anyone entering a laboratory which uses radioactive materials, or for users of radioactive materials. Contact the Radiation Safety Officer at 862-3607 for details.
9. **Laser Safety Training** – required for anyone operating Class III lasers or anyone working in areas where Class III lasers are operating. Contact the Radiation Safety Officer at 862-3607 for details.

A complete list of trainings that may be relevant to laboratory workers are listed below. Details about these trainings can be found on the EHS website: Environmental Health and Safety Training Programs. Please contact OEHS at 862-4041 to request trainings, for one-on-one training, or for additional information.

Biomechanics of Lifting

BSL-1
BSL-2
Autoclaving Biohazardous Waste
Bloodborne Pathogens
UNHCEMS™ User Training
Confined Space Training
Dry Ice Shipping Training
Fall Protection/Scaffolding and Ladder Safety Training
Fire Extinguisher Training
GHS Hazard Communication Training
Hazardous Materials Shipping Training
Hazardous Waste Management
Laboratory and Chemical Safety Training
Laser Safety
Lead Paint Awareness/Removal
Noise/Hearing Conservation
Office Ergonomics
Personal Protective Equipment
Radiation Safety – Radiation Awareness Training
Radiation Safety – Radioactive Worker Training
Respiratory Protection

C. Training Records

Records for health and safety training are maintained by OEHS. Copies of training records may be provided upon request and may also be accessed in UNHCEMS. Records for additional safety training required by departments or individual faculty members should be kept in department offices or by the responsible faculty member.

At a minimum, training records must include the following information:

1. Date of training session.
2. Contents or summary of the training.
3. Name of person(s) attending the training.
4. Name of person(s) conducting the training.

Section 2: UNHCEMS Training Compliance Module

UNHCEMS Training module is available to all UNHCEMS users. It is an online training delivery platform, database of training records, and a tool for PIs and lab managers to assign and manage training requirements for direct reports.

Features available to all users:

- Ability to assess compliance with assigned training requirements;
- Access to all online OEHS training;
- Ability to register for live training sessions;
- View training certificates for all completed health and safety trainings;

Features available to PIs/managers:

- Assign training requirements to direct reports;
- View training compliance of direct reports; and
- View training records of direct reports.

For more information about the UNHCEMS Training Module, contact the UNHCEMS Coordinator at 862-1510.

Chapter 5 – Laboratory Ventilation and Engineering Controls

Section 1: Laboratory Ventilation Policy

All work with hazardous materials presenting an inhalation hazard must be conducted with use of engineering controls such an approved fume hood, gas cabinet, or glovebox. General room ventilation does not provide adequate protection against hazardous gases, vapors, and aerosols. Ductless fume hoods are not acceptable.

Section 2: Fume Hoods

Fume hoods are checked annually by OEHS. The velocity of the air at the face of the hood is measured with the sash at operating height and the results are posted on a sticker, which is attached to the chemical fume hood. Researchers should close the sash as much as possible when conducting experiments. Note that Variable Air Volume (VAV) hoods maintain a constant face velocity at different sash heights.

Hoods that do not meet safe use requirements during OEHS inspections are posted with a "DO NOT USE" sign and Facilities Services is notified about the need for repairs. Once repairs have been made, OEHS will test the fume hood for proper operation. Refer to the **UNH Fume Hood Program** for more detailed information regarding fume hoods.

A. Procedures for Proper Use of Fume Hoods

Before using the hood, make sure air is entering the hood and hood is functioning properly. Do not block baffle openings or place bulky items in the hood that will restrict air movement within the hood. Report any problems to Facilities Services.

1. Ensure that the face velocity monitor displays safe operation.
2. Ensure the baffle openings are not blocked and air is flowing properly.
3. Conduct work at least six inches from the edge of the hood.
4. Lower the sash to protect yourself from splashes and dangerous reactions.
5. Keep hood clean and uncluttered. Wipe up spills immediately.
6. Be aware that drafts from open windows, open doors, fans, air conditioners, high traffic walkways may interfere with normal hood exhaust.

B. Fume Hood Alarms

Fume hood alarms alert users to unsafe fume hood operation. They are installed on every chemical fume hood system and on those which have been upgraded. The fume hood alarm (i.e., audio/visual) will indicate an exhaust flow malfunction by an audio and visual alarm. If the fume hood alarm sounds, close the sash and notify Facilities Services and OEHS. Do not use the fume hood until repairs have been made and OEHS has removed the "Do Not Use" sign.

C. Perchloric Acid Hoods

Standard chemical fume hoods must never be used for perchloric acid. When perchloric acid is heated, vapor is formed which can condense in the ductwork and

form explosive perchlorates. Special perchloric acid hoods which incorporate an internal wash-down feature must be used. The hood must be labeled clearly and can be used only for perchloric acid or other mineral acids, such as nitric, hydrochloric and hydrofluoric. No organic solvents should be stored or used in a perchloric acid hood. Contact OEHS before using perchloric acid.

Section 3: Glove Boxes

Glove boxes can be used for work with particularly hazardous substances including select carcinogens, reproductive toxins, air or water reactive chemicals, nanoparticles and other substances which have a high degree of acute or chronic toxicity. When correctly used, these units prevent vapors, gases, and particulates from escaping into the laboratory.

Written procedures should exist that describe safe means to remove hazardous materials from the box. (ask Roy and Eric for input)

Section 4: Toxic Gas Exhaust Cabinets

Toxic gases with a NFPA Health Hazard rating of 3 or 4 such as arsine, chlorine, phosphine, silane, hydrogen chloride, fluorine, ammonia, hydrogen phosgene, selenide, and nickel carbonyl must be stored in an approved gas storage cabinet. In addition, gas cabinets may be equipped with monitoring devices and alarm systems that sense hazardous conditions, warn employees of a malfunction and automatically shut-off the gas flow.

Section 5: Biological Safety Cabinets

Refer to the Biological Safety Program.

Section 6: Laminar Flow Hoods

Laminar flow hoods are typically used for non-hazardous procedures to keep research materials clean. These hoods deliver air toward the user and provide a very clean environment but must be used only for the manipulation of non-hazardous materials. Since the operator sits in the downstream exhaust from the clean bench, this equipment must never be used for the handling of toxic, infectious, or sensitizing materials, including volatile chemicals, cell culture materials (except plant cell cultures) or drug formulations.

Chapter 6 – Personal Protective Equipment

Section 1: Personal Protective Equipment Policy

Personal protective equipment must be made available to laboratory personnel who are working with hazardous materials. PPE must be provided to all employees at no cost. Laboratories must provide personal protective equipment (i.e., safety glasses, protective gloves, laboratory coat, hearing protection, respiratory protection) for visitors and must post a sign indicting the PPE that is required where hazardous materials are in use.

Eye, skin, body and face protection are required when working with severely corrosive or strongly reactive chemicals, with glassware under extreme pressures, in combustion and other high temperature operations and whenever there is a possibility of an impact, explosion, or implosion. Special safety glasses and face shields may also be required for work with ultraviolet or infrared light, lasers (see **Chapter 14**) and other types of non-ionizing radiation.

Personal protective equipment is not supplied by OEHS. However, PPE is available through the Chemistry Stockroom, or third party vendors. OEHS will assist with recommendations on specific types and uses of protective equipment and the selection of vendors.

Section 2: Eye and Face Protection

Eye and face protection must be worn in the laboratory when there is a potential for impact or contact with hazardous chemicals or other agents (e.g., non-ionizing radiation, biohazardous materials, aerosolized material, flying objects.).

Protective eye and face wear must meet ANSI Z87.1 for laboratory use and ANSI Z136.1 for work with lasers. Ordinary prescription eyewear is **not** acceptable for laboratory procedures. The type of protection needed depends on the hazard. For instance, when corrosive or toxic chemicals are used, eye protection is mandatory and chemical splash goggles may be required, depending on the process. Contact OEHS for assessment and recommendation of personal protective equipment.

Face shields should be worn when working with agents that may adversely harm the eyes and face and/or when eye protection does not provide adequate protection.

Section 3: Laboratory Coats, Gloves, and Other Protective Clothing

Laboratory coats and sturdy shoes must be worn when performing laboratory work; **open toed-shoes, sandals, flip-flops, clogs, crocs, etc. are prohibited**. Depending on the type of work, additional personal protective equipment, such as gloves and aprons may be necessary. Coats, aprons, and gloves must be removed when leaving the laboratory, see more information on protective clothing outside the laboratory below. Gloves must be replaced immediately if they are suspected to be contaminated or torn.

Gloves should be carefully selected for their degradation and permeation characteristics to provide proper protection. Disposable latex gloves are generally not recommended for laboratory use because of their permeability and potential for allergic reaction.

Thin vinyl, or nitrile gloves, popular for their dexterity, protect against incidental exposure only and are not appropriate for continuous exposure to toxic chemicals or solvents. Most glove manufacturers publish glove selection charts based on the chemical(s) handled, and glove material. More information on specific types and uses of personal protective apparel is available from OEHS.

Section 4: Respiratory Protection

The use of air-purifying respirators for routine laboratory work is not recommended. Respirators are discouraged because good laboratory technique and properly operating laboratory fume hoods provide the best overall protection from chemical hazards in the laboratory. Additionally, respirators protect only the wearer and require periodic medical monitoring, specific training, and fit testing before they can be worn effectively.

However, in some isolated instances it has proven necessary to provide respirators to individuals. Please refer to the **UNH Respiratory Protection Program** for more information or contact the Laboratory Safety Officer at 862-5038 or the Occupational Health and Safety Coordinator at 862-4761.

Section 5: Protective Clothing Outside the Laboratory

University policy requires the use of appropriate gloves, safety glasses, lab coats, and other personal protective equipment within the laboratory. Wearing contaminated, potentially contaminated, or having the perception of potentially contaminated protective clothing and equipment beyond the lab may create a hazard or project a careless image to colleagues and visitors. Wearing laboratory coats and other PPE outside of the laboratory is discouraged. Follow these guidelines:

- Minimize the use of gloves outside the laboratory. Package materials so they may be handled without gloves. Transport chemicals from place to place on a cart, in a clean secondary container, or in a bottle carrier with handles.
- If there is a need to transport potentially hazardous materials, use a clean, ungloved hand to touch common surfaces and a gloved hand to carry the items.
- Gloves should never come in contact with door handles, elevator buttons, telephones, lavatory faucets, vending machines, bottled-water dispensers, ice-making machines, or other surfaces outside or inside the laboratory.

Section 6: Laundering Laboratory Clothing

Contaminated clothing (including laboratory coats and gowns) with mild chemical contamination should be laundered separately from other clothes using one of the following methods below. Laundering lab coats and gowns at home or at laundromats is not recommended. For coats contaminated with biological materials, see the UNH Biosafety and Biosecurity Manual for laundering requirements.

A. UNH Laundry Facilities

Laundry facilities exist in a few departments at UNH. Follow departmental procedures for cleaning contaminated clothing as well as recommendations below.

B. Professional Laundering

A professional service company may be used if your department does not have the capability to wash contaminated clothing. It is your responsibility to determine if the cleaning company is capable and willing to launder your contaminated clothes.

C. Contaminated Clothing

- Clothing that is overtly contaminated with chemicals must be disposed as hazardous waste.
- Clothing contaminated with radiological material must be disposed as radiological waste.
- Clothing that is contaminated with blood, blood products, or other bodily fluids must be removed and containerized in leak-proof bags or boxes at the location where it was used. Containers or bags must be marked with the biohazard symbol. Contaminated clothing may not be sorted or rinsed in the location of use, and may never be sent home with the researcher for personal laundering.
- Laboratory managers may launder contaminated clothing using departmental laundry facilities where available. Contaminated clothing shall be washed, at a minimum in accordance with the manufacturer's directions. However, Departments are encouraged to launder contaminated clothing in hot water (160º F or greater). Where Departmental facilities are not available, contaminated clothing must be laundered by a professional laundry service. Laboratory managers shall ensure that all laundry contaminated with blood and/or potentially infectious bodily fluids which is sent off-site is containerized in leak-proof bags or boxes marked with the biohazard symbol.

Chapter 7 – Emergencies & Accidents

Section 1: Emergency Assistance

Dial 911 to request emergency assistance (e.g., fire, police, ambulance) on campus. A summary of emergency contact information is available on the second page of this document. In all emergencies and accidents, the first consideration is your safety and the safety of those around you. See the **UNH Emergency Procedures Program** for more information.

Section 2: Preparation

In order to be prepared for an emergency, know the hazards associated with each compound and the procedures you will work with. Assess the risks before using any chemical and have a laboratory emergency plan for all procedures with hazardous materials on file and posted in a conspicuous area for employees and emergency responders. Consider the following criteria before working with any hazardous agent:

- Toxicity, reactivity, and flammability of the compound.
- The amounts involved.
- The expected duration of your exposure to the compound.
- Potential routes of entry for the chemical (i.e., inhalation, ingestion, injection, skin contact).

Refer to the UNH Chemical and Environmental Management System (UNHCEMS™) website for additional information at https://cems.unh.edu.

Section 3: Chemical Spills

Chemical spills may occur in academic and research laboratories. Controlling the extent of a chemical spill requires pre-planning and a prompt response. Using shatter resistant containers (e.g., primary, secondary) can help to prevent many chemical spills.

A. A minor chemical spill is when:

- The chemical spill has a low to moderate hazard;
- No one has been exposed to the chemical; and
- Laboratory workers have sufficient equipment and training to properly clean up the spill.

Follow these procedures for **minor chemical spills**:

1. **Protect yourself and alert others:** Avoid contact with the spilled material. Wear appropriate PPE. Treat all chemicals as if they are hazardous.
2. **Contain the spill and secure the area:** Cordon off the spill area. Do not walk through or allow others to walk through the spilled material.
3. **Clean up the spill:** Use your chemical spill kit to clean up the spill. Cover liquid spills with vermiculite. Use scoop and broom to sweep up spill or vermiculite. Place spill material and vermiculite in plastic bag or other

compatible container and label to identify contents. Further decontaminate the area as necessary with mop or paper towels, if appropriate.

4. **Clean Up.** Wash hands and replace items used in chemical spill kit.
5. **Contact OEHS** to request chemical waste pickup. Call 862-4041 or 862-3526.

B. A major chemical spill is when:

- A chemical is flammable, reactive, or highly toxic;
- Someone has been exposed to the chemical; or
- Too much of a chemical has been spilled for the amount of absorbent in the laboratory.

Follow these procedures for **major chemical spills**:

1. **Protect yourself and others:** Right the container, if safe to do so. Shut off any sources of ignition and stop the source of the spill, if you can do so without endangering yourself.
2. **Evacuate the immediate area,** closing the door behind you.
3. **Pull the fire alarm,** if building evacuation is necessary because:
    - A chemical reaction creates a fire or potential for a fire.
    - The spill is flowing outside of the room.
    - Fumes or odors are permeating the building.
4. **Call OEHS at 2-4041 or 911** and immediately notify your supervisor.

C. Every laboratory with hazardous chemicals must have a readily-accessible spill kit. Recommended contents include:

Material	Quantity
Inert absorbent powder	32 oz.
Inert absorbent pads	10
4-mm polyethylene bags	5
5 gallon pail with lid	1
Chemical-resistant scoop	1
Chemical-resistant broom	1
Nitrile/Silver Shield combination gloves	2 pair
Splash goggles	2 pair
Chemical waste labels	2

Section 4: Chemical Exposure

Follow these procedures in the event of chemical exposure:

- Go to the nearest eyewash station or safety shower.
- Flush the contaminated area with large volumes of water.
- While flushing, remove any clothing that may have been contaminated.
- Continue flushing until area of exposure is free of contamination.

- Seek medical attention as necessary. Provide the Safety Data Sheet for the spilled chemical to emergency response personnel or medical services providers.

Section 5: Mercury Spills

Mercury has been historically used at UNH in thermometers, thermostats, and certain laboratory devices. All mercury spills including droplets of mercury from a broken laboratory thermometer need to be cleaned up following safe and environmentally sound procedures.

Mercury spill procedures:

1. Notify people in the immediate area that a mercury spill has occurred and isolate the area to avoid more extensive contamination by tracking or cross-contamination.
2. If the spill occurred on the floor, determine the extent of the area and mark the boundary of the spill.
3. Call OEHS for cleanup and removal. It is preferred that the lab or spill area be evacuated until the spill is removed.
4. Always thoroughly wash hands, arms and face several times after working around mercury areas.
5. Report the spill to OEHS immediately for an industrial hygienist to evaluate the area for any mercury remnants that may have gotten under cabinets or behind equipment.

Section 6: Environmental Chemical Releases

If a spill of any hazardous material reaches the environment (e.g., floor drain, sink drain, storm water drain), immediately contact OEHS at 603-862-4041. Attempt to stop or contain the spill/release at the source without endangering yourself and others by following these procedures:

- Eliminate all sources of ignition, if appropriate.
- Isolate all potential environmental receptors (e.g. drains, sumps, soil).
- Immediately report the spill/release to OEHS.
- Wait for OEHS to arrive on the scene.

Section 7: Biological Spills

Refer to the Biological Safety Program: http://www.unh.edu/research/biological-safety.

Section 8: Fires or Explosions

All building occupants must exit the building during all fire alarms. Failure to leave a building is illegal and may result in disciplinary action from the University Police Department or an academic or administrative unit.

Whenever a fire alarm is activated:

- Extinguish all open flames or likely sources of ignition.
- Safely store hazardous materials.
- Leave the work area.
- Shut all doors on the way out of the laboratory.
- Evacuate through the nearest fire exit.
- Do not use elevators.

Extinguish the fire, if you can do it safely and have received fire extinguisher training. You are not required to use fire extinguishers; however, you are required to receive fire extinguisher training if you want to use fire extinguishers in the event of an incipient-stage fire in your work area.

Section 9: Accidents and Injuries

In the event of an accident or injury:

2. Call 911 if the incident requires an ambulance or other form of emergency response.
3. Alert your supervisor, Department Chair, and OEHS of the incident.
4. Complete the UNH Report of Occupational Injury or Illness Form on the HR website at http://www.unh.edu/hr/forms within 24 hours of the incident.

A medical care provider should assess all injuries. During regular business hours non-critical injuries may be evaluated at a medical facility contracted with the University including:

- UNH Health Services;
- Lee Urgent Care, 868-8500, Wentworth Douglas Professional Center, 65 Calef Highway, Lee NH 03861; or
- Seacoast Redicare, 692-6066, 396 High Street, Somersworth NH 03878.

For a chemical exposure, medical personnel should be given the following information:

- Identity of chemical(s);
- Conditions under which exposures occurred;
- Signs and symptoms of exposure; and
- Whenever possible, a SDS should also be provided.

Those seeking treatment for non-life-threatening injuries or exposures should not transport themselves to a medical provider in case of adverse reactions en route.

Section 10: Power Outages, Service Interruptions, and Curtailed Operations

Laboratory operations involving hazardous materials or hazardous operations are strongly discouraged any time when UNH has curtailed operations or any time there is an elevated risk of power outage such as during severe weather events, high wind events, etc.

Procedures requiring engineering controls to protect workers safety such as chemical fume hoods may not be performed during curtailed operations because of increased risk of power outages; chemical fume hoods will not be operational during power outages.

Please note that during severe weather events such as what is typical during curtailed operations, emergency personnel may not be able to access buildings to respond to emergencies. Also, during severe weather events, power outages are more likely.

Although some buildings have standby or backup power, it is only designed for essential services, and not for continued operations in the laboratory. Engineering controls such as fume hoods will not be operational during power outages. Other engineering controls such as biosafety cabinets and glove boxes likely will not be operational during a power outage. Also, the audible and visible alarms indicating fume hood, biosafety cabinet, or glove box failure will not be operational during a power failure, so there will be no audible or visible warning that the systems are not working. If the power should be interrupted:

- Immediately stop all laboratory work;
- Stabilize chemical reactions or other work taking place;
- Close all chemical containers;
- Shut-off or unplug equipment; and
- Close chemical fume hood sashes.

Section 11: Emergency Equipment

The following safety devices/equipment should be available for laboratory personnel working with hazardous materials.

A. Drench Showers

Drench showers and other emergency wash systems are used in an emergency to flush chemicals that have accidentally come in contact with laboratory personnel. In order to wash the body properly, clothing should be removed as water is applied. The drench shower *can* be used to extinguish a clothing fire, but this is *not* recommended if the shower is more than a couple of feet away. The best method of extinguishing a clothing fire is to "Stop, Drop, and Roll," and then remove clothing.

In order to ensure adequate access to the shower, ***a minimum of 32 inches in diameter below the center of the shower must be free of obstructions at all times.*** Facilities Services inspects drench showers annually for proper flow and operation.

B. Eye and Face Washes

The best treatment for chemical splashes of the eye and face is immediate flushing with copious amounts of water for 15 minutes. Eye and face washes are equipped with a stay-open valve. All plumbed eye and face washes should be flushed by laboratory occupants on a *weekly basis* by allowing the water to flow for 5 seconds or

longer, until water is clear. Contact OEHS or Facilities Support Center to report problems with eyewashes. Plastic eye wash bottles ***are recommended as supplemental equipment only.***

In general, the emergency eyewash equipment should be installed within 10 seconds walking time from the location of a hazard. The equipment must be installed on the same level as the hazard (accessing the equipment should not require going up or down stairs or ramps). In addition, the path of travel from the hazard to the equipment should be free of obstructions and as straight as possible.

In order to ensure adequate access to the eyewash, ***a minimum of six inches radius around the eyewash nozzle must be free of obstructions at all times.***

C. Fire Extinguishers

Fire extinguishers are placed in or just outside laboratories depending on the hazards. A dry chemical (e.g., BC, ABC) type extinguisher is located in laboratory facilities where flammable liquids are used and a carbon dioxide (CO_2) type extinguisher is located in laboratories with computer and electrical equipment (i.e., mass spectrometers, gas chromatographs and NMR facilities). Class D (flammable solids) fire extinguishers are installed in laboratories with combustible metals such as lithium. Staff members who plan to attempt extinguishing small fires must be trained in extinguisher operation. For more information about fire extinguishers, contact OEHS.

D. First Aid Kits

First aid kits must be available in each laboratory. According to the American National Standards Institute (ANSI), the kit should contain the following:

Item and Minimum Size or Volume*	Minimum Quantity
Absorbent compress, 32 square inches (No side smaller than 4")	1
Adhesive bandages, 1" x 3"	16
Adhesive tape, 5 yards	1
Antiseptic, 0.5 gram application	10
Ice packs	2
Medical exam gloves (disposable)	2 pair
Sterile pads, 3" x 3"	4
Triangular bandage, 40" x 40" x 56"	1
* *Other items as needed.*	

First aid kits should *not* have topical creams, liquids or ointments that can cause further discomfort and/or hinder medical treatment.

E. Laboratory Vision Panel

The Laboratory Vision Panel is the window space in the main door of the laboratory, used by emergency response personnel to identify internal problems (e.g., an injured person, a small fire, a chemical spill). The Durham Fire Department requests that the

vision panel in the door not be blocked, unless it is necessary to maintain darkness for optical work, spectroscopy, or photography.

Chapter 8 – UNHCEMS™

The UNH Chemical Environmental Management System (**UNHCEMS™**) is a tool for chemical safety & compliance developed by the Office of Environmental Health and Safety and the Research Computing Center. This online chemical inventory and compliance tool is available for use by chemical owners, laboratory associates, students, and emergency responders on the campuses of UNH Durham and UNH Manchester.

UNHCEMS™ can be found at https://cems.unh.edu.

Incoming chemicals will pass through the Chemical Transfer Station or the Chemistry Stockroom, where the containers will be barcoded and entered into UNHCEMS. The Chemical Transfer Station delivers chemical orders directly to the end user.

Section 1: Roles and Responsibilities

Responsibilities of PIs, chemical owners, and room occupants:

- Keep your chemical inventory up-to-date by marking empty containers that are used up or disposed;
- Update your associates such as staff or graduate students who you will assign chemical management duties;
- Update locations of chemicals that are transferred to another storage location or transferred to another user. These changes can be made in UNHCEMS or by contacting OEHS;
- Submit a sign change request through UNHCEMS if information on one of your door Caution Signs is out-of-date. See section 3 for more information on door Caution Signs.

Responsibilities of OEHS:

- Verify chemical inventories at least every two years;
- Print and post door Caution Signs as necessary;
- Operate the Chemical Transfer Station;
- Perform administration functions of UNHCEMS including QA/QC of all data, create accounts for new users, respond to users questions, etc.;
- Make UNHCEMS training available to users.

Section 2: Key Features of UNHCEMS™

Chemical Inventory Tracking
Cradle-to-grave container tracking using barcodes
Preloaded chemical catalog - no need to key in chemical information for items in catalog
Reduce waste by enabling users to surplus / adopt inventory
Track consumption by department, owner, location

Documentation Archive
Search & upload SDS/MSDS (Material Safety Data Sheets), Chemical Fact Sheets
Integrated access with the Chemical Inventory and Emergency Response modules

Emergency Response
Specialized reports with real time calculations for total flammable liquids, oxidizers, and water reactants broken down by location
Direct Links to NFPA Door Signs, SDS, Fact Sheets, chemicals inventory in room

Laboratory Door Sign Creator
Specify NFPA, pictograms
Users can manage and print their own signs, upload custom pictograms

Hazardous Waste Tracking
Request removal form
Waste pick up email reminders, pick up reports organized by location

Radioactive Usage Log
Assign limits for a site, user, and isotope
Real-time total activity calculations
Ensure user and site limits are never exceeded with automated alerts

Biological Inventory
Search inventory by agent name, risk group, location, or owner

Training Database
Manage user training requirements online.

Many frequently asked questions about using UNHCEMS™ are available online. Also contact the UNHCEMS Coordinator at 603-862-1510 for more information.

Section 3: Door Caution Signs

UNHCEMS Door Caution Signs serve as a general warning system prior to entry to a potentially dangerous area. They are used to indicate contact information and significant hazards at the entry to rooms containing hazardous materials. They display information regarding hazards inside the room, may list the location of spill kits, special instructions for entering the room, emergency contact information, and additional information as appropriate to the room.

Content

Door Caution Signs contain several standard elements, described below.

Required information: Information that must be incorporated into a door sign, when applicable:

- Emergency contact information for at least 2 individuals responsible for the room;
- NFPA Diamond when chemicals are present;
- Radiation symbol for isotope areas, irradiator, and x-ray area;
- Biohazard symbol when infectious or potentially infectious agents are in use;
- Laser warning when Class 3b and 4 lasers are present; and
- Identification of a "designated area" for work with Particularly Hazardous Substances, as described in the Chemical Hygiene Plan.

Pictograms: Door Caution Signs utilize a grid of six tiles where hazards or requirements are displayed, as seen in Figure 2. Pictogram placement is standardized as much as possible to keep signage consistent throughout the campuses. Pictogram placement is as follows, when applicable:

Tile 1: NFPA Diamond. A rating is automatically generated by UNHCEMS based on the chemical inventory stored in the room. A UNHCEMS administrator may use this rating when it is believed to be accurate, or choose another rating based on materials expected to be in the room. The rating must be consistent with NFPA 704.

Tile 2: Radiation symbol

(1) First alternate is biohazard symbol if radioactive materials are not used in the room
(2) Second alternate is pictogram for lasers
(3) Third alternate is pictogram for Personal Protective Equipment (PPE) requirements

Tile 3: Biohazard symbol

(1) Alternate: pictogram for PPE requirements
(2) Alternate: pictogram for the most hazardous material in room (examples: compressed gas, flammable liquids, corrosive liquids, etc.)

Tile 4: No food or drink pictogram

(1) Alternate: pictogram for the most hazardous material in room

Tile 5: PPE pictogram, if tiles 2 and 3 are used by the radiation and biohazard symbols

(1) Alternate: pictogram for the most hazardous material in room

Tile 6: No open toed shoes

(1) Alternate: pictogram for the most hazardous material in room

Figure 2. UNHCEMS Door Caution Sign

Additional information: the flammable liquid inventory limit for the room (required for Parsons Hall rooms), more details about hazards listed on the sign, and identification of a "designated area" for work with Particularly Hazardous Substances (see Chapter 9, Section 12).

Special instructions: PPE requirements, medical surveillance requirements, or specific requirements for entry should be listed here.

MSDS Location: Typically this is the URL for UNHCEMS: https://cems.unh.edu. If hard copies of SDSs are kept by the occupants, this is indicated here.

Spill Kit Location: description of the location of the chemical spill kit and/or biological spill kit. This information is non-mandatory on the sign as spill kits should be readily available and clearly marked.

Emergency Contacts: Emergency contacts are individuals knowledgeable about activities and personnel in the room. An emergency contact is someone an emergency responder can contact in the event of an emergency in the room such as a medical emergency, water leak, or chemical spill. At least two and at most three emergency contacts may be listed on a sign.

Updating Caution Signs and Requesting a New Door Caution Sign

Principal Investigators, chemical owners, and room occupants should update door Caution Signs whenever pertinent information about 1) hazards in the room, 2) contact

information, 3) locations of SDS or spill kits; or 4) additional requirements change. It is not sufficient to edit signs by hand, all sign change requests must be made in UNHCEMS.

If a room does not have a door Caution Sign, and it contains hazardous chemicals or hazardous processes occur in the room, request a new sign from OEHS by calling 862-4041.

UNHCEMS users may edit door a Caution Sign when they own chemical inventory in the room, or when they are listed as an emergency contact on the sign. Users who would like to request a change to a sign where these conditions are not met should contact OEHS at 862-4041. All edits to Caution Signs are reviewed by OEHS prior to printing and posting.

Edit a door Caution Sign by logging in to UNHCEMS at https://cems.unh.edu. Scroll down to the heading "Signs" and click on the drop-down "signs I am responsible for." Review the sign and click whichever is appropriate: "sign is NOT accurate," or "sign is accurate." After clicking "sign is not accurate," the sign can be edited and submitted to OEHS for approval. OEHS will review the sign change request and print and post.

Chapter 9 – Monitoring and Examination

Section 1: Exposure Monitoring

Section 2: Medical Examination and Consultation

Section 3: Reproductive Hazards, Teratogenic Agents, and Pregnancy

Section 1: Exposure Monitoring

Regular environmental or employee exposure monitoring of airborne concentrations is typically not warranted in laboratories because the chemicals are used for relatively short periods of time and in small quantities. Procedures are designed to minimize possible exposures. Sampling may be appropriate when highly toxic substances are used regularly. Contact OEHS to determine what exposure sampling should be performed.

Laboratory employees who suspect that they have been overexposed to a toxic chemical should notify their supervisor immediately. If any adverse health effect is experienced, anticipated, or suspected and the employee is physically able, the employee should be evaluated at a medical facility contracted with the University including:

- UNH Health Services;
- Lee Urgent Care, 868-8500, Wentworth Douglas Professional Center, 65 Calef Highway, Lee NH 03861; or
- Seacoast Redicare, 692-6066, 396 High Street, Somersworth NH 03878.

Notify OEHS of the exposure and file an "Incident Injury Report Form" with the Office of Human Resources within 24 hours of the incident. This form is online at the Human Resources website. OEHS will make an initial exposure assessment and if warranted, specific monitoring will be conducted.

Section 2: Medical Examination and Consultation

Medical consultation and evaluation is available to employees through Student Health Services and/or a separate clinic contracted with the University. In general, a medical provider should be consulted when:

- An employee or student develops signs and symptoms of exposure;
- An event takes place resulting in the likelihood of an exposure;
- Exposure monitoring is above the OSHA "action level"; or
- There are special concerns about chemicals, such as reproductive toxins.

In the event of an exposure to a hazardous chemical, UNH is required to provide the medical provider with relevant information about the circumstances of the known or suspected exposure and they typically will include this information within their written opinion.

Recommendations for immunization and/or medical surveillance may be made for personnel working with pathogenic agents or extremely toxic chemicals. In addition, special health and educational programs have been set up for:

- Laboratory animal care personnel and feral animal handlers.
- Personnel handling human/non-human primate blood, body fluids, or unfixed tissues.

Confidential medical records are maintained for employees and students receiving medical surveillance and medical care at UNH Health Services or other designated health care facilities. Contact OEHS for more information.

Section 3: Reproductive Hazards, Teratogenic Agents, and Pregnancy

Substances or agents that affect the reproductive health of women or men or the ability of couples to have healthy children are called reproductive hazards. A teratogen is substance which interferes with embryonic or fetal development and women of child bearing potential should take care to avoid exposure. A fetotoxin is a substance that can poison or cause degenerative effects in a developing fetus or embryo. Radiation, some chemicals, certain drugs (legal and illegal), cigarettes, some infectious agents, and alcohol are other examples of reproductive hazards.

A reproductive hazard may cause one or more health effects, depending on the time and duration of the exposure. For example, exposure to harmful substances during the first 3 months of pregnancy may cause a birth defect or a miscarriage. During the last 6 months of pregnancy, exposure to reproductive hazards could slow the growth of the fetus, affect the development of its brain, or cause premature labor.

Reproductive hazards may not affect every person or every pregnancy in the same way. Whether a woman or fetus is harmed depends on how much of the hazard they are exposed to, when they are exposed, how long they are exposed, and how they are exposed.

A. Reproductive Health in the Laboratory

State and federal laws and UNH policy protect students and employees from discrimination on the basis of pregnancy. These protections are described in the following state and federal laws and UNH policy:

- NH RSA 354-A:7 VI. Pregnancy Discrimination Prohibited;
- Pregnancy Discrimination Act, an amendment to Title VII of the Civil Rights Act of 1964;
- Title IX of the Education Amendments of 1972; and
- UNH Discrimination and Discriminatory Harassment Policy.

Pregnancy may raise particular concerns for the safety of the mother or the health of the child. Likewise, there may be particular concerns about effects of workplace hazards on reproductive health. Resources are available at UNH to assist in addressing concerns related to pregnancy or reproductive health in the laboratory while maintaining an environment free from discrimination.

B. Student and Employee Rights

Listed below is an overview of student and employee rights as they relate to pregnancy and reproductive health in the laboratory. Each person's situation is different and must be handled appropriately for the individual circumstances. Questions about fairness and

rights of students or employees can be addressed on an individual basis by the Affirmative Action and Equity Office (AAEO) or Disability Services for Students (DSS).

- Employees/students are not required to identify themselves as pregnant; privacy is respected with regard to pregnancy.
- Employees/students may not be discriminated against as a result of pregnancy or reproductive health concerns.
- Employees/students may not be excluded from any course or workplace because they are pregnant or have reproductive health concerns.
- Employees/students may, with guidance from AAEO or DSS, request an accommodation that would provide them an opportunity to engage in an interactive process to identify the barriers to job or academic performance and to further identify and make an accommodation that is reasonable and effective.

Those wishing to consult with the AAEO or DSS regarding pregnancy or reproductive health concerns may do so confidentially at any time.

C. Managing Risk in the Laboratory

Health risks posed in science laboratories vary according to the materials and processes used. Safety in laboratories is managed by administrative and engineering controls as well as through the use of personal protective equipment. Established methods of protection are designed to offer a high level of protection to students and employees. However, while there is no comprehensive list, certain chemical, physical, and disease-causing agents may present particular risks to pregnant women, pregnancy, the child, or persons with reproductive health concerns. Educating yourself about these risks by reading Safety Data Sheets (SDS) for chemicals you may be exposed to and consulting with the principal investigator, course instructor, and the Office of Environmental Health and Safety (OEHS) can help you make informed decisions about how you would like to manage these risks.

If you are planning to become pregnant, are pregnant, have reproductive health concerns, work or study in UNH laboratories, and have safety concerns related to pregnancy or reproductive health, be aware of the following:

- You are urged to review and understand the hazards of your workplace or courses. Review SDSs for chemicals used and stored in your laboratory. Understand and follow all safety procedures related to your work or study. This is required for all employees and students working in UNH laboratories.
- Review guidance from the National Institute for Occupational Safety and Health (NIOSH):

  - The Effects of Workplace Hazards on Male Reproductive Health, or
  - The Effects of Workplace Hazards on Female Reproductive Health.

- Request a review of your work environment or course of study with OEHS. A review of your environment will include identification of hazards that may pose particular risks to women planning to become pregnant, or are pregnant, or persons who have reproductive health concerns. The goal of the review will

be to ensure that any risks present are communicated and managed according to established laboratory safety procedures and practices. You are encouraged to share information from this review with your health care provider.

- If you are pregnant and work with radioactive material or work in a laboratory that uses radioactive material, review the UNH Radiation Protection Program, Section 6.3, Declared Pregnant Workers, available on the OEHS website at Radiation Protection Program. Contact the Radiation Safety Officer with questions.
- If you would like to discuss the possibility of modifying your work assignments or course of study, or to discuss fair access to work or courses as a result of your planned pregnancy, or pregnancy, or reproductive health concerns, the following offices are available to assist you:

  - Faculty, Staff, Graduate Assistants, Teaching Assistants: Affirmative Action and Equity Office (AAEO), 862-2930 v/tty; or
  - Students: Disability Services for Students (DSS), 862-2607 v/tty.

D. Reproductive Health in the Laboratory: Questions and Answers

Refer to the following questions and answers for clarification of issues that may face students, staff, and faculty.

Students/Employees

Q. I am pregnant or am planning on becoming pregnant or have reproductive health concerns and feel unsafe in the laboratory. What do I do?

A. You can request a review of your workplace or courses with OEHS. OEHS will review chemical, physical, and disease-causing agents that you may encounter and share this information with you. You are encouraged to share this information with your health care provider to help you decide what level of participation you feel comfortable with.

Q. I may not be able to complete certain course requirements/assignments due to my pregnancy or reproductive health concern or I have decided to skip a required course because I am pregnant or have a reproductive health concern. What do I do?

A. Students are required to meet the academic standards and technical requirements of their program of study. DSS or AAEO will work with you to consider accommodations regarding your course schedule or requirements as a result of your pregnancy or reproductive health concerns.

Q. How do I know if chemicals I am working with in the laboratory pose reproductive hazards?

A. Review the Safety Data Sheet for the chemicals. Manufacturers are required to provide SDSs for all hazardous chemicals including information about toxicity. SDSs for materials at UNH are provided through the UNHCEMS™ website at http://www.cems.sr.unh.edu. OEHS can review SDSs with you upon request.

Q. I have concerns about pregnancy or reproductive health, but I am not comfortable discussing this with my supervisor or instructor/faculty. What do I do?

A. You are not required to disclose your pregnancy or reproductive health concerns. You may request a confidential consultation with AAEO or DSS to discuss your concerns.

Q: I have general concerns about potential effects of laboratory chemicals on my reproductive health. What rights do I have as a male and who do I speak to?

A: The University will respond to concerns about reproductive health without regard to gender. For more information regarding reproductive health as it relates to chemical safety, contact OEHS.

Supervisor/Faculty

Q. A student requests to have absences excused or to change the due date of an assignment as a result of issues related to pregnancy. Am I compelled to change course requirement for her?

A. Modification of course requirements should only be made with consultation with DSS or AAEO.

Q. A graduate student requests a change in teaching responsibilities or research activities due to her pregnancy. Am I required/allowed to change her job functions or research due to her pregnancy?

A. Modification of work functions and research activities should only be made with consultation with AAEO.

Q. I require a note from a health care provider if a student misses an exam or other course requirement. Can I request a note from a health care provider if a student says she is pregnant?

A. You cannot ask for proof from a health care provider that a student is pregnant. However, you can ask for verification that an absence was excusable; this can be in the form of a note from a health care provider, as long as you do not request any personal medical information.

Q. A student/employee raised concerns about her safety because she is pregnant or has reproductive health concerns. What do I tell her?

A. Refer her to the Pregnancy and Reproductive Health section in the UNH Chemical Hygiene Plan; it explains her rights and resources available to her. Immediate safety concerns should be forwarded to OEHS.

Q: What may be included in a course syllabus or announced to a class regarding pregnancy in a laboratory environment?

A: The following are examples of statements that may be included in a syllabus or announcement:

- Pregnant students or those with reproductive health concerns are encouraged to review SDSs for chemicals used in the laboratory; OEHS can assist with this review. You are encouraged to review this information with your health care provider. Other resources are available to assist you, for details, see the Pregnancy and Reproductive Health section of the UNH Chemical Hygiene Plan.
- Pregnancy may raise particular concerns for the safety of the mother or health of the child. Likewise, there may be particular concerns about how workplace hazards may effect male/female reproductive health. For details on how to address these concerns, see the Pregnancy and Reproductive Health section of the UNH Chemical Hygiene Plan.
- During this course, students may use chemical, physical, or disease causing agents with known reproductive hazards. UNH offices which are available to discuss concerns related to pregnancy and reproductive health in the laboratory include OEHS, DSS, and AAEO.

The following are examples of statements that may not be included in a syllabus or announcement:

- Pregnant students are encouraged not to take this course.
- If you are pregnant, see me to discuss safety in the laboratory.
- If you are pregnant, you must let someone know such as the TA, instructor, or professor.
- If you are pregnant or have concerns about reproductive health, you may be excused from certain requirements of this course.

Chapter 10– Related Safety Programs

Section 1: Nanomaterials

Section 2: Biological Safety

Section 3: Radiation Safety

Section 4: Laser Safety

Section 5: Electrical Safety Plan

Section 1: Nanomaterials

Nanomaterials are defined by the American Society for Testing and Materials (ASTM) as a material with two or three dimensions between 1 to 100 nanometers. They can be composed of many different base materials (e.g., carbon, silicon, and metals such as gold, cadmium, and selenium). They can also have different shapes, such as nanotubes, nanowires, crystalline structures such as quantum dots, and fullerenes. Nanomaterials often exhibit very different properties from their respective bulk materials including greater strength, conductivity, and fluorescence.

The toxicity of most nanomaterials is largely unknown. Preliminary toxicity testing has indicated that some nanoparticles may be more toxic than the corresponding micrometer-sized particle because of their greater surface area and reactivity. Nano-sized titanium dioxide produces 40 fold more lung inflammation than micrometer-sized particles. In preliminary tests, carbon nanotubes have produced lung inflammation and fibrosis similar to crystalline quartz and asbestos. Nanoparticles are similar in size to viruses and are easily taken into the body's cells, translocate in the body, and can possibly pass into the brain and through the skin.

Nanoparticles that have the potential to be released into the air must be handled as particularly hazardous substances because their toxicity is, for the most part, unknown and early studies have been suggestive of toxic effects. In the future, many types of nanoparticles may turn out to be of limited toxicity but precaution should be used until more is known. Work with nanoparticles that may release particles should be conducted in vented enclosures including glove boxes and fume hoods. All work should be done while wearing protective gloves (e.g., nitrile). Please refer to the UNH Nanomaterials Safety Program for additional information: http://unh.edu/research/chemical-safety-plans-and-programs.

Currently, nanoparticles and solutions containing them are being disposed as hazardous waste. Please contact OEHS for exposure evaluation of experimental setups and additional information. In addition, all containers of nanomaterials (including waste) should be labeled with the designation "nano."

Section 2: Biological Safety

OEHS has a Biosafety Program, available on the OEHS website at http://www.unh.edu/research/biological-safety .

The UNH Biosafety and Biosecurity manual details safe handling, storage and security of biohazardous materials; as well as to provide emergency response guidance for incidents involving biohazardous materials; and to educate the UNH community about the safe use of these materials in research, teaching, and public service activities.

In addition, UNH has an Exposure Control Plan (ECP) to fulfill the requirements of OSHA's Bloodborne Pathogens Standard (29 CFR 1910.1030). The ECP documents an exposure determination for UNH staff and employees who might come in contact with human blood, blood components or Other Potentially Infectious Materials in an

occupational situation. See http://www.unh.edu/research/bloodborne-pathogens for more information.

The procedures for the disposal of biohazardous materials are contained in the Biohazardous Waste Disposal Plan, located at http://www.unh.edu/research/biohazardous-waste.

All work with biological materials must be registered with the Biological Safety Officer (BSO).Please call the Biological Safety Officer (BSO) Safety Officer, at 862-4041 for more information.

Section 3: Radiation Safety

OEHS has a **Radiation Protection Program**, available on the OEHS website at http://unh.edu/research/radiation-safety, which operates under the authority of the Radiation Safety Committee. This program assures compliance with the State of New Hampshire's agreement with the Nuclear Regulatory Commission and State license (190R) to use radioactive materials. OEHS provides a range of radiation protection services, including training of laboratory personnel, inventory of all radioisotopes used on campus, receipt, and delivery of all radioactive material and waste pickup and disposal.

Please call the Radiation Safety Officer (RSO), at 862-3607 for more information.

Section 4: Laser Safety

OEHS has a Laser Safety Program, available on the OEHS website at http://unh.edu/research/radiation-safety, The **Laser Safety Program** at UNH oversees the safe use of lasers on campus. It provides guidance for the compliance with Federal standards of the American National Standard for the Use of Lasers (ANSI Z136-1) and regulations of the Occupational Safety and Health Administration (OSHA). Equipment registration, Standard Operating Procedures and laser safety training are required for all those operating Class 3B or 4 lasers.

Please call the Laser Safety Officer, at 862-3607 for more information.

Section 5: Electrical Safety

A. Introduction

Electrical hazards for laboratory employees and students usually include shock, burn, or fire hazards. Electrical shocks occur when a part of the body becomes part of the electrical circuit. One way this can occur is by contacting a metallic part of a piece of equipment that has become energized by contact with an electrical conductor. The severity of the electrical shock depends on the following:

- The amount of the current (measured in Amperes or Amps);
- The pathway through the body;

- The duration of the exposure; and
- Whether the skin is wet or dry.

B. Roles and Responsibilities

Facilities Project Management specifies electrical design standards for UNH and oversees the design of electrical systems in new buildings as well as renovations and changes to existing buildings. Facilities Services in each of the zones is responsible for responding to maintenance requests made by laboratory personnel and fulfilling those requests in a manner that meets the design guidelines set forth by Facilities Project Management.

Laboratory personnel are responsible for their electrical equipment. Facility Operations personnel may only perform design changes to the building's electrical infrastructure. Specific changes may be required when converting a dry laboratory to a wet environment or when a change in the electrical load exceeds the capacity in a given area (such as after a new laboratory is established in an existing space). Laboratory personnel are responsible for ensuring that electrical equipment connected to the building power system is in good condition.

OEHS provides electrical safety guidance for the University community. OEHS will respond to technical questions and provide individual assistance on electrical safety issues. OEHS inspects laboratories for electrical safety compliance and investigates all accidents resulting from electrical exposure. Any electrical accident of a serious nature would also be investigated by the State Fire Marshal and the State Electrical Inspector.

C. General Requirements

Laboratory personnel typically encounter electricity in the form of hard-wired equipment (e.g., specialty microscopes, generators), plug-and-cord equipment (e.g., refrigeration, centrifuges, heating baths, electrophoresis devices), extension cords, and outlets. The following requirements must be followed to ensure electrical safety:

- All electrical equipment used by laboratories must be listed by a nationally recognized testing laboratory (NRTL), with a label showing its approval. It must be used in accordance with the instructions on the listing or labeling. Two examples of NRTLs include Underwriter's Laboratory (UL) and Factory Mutual (FM). A full listing of approved NRTLs can be found on the OSHA website at: http://www.osha.gov/dts/otpca/nrtl/index.html.
- Only an electrician that is properly licensed in the State of New Hampshire may work on electrical utilization systems. Under no circumstances may laboratory personnel undertake changes to the building electrical service.
- Laboratory personnel must always disconnect the power source to any electrical equipment before attempting non-electrical service or repair.
- Live parts of electrical equipment operating at 50 volts or more must be guarded against accidental contact.
- A minimum 36-inch clearance must be maintained around electrical controls, panels and disconnects at all times. Greater clearance distances may be

required when the equipment voltage is greater than 150V in conjunction with certain workplace conditions. Contact OEHS for more information.

- When unplugging a device, be sure to pull from the plug to prevent wiring damage.
- Never override electrical safety equipment such as guards or electrical interlocks.

D. Use of Extension Cords

In general, extension cords are not appropriate where a permanent wiring solution is available, regardless of convenience. Extension cords should be used only for temporary purposes and replaced with surge protectors if needed for longer periods of time. When extension cords are used, the following restrictions apply:

- Use only extension cords that are listed and labeled by a NRTL.
- Use only extension cords that are rated for hard or extra hard usage. The rating must be denoted not only on the original package but also printed on the extension cord insulating jacket. Review the capacity of the extension cord to ensure that you are staying within the cord's power rating.
- Use only extension cords with a minimum conductor size of 12 AWG (American Wire Gauge) and only cords with a grounding pin. Never remove the grounding pin to make a three prong cord fit in a two-prong outlet.
- Extension cords may not be run through doors, windows, walls, or ceilings and may not be attached to building surfaces (i.e., walls, ceilings) by staples or other means.
- Extension cords must never be placed inside a fume hood.
- Extension cords must be protected from damage and may not be placed in such a way that they create a tripping hazard.
- Extension cords may not be plugged in end-to-end or "daisy-chained."
- Extension cords must be inspected regularly for wear, as it is especially likely around the plug. Worn or frayed cords must be removed from service and replaced. Cracks in extension cords may not be repaired with electrical tape.

E. Use of Power Strips

Power strips permit more products to be plugged into the same outlet. While power strips may be convenient, they may also create safety hazards when used incorrectly. Power strips do not increase the amount of power available to a location, but rather more access to the same electrical source. A heavy reliance on power strips generally indicates that additional wall outlets are needed. Follow these procedures when using power strips:

- Use only NRTL (Nationally Recognized Testing Laboratory) tested power strips, and be sure they are used only as intended by their NRTL listing.
- Select power strips that are properly rated for the application. For example, in a wet chemistry laboratory the power strip must be rated for corrosive and indoor wet locations. Do not place power strips inside fume hoods.
- Read and understand the manufacturer's instructions and limitations on the power strip. For example, the on/off switch on the power strip may not be designed to interrupt the power of the devices plugged into the strip during normal applications.
- Do not overload the circuit. Review the capacity of the circuit and the power requirements of all of the items plugged into it. This includes not only the items plugged into the power strip but also other devices plugged into wall outlets along the same circuit.

F. Use of Clamp Lighting

Clamp lighting refers to lamps that can be attached to objects (such as desks, benchtops, or equipment) using a clamp connected to the lamp assembly. These devices are commonly available at many home and office product retailers. Clamp lighting poses special hazards in the laboratory due to the generation of heat and the potential for the equipment to accidentally fall. Follow these procedures when using clamp lighting:

- Use only NRTL (Nationally Recognized Testing Laboratory) tested clamp lights, and ensure they are used only as intended by their NRTL listing.
- Use clamp lights that are properly rated for the application. Many clamp lights cannot be used in a wet environment.
- Clamp lights may not be attached to any surface within 6 feet of a water source (e.g., sinks, emergency showers, water tanks). Clamp lights may not be attached to any surface directly above a water source at any distance.
- Prevent lights from contacting combustible materials (such as paper goods). Move combustible materials at least three feet away from the lamp reflector surface. Move any combustible materials that could potentially fall onto the reflector surface to another location.
- Do not wrap excess cord around the lamp. The reflector surface gets very hot and may damage the cord jacket.
- Inspect cords daily prior to use for cracks, wear, or exposed conductor wires. Discard lamps with damaged cords.

G. Ground Fault Circuit Interrupters

Ground Fault Circuit Interrupters, or GFCIs, are designed to protect the end user from electrical shock. GFCIs are not required on all circuits in laboratories. Best management practices in laboratory safety call for all outlets within 6-feet of a water source (such as a sink) or in a wet environment to have GFCI protection. All maintenance requests and renovation designs must include a provision for GFCI protection under these circumstances. Older buildings may be "grandfathered" and exempt from this requirement.

If a laboratory currently has outlets with GFCI protection, they should be tested at least once per month. Laboratory personnel are responsible for testing the GFCI. To test the receptacle GFCI, first plug a lamp into the outlet and turn it on. Next, press the "TEST" button on the GFCI. Under properly functioning conditions, the GFCI's "RESET" button should pop out and the light will turn off. Press the "RESET" button to restore power to the outlet.

- If the "RESET" button pops out but the light does not go out, the GFCI has been improperly wired. Contact the Facilities Support Center (603-862-1437) to correct the wiring errors.
- If the "RESET" button does not pop out, the GFCI is defective and should be replaced.

H. Changes to Building Electrical Services

Only an electrician that is properly licensed in the State of New Hampshire may perform changes to electrical services in the laboratory. Adding or modifying building circuitry or wiring are examples of a change to the electrical service. Changes are requested by contacting the Facilities Control Center at 603-862-1437 as appropriate.

I. Damaged or Defective Equipment

Any of the following circumstances requires that the user immediately take the equipment out of service:

- Experiencing shocks, even mild shocks, when the equipment is touched;
- Abnormal heat generation; and
- Arcing, sparking, or smoking from the equipment.

Laboratory personnel must tag the equipment, "Do Not Use" and should arrange for equipment repair either through the equipment manufacturer or through the Facilities Control Center as appropriate.

J. Special Considerations

Follow these guidelines when working with electrical equipment or devices:

- Laboratory personnel frequently construct equipment such as lighting fixtures or housings for use in specialty applications. All electrical equipment constructed by UNH employees or students must be inspected prior to use by a New Hampshire licensed electrician or qualified electrical engineer. All electrical equipment must be constructed in accordance with the requirements of the current National Electric Code.
- If flammables are used, electrical equipment with motors must be rated for Class I Division II environments. This requirement is waived if the motor is permanently housed in a fume hood or fitted with special local exhaust ventilations designed to prevent flammable concentrations of gases or vapors from reaching the motor.
- The manufacturer must certify refrigerators used to store flammable chemicals.
- Variac is a brand name for a type of variable voltage transformer. These transformers are used to control the temperature of heating mantles and sometimes for the rate of a stirring motor, or heating a high vacuum line. Some older models of Variacs will keep whatever is plugged into them electrically live even though the Variac is switched off. Touching this device and ground at the same time could complete a circuit with your body and lead to electrocution.
- Install ground fault circuit interrupter (GFCI) outlets within 6 feet of a water source.
- Electrophoresis devices should be evaluated for electrical safety concerns.

Chapter 11 – Individual Health and Safety Plan

Section 1: Individual Laboratory Safety Plan

The **Chemical Hygiene Plan** provides a general outline of laboratory policies and procedures. This plan should be adapted by each faculty member to meet the specific needs in his/her laboratory by adding safety and health policies and procedures specified by the faculty member and the department. The following is suggested list of information to be included:

- Hazardous Materials Used in the Laboratory
- Required Training
- Medical Monitoring
- Registrations/Notifications/Permits
- List of Laboratory Personnel
- Special Emergency Procedures
- Individual Laboratory Procedures
- Departmental Policies and Procedures

A sample form has been included which can be further developed to meet the needs of individual laboratories (see **Appendix F** for an example).

Appendix A – Glossary

ACGIH (**A**merican **C**onference of **G**overnmental **I**ndustrial **H**ygienists)	Organization of professionals in government agencies or educational institutions engaged in occupational safety and health programs. ACGIH develops and publishes recommended occupational exposure limits for chemical substances and physical agents (see TLV and BEI).
Action Level	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	An adverse effect on the human body with symptoms of high severity coming quickly to a crisis.
Allergic Sensitization	A condition acquired through exposure to a particular substance. Additional exposure may cause a more severe reaction.
Aspiration	The removal of fluids or gases from a cavity by suction.
BEI (Biological Exposure Indices)	Levels of determinants in specimens from a healthy worker who has been exposed to chemicals. A reference value for biological monitoring.
Bronchitis	The inflammation of one or more of the larger passages leading to the lungs.
BSC	Biological Safety Cabinet.
Carcinogen	Any substance which meets one of the following criteria: • It is regulated by OSHA as a carcinogen; or • 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 • It is listed under Group 1 ("carcinogenic to humans") by the International Agency for research on Cancer Monographs (IARC); or • 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 in accordance with any of the following criteria.
Catalyst	A chemical which changes the rate of a chemical reaction between two other chemicals without affecting the chemical itself.
Chemical Hygiene Officer	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.

Chronic	An adverse effect on the human body with symptoms, which develop slowly over a long period of time or which frequently recur.
Combustible	A chemical or agent with a flashpoint at or above 100ºF but below 200ºF.
Combustible Liquid	Any liquid having a flashpoint at or above 100 degrees Fahrenheit (37.8 degrees Celsius), but below 200 degrees Fahrenheit (93.3 degrees Celsius), except any mixture having components with flashpoints of 200 degrees Fahrenheit (93.3 degrees Celsius), or higher, the total volume of which make up 99 percent or more of the total volume of the mixture.
Compressed Gas	• A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70 degrees Fahrenheit (21.1 degrees Celsius); or • A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130 degrees Fahrenheit (54.4 degrees Celsius) regardless of the pressure at 70 degrees Fahrenheit (21.1 degrees Celsius); or • A liquid having a vapor pressure exceeding 40 psi at 100 deg. F (37.8 C) as determined by ASTM D-323-72.
Conjunctivitis	The inflammation of the delicate membrane lining the eyelids and covering the eyeball.
Cornea	The transparent membrane that covers the anterior part of the eye.
Corrosive	A chemical that causes visible destruction of or irreversible alterations in, living tissue by chemical action at the site of contact.
CSC	Chemical Safety Committee.
Cyanosis	A bluish discoloration of the skin, especially on the face and fingers, indicating a lack of sufficient oxygen in the blood.
Deflagration	The propagation of a reaction zone at a velocity that is less than the speed of sound in the unreacted medium.
Dermatitis	An inflammation of the skin.
Designated Area	An area which may be used for work with 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.
Detonation	Propagation of a reaction zone at a velocity that is at or above the speed of sound in the unreacted medium.
Emergency	Any occurrence such as, but not limited to, equipment failure, rupture of containers or failure of control equipment which results in an uncontrolled release of a hazardous chemical into the workplace.

Employee	An individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments.
Evaporation Rate	A measure of the length of time required for a given amount of a substance to evaporate, compared with time required for an equal amount of ether or butyl acetate to evaporate.
Explosive	A chemical or agent that causes a sudden, almost instantaneous release of pressure, gas and heat when subjected to sudden shock, pressure or high temperature.
Eye Hazard	A chemical or agent that adversely affects the eye or visual acuity of the eye.
Flammable	A chemical or agent with a flashpoint below 100ºF.
Flammable Aerosol	An aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame protection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening.
Flammable Gas	• A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent by volume or less; or • A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12 percent by volume, regardless of the lower limit.
Flammable Limits (Explosive Limits)	• Lower Flammable (Explosive) Limit - The lowest concentration of a combustible or flammable gas or vapor in air that will produce a flash of fire. Mixtures below this concentration are too "lean" to burn. • Upper Flammable (Explosive) Limit - The highest concentration of a combustible or flammable gas or vapor in air that will produce a flash of fire. Mixtures above this concentration are too "rich" to burn.
Flammable Liquid	Any liquid having a flashpoint below 100 degrees Fahrenheit (37.8 degrees Celsius), except any mixture having components with flashpoints of 100 degrees Celsius) or higher, the total of which make up 99 percent or more of the total volume of the mixture.
Flammable Solid	A solid, other than a blasting agent or explosive as defined in § 1910.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.
Flashpoint	The minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested as follows:

- Tagliabue Closed Tester (See American National Standard Method of Test for Flash Point by Tag Closed Tester, Z11.24 - 1979 (ASTM D 56-79)) - for liquids with a viscosity of less than 45 Saybolt Universal Seconds (SUS) at 100 deg. F (37.8 deg. C), that do not contain suspended solids and do not have a tendency to form a surface film under test; or

- Pensky-Martens Closed Tester (See American National Standard Method of Test for Flashpoint by Pensky-Martens Closed Tester, Z11.7 - 1979 (ASTM D 93-79)) - for liquids with a viscosity equal to or greater than 45 SUS at 100 deg. F (37.8 deg. C), or that contain suspended solids, or that have a tendency to form a surface film under test; or

- Setaflash Closed Tester (see American National Standard Method of test for Flash Point by Setaflash Closed Tester (ASTM D 3278-78)).

Note: *Organic peroxides, which undergo auto-accelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified above.*

Hazardous Chemical — Any chemical whose presence or use is a physical or health hazard. Some examples include chemicals that are toxic, corrosive, flammable, highly reactive or explosive or emit ionizing radiation.

Health Hazard — Chemical, biological, radioactive or physical agents which may cause an adverse effect on the human body.

Health Hazard — A chemical which is a carcinogen, toxic or highly toxic agent, reproductive toxin, irritant, corrosive, sensitizer, hepatotoxin, nephrotoxin, neurotoxin, or an agent which acts on the hematopoietic system or damages the lungs, skin, eyes, or mucous membranes.

Hematopoetic Toxin — A chemical or agent that adversely affects blood function.

Hepatotoxin — A chemical or agent that adversely affects the liver.

IBC — Institutional Biosafety Committee (same as Biological Safety Committee).

IDLH (**I**mmediately **D**angerous to **L**ife and **H**ealth) — Immediately dangerous to life and health. The maximum concentration of a chemical from which one could escape within 30 minutes without any escape - impairing symptoms or irreversible health effects. (Note: carcinogenic effects are not considered in setting these values.)

Ingestion — The taking in of a substance through the mouth.

Inhibitor — A chemical which is added to another substance to prevent an unwanted chemical change from occurring.

Irritant — A chemical which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact.

Laboratory	A facility where the "laboratory use of hazardous chemicals" occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.
Laboratory Use of Hazardous Chemicals	Handling or use of such chemicals in which all of the following conditions are met: • Chemical manipulations are carried out on a "laboratory scale;" • Multiple chemical procedures or chemicals are used; • The procedures involved are not part of a production process, nor in any way simulate a production process; and • "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.
Laboratory-Scale	Work with substances in which the containers used for reactions, transfers, and other handling of substances which are designed to be easily and safety manipulated by one person. "Laboratory scale" excludes those workplaces whose function is to produce commercial quantities of materials.
Laboratory-Type hood	A device located in a laboratory, enclosure on five sides with a movable 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. Walk-in hoods with adjustable sashes meet this definition provided that the sashes are adjusted during use so that the airflow and the exhaust of air contaminants are not compromised and employees do not work inside the enclosure during the release of airborne hazardous chemicals.
Lavage	The washing or irrigation of an organ.
LD_{50} (Lethal Dose 50)	The single dose of a substance which causes the death of 50% of an animal population when exposed to the substance by any route other than inhalation. LD50 is usually expressed as milligrams or grams or material per kilogram of animal weight. (mg/kg or g/kg). The animal species and means of administering the dose (oral, intravenous, etc.) should also be stated.
LEL, LFL (**L**ower **E**xplosive **L**imit, **L**ower **F**lammable **L**imit)	Refers to the lowest concentration of gas or vapor (% by volume in air) that burns or explodes if an ignition source is present at ambient temperatures.
LSO	Laboratory Safety Officer.
Lung Hazard	A chemical or agent that adversely affects lung tissue.

Medical Consultation	A consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examinations or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.
MSDS	Material Safety Data Sheet, currently referred to as Safety Data Sheet.
Mutagen	A substance that causes changes in the genetic material in cells. Some mutagens may also be carcinogens.
Narcosis	An unconscious state, normally caused by a drug.
Nephrotoxin	A chemical or agent that adversely affects the kidneys.
Neurotoxin	A chemical or agent that adversely affects the nervous system.
Organic Peroxide	An organic compound that contains the bivalent -O-O- structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.
OSHA	**O**ccupational **S**afety and **H**ealth **A**dministration, United States Department of Labor.
Oxidizer	A chemical other than a blasting agent or explosive as defined in 29 CFR 1910.109(a), that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.
Oxidizing Material	A chemical which gives off free oxygen in a chemical reaction. This includes chemicals such as peroxides, chlorates, perchlorates, nitrates and permanganates. These can react vigorously when stored in contact with reducing materials.
PEL (**P**ermissible **E**xposure **L**imit)	Established by OSHA this maybe expressed as a time-weighted average (TWA) limit or a ceiling exposure limit (CEL). OSHA PELs have the force of the law.
Physical Hazard	A chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer pyrophoric, unstable (reactive) or water-reactive.
Polymerization	A chemical reaction in which two or more small molecules combine to form larger molecules.
Protective Laboratory Practices and Equipment	Laboratory procedures, practices and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective, in minimizing the potential for employee exposure to hazardous chemicals.
Pulmonary Edema	An abnormal accumulation of fluid in the lungs.

Pyrophoric	Chemicals or agents that ignite spontaneously in air at a temperature of 130 ºF (54.4 ºC) or below.
Reactivity	A measure of the tendency of a substance to undergo chemical reaction with the release of energy.
Reducing Material	A chemical which absorbs oxygen or accepts electrons in a chemical reaction.

Reproductive Health Hazard	A chemical, physical or biological agent that causes reproductive impairment in adults and/or developmental impairment or death in the embryo/fetus or child. Men and women of childbearing potential should take care to avoid exposure.
Reproductive Toxins	Chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis): • After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m(3); • After repeated skin application of less than 300 (mg/kg of body weight) per week; or • After oral dosages of less than 50 mg/kg of body weight per day.
RSC	Radiation Safety Committee.
RSO	Radiation Safety Officer.
SDS	Safety Data Sheet (Formerly known as Material Safety Data Sheet or MSDS)
Sensitizer	A chemical that causes those exposed to develop an allergic reaction after repeated exposure (See allergic sensitization above).
Skin Hazard	A chemical or agents that adversely affects the dermal layer of skin.
Solubility	A measure of the amount of the substance that will dissolve in a given amount of water or other solvent.
Spontaneous Heating	An increase in the internal temperature of substance due to a chemical or physical change without the application of external heat
Stability	A measure of the ability of a substance to be handled and stored without undergoing unwanted chemical changes.
Systemic	Affecting the body as a whole.
Teratogen	A substance which interferes with embryonic or fetal development. Women of child bearing potential should take care to avoid exposure.
Thermal Decomposition	Chemical breakdown of a material brought about by exposure to heat.
TLV (**T**hreshold **L**imit **V**alue)	The airborne concentration of a substance which represents conditions under which it is believed that nearly all workers may be repeatedly exposed day after day (for eight hours each day) without adverse effects.
TLV-C (**T**hreshold **L**imit **V**alue - **C**eiling)	The airborne concentration of a substance that should not be exceeded during any part of the working day.

Toxicity	The measure of the adverse effect exerted on the human body by a poisonous material.
UNHCEMS™	University of New Hampshire's Chemical and Environmental Management System.
Unstable Reactive	Chemicals or agents that vigorously polymerize, decompose, condense or become self-reactive under conditions of shock, pressure or temperature.
Vapor Density	Relates the density of the vapors from a substance to the density of air. Chemicals with a vapor density less than 1 will rise and those with a value greater than 1 will sink in air.
Vapor Pressure	The pressure a vapor exerts when it is in equilibrium with its liquid or solid form. Units are usually expressed in mm of Hg.
Volatile	Evaporates quickly.
Water Reactive	A chemical or agent that reacts with water to release a gas that is either flammable or presents a health hazard.

Appendix B – References

1. Fire Protection Guide on Hazardous Materials. National Fire Protection Association, Quincy, MA (latest edition).
2. Chemical Hazards of the Workplace. Proctor, N. and J. Hughes. J.B. Lippincott Co., Philadelphia, PA (latest edition).
3. Prudent Practices for Handling Hazardous Chemicals in Laboratories. National Research Council Committee on Hazardous Substances in the Laboratory. National Academy Press, Washington, D.C. (latest edition).
4. Dangerous Properties of Industrial Materials. Sax, N. Irving. Van Nostrand Reinhold, New York, NY (latest edition).
5. CRC Handbook of Laboratory Safety, Steere, N. ed. CRC Press, Inc., Boca Raton, FLA (latest edition).
6. The Merck Index. Windholz, M., ed. Merck and Co. Inc., Rahway, N.J. (latest edition).
7. Guidelines for Laboratory Design – Health and Safety Considerations. L. DiBerardinis et al. (latest edition).

OEHS has the following publications available at no charge:

1. Safety Data Sheets.
2. Chemical Hygiene Plan.
3. Hazardous Waste Management Plan.
4. Exposure Control Plan
5. OSHA Bloodborne Pathogens Standard
6. Radiation Protection Program.
7. Safety in Academic Chemistry Laboratories, American Chemical Society (latest edition).
8. Biosafety in Microbiological and Biomedical Laboratories, U.S. Department of Health and Human Services (available at http://www.cdc.gov/OD/ohs/biosfty/bmbl5/bmbl5toc.htm).

Appendix C – Laboratory Safety Survey

Doors

☐ YES	☐ NO	☐ N/A	1.	The door Caution Sign is up to date?
☐ YES	☐ NO	☐ N/A	2.	Appropriate pictograms are present (i.e., Biosafety, Radioactive Materials, X-rays etc.)?
☐ YES	☐ NO	☐ N/A	3.	Vision panel in door is free from obstructions?

Gas Cylinders

☐ YES	☐ NO	☐ N/A	4.	All gas cylinders are properly capped or regulated?
☐ YES	☐ NO	☐ N/A	5.	All gas cylinders are properly secured or fastened in an upright position?
☐ YES	☐ NO	☐ N/A	6.	All flammable gas cylinders are located at least 3 feet away from doors?
☐ YES	☐ NO	☐ N/A	7.	All gas cylinders are located at least 30 inches away from electrical panels?
☐ YES	☐ NO	☐ N/A	8.	Particularly Hazardous Gases are used in approved fume hood or gas cabinet?
☐ YES	☐ NO	☐ N/A	9.	Gas cylinders are transported on appropriate carts with straps/chains?
☐ YES	☐ NO	☐ N/A	10.	Flammable gas cylinders are not stored next to oxidizing gases?

Refrigerators

☐ YES	☐ NO	☐ N/A	11.	Flammable liquids are not stored in household refrigerators?
☐ YES	☐ NO	☐ N/A	12.	Food and beverages are not stored in the refrigerator?
☐ YES	☐ NO	☐ N/A	13.	All chemicals and containers are properly labeled?
☐ YES	☐ NO	☐ N/A	14.	Refrigerators are cleaned and are regularly maintained?

Electrical Safety

☐ YES	☐ NO	☐ N/A	15.	Equipment is properly grounded?
☐ YES	☐ NO	☐ N/A	16.	Room occupants test GFCI devices monthly?
☐ YES	☐ NO	☐ N/A	17.	Extension cords are not run through doors, windows, walls, ceilings?
☐ YES	☐ NO	☐ N/A	18.	All electrical cords are in good condition, without defect?
☐ YES	☐ NO	☐ N/A	19.	Electrical cords do not present a tripping hazard?
☐ YES	☐ NO	☐ N/A	20.	Clamp lighting is more than 6' away from water sources?
☐ YES	☐ NO	☐ N/A	21.	Clamp lighting is more than 3' away from combustible materials?
☐ YES	☐ NO	☐ N/A	22.	Electrical disconnects clearly marked?

General Building Safety

☐ YES	☐ NO	☐ N/A	23.	Aisles, corridors and exits are free of obstruction and tripping hazards?
☐ YES	☐ NO	☐ N/A	24.	Written lockout-tagout (LOTO) procedures are in place?
☐ YES	☐ NO	☐ N/A	25.	Overhead cranes and hoists labeled on each side with manufacturer load rating?
☐ YES	☐ NO	☐ N/A	26.	Combustible storage (boxes, paper) is kept to a minimum and is not stored within 24" of the ceiling in non-sprinkled buildings or within 18" of the sprinkler head in sprinkled buildings?
☐ YES	☐ NO	☐ N/A	27.	Fire doors are kept closed and unobstructed?
☐ YES	☐ NO	☐ N/A	28.	The ceiling is intact (i.e., ceiling tiles in place, etc.)?
☐ YES	☐ NO	☐ N/A	29.	Penetrations in firewalls are sealed with appropriate fire stop material?

University Policies

☐ YES	☐ NO	☐ N/A	30.	The UNH Chemical Hygiene Plan is easily accessible.
☐ YES	☐ NO	☐ N/A	31.	University rules regarding the use and disposal of sharps (e.g., hypodermic needles, scalpel blades, Pasteur pipettes) has been reviewed (see **Appendix F**) by laboratory personnel.

Emergency Procedures

☐ YES ☐ NO ☐ N/A 32. The spill kit contains: absorbent, safety glasses, gloves. Location: _____

☐ YES ☐ NO ☐ N/A 33. Occupants of the room know the campus emergency number, 911?

☐ YES ☐ NO ☐ N/A 34. There is a telephone w/ 911 sticker attached, in the room?

☐ YES ☐ NO ☐ N/A 35. A biological spill kit is easily accessible? Location: _____

☐ YES ☐ NO ☐ N/A 36. The spill kit is non-breakable and contains: nitrile or latex gloves, disinfectant (i.e., bleach, Lysol™), paper towels, tongs and utility gloves.

☐ YES ☐ NO ☐ N/A 37. Occupants know evacuation route and areas of assembly in case of emergency?

Personal Protective Equipment (PPE)

☐ YES ☐ NO ☐ N/A 38. PPE is easily accessible and worn when appropriate. Type of PPE present:

☐ **Lab coats or gowns**	☐ **Disposable gloves**	☐ **Respirators (List type)**
☐ **Goggles**	☐ **Utility gloves**	_____
☐ **Safety glasses**	☐ **Hearing protection**	_____
☐ **Face shield**	☐ **Booties or shoe covers**	_____

☐ YES ☐ NO ☐ N/A 39. Occupants do not wear open-toed shoes, sandals, flip-flops, clogs, etc.

☐ YES ☐ NO ☐ N/A 40. Occupants wear gowns/lab coats when large areas of skin are exposed (i.e., when lab occupants wear shorts, skirts, etc.).

☐ YES ☐ NO ☐ N/A 41. All occupants wear appropriate gloves?

☐ YES ☐ NO ☐ N/A 42. All occupants wear the appropriate eye/face protection?

☐ YES ☐ NO ☐ N/A 43. Loose clothing and long hair do not come in contact with equipment?

☐ YES ☐ NO ☐ N/A 44. Visitors are required to wear personal protective equipment?

☐ YES ☐ NO ☐ N/A 45. Occupants have been certified to wear a respirator?

Facilities

☐ YES ☐ NO ☐ N/A 46. A hand washing sink is available, supplied with soap and paper towels.

☐ YES ☐ NO ☐ N/A 47. The room does not show signs of mold contamination.

☐ YES ☐ NO ☐ N/A 48. If lab windows can be opened, they have been fitted with screens.

☐ YES ☐ NO ☐ N/A 49. Belts, pulleys, and other exposed moving equipment parts are guarded to prevent injury?
Comments: _____

☐ YES ☐ NO ☐ N/A 50. Vacuum line filter protection is in place. If yes, please indicate the type:
☐ **Central (Main)** ☐ **Local pump** ☐ **Sink**

☐ YES ☐ NO ☐ N/A 51. Animals are not housed within the room.

☐ YES ☐ NO ☐ N/A 52. A fermentor is used to grow bacteria. If yes, please indicate the following:

Make	***Model***	***Serial #***	***Volume Use (L)***
_____	_____	_____	_____

Work Practices

☐ YES ☐ NO ☐ N/A 53. Staff does not eat, drink, store food, apply make-up (including lip balm), insert contact lenses, etc., in the room.

☐ YES ☐ NO ☐ N/A 54. Mechanical pipetting devices are in use; mouth pipetting does not occur.

☐ YES ☐ NO ☐ N/A 55. Hands are washed at the end of experiments and gloves are removed prior to leaving the room.

☐ YES ☐ NO ☐ N/A 56. Workstations, closets, etc. are clean, neat and orderly?

☐ YES ☐ NO ☐ N/A 57. The trash containers are noncombustible and emptied regularly?

Safety Equipment

☐ **YES**	☐ **NO**	☐ **N/A**	58. A drench shower is unobstructed (at least 3 square feet)?
☐ **YES**	☐ **NO**	☐ **N/A**	59. All persons in the room are aware of the location of the drench shower?
☐ **YES**	☐ **NO**	☐ **N/A**	60. A fire extinguisher is available in the room?
☐ **YES**	☐ **NO**	☐ **N/A**	61. All fire extinguishers have been inspected?
☐ **YES**	☐ **NO**	☐ **N/A**	62. All fire extinguishers are unobstructed?
			Comments: _____
☐ **YES**	☐ **NO**	☐ **N/A**	63. An eyewash station is easily accessible? (Bottled eyewashes are not recommended)
☐ **YES**	☐ **NO**	☐ **N/A**	64. Bottled eyewash solution is not expired?
☐ **YES**	☐ **NO**	☐ **N/A**	65. The eyewash station is "flushed" weekly (recommended for at least 3 minutes)?
☐ **YES**	☐ **NO**	☐ **N/A**	66. A first-aid kit is available in the room?
☐ **YES**	☐ **NO**	☐ **N/A**	67. Occupants know the location of the first aid kit?
☐ **YES**	☐ **NO**	☐ **N/A**	68. The kit contains clean, sterile bandages, pads, bandaids, tape?

Chemical Safety

☐ **YES**	☐ **NO**	☐ **N/A**	69. Occupants know how/where to access SDSs?
☐ **YES**	☐ **NO**	☐ **N/A**	70. All hazardous/odiferous/toxic chemicals are used in an approved fume hood?
☐ **YES**	☐ **NO**	☐ **N/A**	71. Incompatible chemicals segregated (i.e., no water reactives under the sink, etc.).
☐ **YES**	☐ **NO**	☐ **N/A**	72. Flammable liquids are stored in approved safety cans, flammable storage cabinets or flammable storage refrigerators?
☐ **YES**	☐ **NO**	☐ **N/A**	73. Ether and other highly flammable liquids are stored away from sources of heat, direct sunlight and ignition?
☐ **YES**	☐ **NO**	☐ **N/A**	74. All chemicals have been registered through UNHCEMS™ (http://www.cems.sr.unh.edu)?
☐ **YES**	☐ **NO**	☐ **N/A**	75. All chemical containers are capped and sealed except when actively adding or removing materials?
☐ **YES**	☐ **NO**	☐ **N/A**	76. Chemicals are not placed or stored on the floor?
☐ **YES**	☐ **NO**	☐ **N/A**	77. All chemicals and containers are properly labeled?
☐ **YES**	☐ **NO**	☐ **N/A**	78. Procedures for working with Particularly Hazardous Substances are followed?

Fume Hoods & Exhaust Systems

☐ **YES**	☐ **NO**	☐ **N/A**	79. The fume hood is being used at a proper sash height?
☐ **YES**	☐ **NO**	☐ **N/A**	80. Airflow in hood is not blocked or restricted?
☐ **YES**	☐ **NO**	☐ **N/A**	81. Occupants contact Facilities (603-862-1437) if they suspect a fume hood problem?
☐ **YES**	☐ **NO**	☐ **N/A**	82. Room has window-mounted air-conditioning units? How many: _____?

Chemical Waste

☐ **YES**	☐ **NO**	☐ **N/A**	83. Chemical waste is located within the area of generation?
☐ **YES**	☐ **NO**	☐ **N/A**	84. Each hazardous waste container has a completed EHS hazardous waste label including proper identification of contents?
☐ **YES**	☐ **NO**	☐ **N/A**	85. Chemical waste containers are in secondary containment?
☐ **YES**	☐ **NO**	☐ **N/A**	86. All chemical waste containers are capped when not in use?
☐ **YES**	☐ **NO**	☐ **N/A**	87. Room occupants know how to access the UNH Hazardous Waste Management Plan.
☐ **YES**	☐ **NO**	☐ **N/A**	88. If chemical waste is generated, all personnel have taken the online Hazardous Waste Training?

Appendix D – Sharps

Sharps can be defined as any device having corners, edges or projections with the potential of cutting or piercing the skin. This pertains to both regulated sharps contaminated with biohazardous waste and sharps that pose a safety hazard to custodial staff and other personnel.

The following items are examples of regulated sharps and must be disposed in sharps containers and managed as medical waste, whether or not they are contaminated with biohazardous waste:

- Needles, including those with syringes, vacutainers, and attached tubing.
- Scalpels.
- Razors.
- Surgical saw blades.
- Glass pipettes.
- Glass slides.

When disposing of glassware contaminated with biohazardous waste, it must be placed into a biological burn box. If the broken glassware is contaminated with infectious material, it must be placed into a sharps container prior to placement into the burn box. Examples include:

- Glass bottles.
- Test tubes.
- Flasks.

SHARPS CLASSIFICATIONS

There are three classes of sharps waste produced at UNH. This information complies with the OSHA Bloodborne Pathogen Standard (29 CFR 1910.1030) and federal, state, and local waste disposal guidelines. The disposal procedures for these classes are as follows:

Class 1: Non-chemically contaminated broken glass and Non-biologically contaminated broken glass

This class consists of any type of broken glass that has been rinsed of any chemical contamination, including:

- Solvent bottles.
- Chemical bottles.
- Test tubes.
- Broken flasks.

Procedure for disposal:

1. Place waste in a sturdy, leak proof, puncture-resistant broken glass box.
2. Securely close the box and label it with the building, room number, and principal investigator.
3. Laboratory personnel should place the box directly into a dumpster.

Class 2: Chemically contaminated broken glass

This class consists of any broken glass that is contaminated with a "P" listed waste. Contact the Hazardous Waste Coordinator at 603-862-3526 to determine if a chemical is on the "P" list. Glass contaminated with non-listed waste can be placed in a broken glass box. This includes:

- TLC plates.
- Flasks with irremovable residues.

Procedure for disposal:

1. Place waste in a puncture-resistant container that can be capped and sealed.
2. Label with a completed UNH Hazardous Waste label.
3. Call the Hazardous Waste Coordinator at 603-862-3526 to schedule a pickup.

Class 3: Biologically contaminated sharps

This class consists of:

- All biologically contaminated sharps from BSL-1 or BSL-2 laboratories.
- All syringes and needles, whether they are biologically contaminated or not.

Procedure for removal:

1. Place waste in Sharps containers for removal by Environmental Health and Safety. Sharps containers must be leak proof, puncture-resistant and labeled with the biohazard symbol or the word "Biohazard."
2. Place the sharps container in an infectious agent burn box.
3. Secure the box, seal it with tape and label it with the building, room number and principal investigator.
4. Call the Hazardous Waste coordinator at 603-862-3526 to schedule a pickup.

If your lab is not a BSL-1 or BSL-2 and generates syringes and needles only:

- Place waste in a puncture-resistant container (such as a red sharps container puncture resistant plastic screwtop container).
- Call the Hazardous Waste Coordinator at 603-862-3526 for pickup.

The following are general guidelines for all sharps containers in the laboratory:

- Never overfill sharps containers.
- Close the lid on sharps containers when they are ¾ full.
- Never re-use sharps containers.

Appendix E – Incompatible Chemicals

Many chemicals, when mixed with other chemicals or materials, can produce effects which are harmful to human health and the environment, such as (1) heat or pressure, (2) fire or explosion, (3) violent reaction, (4) toxic dusts, mists, fumes, or gases, or (5) flammable fumes or gases.

Below are examples of potentially incompatible chemicals or materials, along with the harmful consequences, which result from mixing materials in one group with materials in another group. The list is intended as a guide to indicate the need for special precautions when managing these potentially incompatible materials or components. This list is not intended to be exhaustive.

Group 1 **Potential consequences:** Heat generation; violent reaction	
A	**B**
Acetylene sludge Alkaline caustic liquids Alkaline cleaner Alkaline corrosive liquids Alkaline corrosive battery fluid Caustic water Lime sludge and other corrosive alkalis Lime wastewater Lime and water Spent caustic	Acid sludge Acid and water Battery acid Chemical cleaners Electrolyte, acid Etching acid liquid or solvent Mixed acid Pickling liquor and other corrosive acids Spent acid Sulfuric acid

Group 2 **Potential consequences:** Fire or explosion; generation of flammable hydrogen gas.	
A	**B**
Aluminum Beryllium Calcium Lithium Magnesium Potassium Sodium Zinc powder Other reactive metals and metal hydrides	Any chemical or waste listed in **Group 1**

Group 3 **Potential consequences:** Fire, explosion, or heat generation; generation of flammable or toxic gases.	
A	**B**
Alcohols Water	Calcium Lithium Metal hydrides Potassium SO_2Cl_2, $SOCl_2$, PCl_3, CH_3SiCl_3 Other water-reactive waste Concentrated chemicals or wastes listed in **Group 1**

Group 4 **Potential consequences:** Fire, explosion, or violent reaction.	
A	**B**
Alcohols Aldehydes Halogenated hydrocarbons Nitrated hydrocarbons Unsaturated hydrocarbons Other reactive organic compounds and solvents	Concentrated chemicals or wastes listed in **Group 1**. Any chemical or waste listed in **Group 2-A.**

Group 5 **Potential consequences:** Generation of toxic hydrogen cyanide or hydrogen sulfide gas.	
A	**B**
Cyanide and sulfide solutions	Any chemical or waste listed in **Group 1-B**

Group 6 **Potential consequences:** Fire, explosion, or violent reaction.	
A	**B**
Chlorates Chlorine Chlorites Chromic acid Hyphochlorites Nitrates Nitric acid, fuming Perchlorates Permanganates Peroxides Other strong oxidizers	Acetic acid and other organic acids Concentrated mineral acids Other flammable and combustible chemicals/wastes Any chemical or waste listed in **Group 2-A** Any chemical or waste listed in **Group 4-A**

Source: 40 CFR Part 264, Appendix V

Appendix F – Individual Health and Safety Plan

Individual Laboratory Safety Plan			
(To be filled out by faculty member)			
Faculty Member:		**Department:**	
Building:		**Room:**	
Office Phone:		**Lab Phone:**	
Identification of Hazards: [e.g., chemical, biological, ionizing or non-ionizing radiation, physical (be specific)].			
Required Training: Include appropriate training (e.g., Biological Safety and Sharps Training, Hazard Communication Training, Fire Extinguisher Training, Radiation Safety Training), departmental training and individual lab training.			
Medical Monitoring: (e.g., if working with human blood, hepatitis B immunization must be offered).			
Registrations/Notifications/Permits: e.g., Animal Use (IACUC), radiation (RSC, OEHS), biohazards (IBC, OEHS).			
Special Emergency Procedures			
List of Laboratory Personnel:			
Signature:		**Date:**	

Appendix G – Laboratory Check Out/Check In Forms

LABORATORY CHECK-OUT FORM	Completed			Date Completed	Questions
GENERAL					
Contact EHS at least one month prior to lab move.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-4041
Remove ***Caution Door Signs*** when lab is vacated and all hazardous materials have been removed.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-1510
Ensure that laboratory personnel have decontaminated all potentially contaminated surfaces (chemical, biological or radiological contaminants).	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-4041
Ensure that potential ***asbestos containing materials*** (e.g., lab ovens, benchtops) are tested prior to disposal. Contact EHS if you have any questions.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-4041
Collapse uncontaminated, unwanted cardboard boxes for recycling. Alert **Custodial Services** when bundled cardboard is ready for removal.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-2656
Indicate who will assume ownership of chemicals that are left behind (if any). Name: _____	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-1510
Ensure that all unwanted chemicals are added to the UNHCEMS™ website.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-1510
HAZARDOUS WASTE					
Ensure that all hazardous waste containers have a completed UNH hazardous waste label including proper identification of contents.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-3526
Ensure that all hazardous waste is removed prior to last day of occupancy.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-3526
Return all gas cylinders and lecture bottles to their respective vendors.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-3526
Retrieve all mercury-containing devices for waste pickup by EHS if they will not be taken with PI.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-4041
BIOLOGICAL SAFETY					
Notify EHS to inactivate IBC registered activities.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-4041
Ensure that biosafety cabinet surfaces have been decontaminated and cleaned (or call a vendor to decontaminate).	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-4041
Decontaminate biological safety cabinet filters or replace with new HEPA filters.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-4041
Remove all biological materials from storage equipment. Decontaminate surfaces with an appropriate disinfectant. Remove all biohazard stickers from equipment after decontamination.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-4041
Ensure that all biological waste has been packaged, sealed and labeled before removal.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-3526
Ensure that all contaminated sharps are enclosed within ***Sharps*** containers. Place the ***Sharps*** container in a burn box and dispose as biological waste. Do not leave any sharps in the laboratory.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-3526
RADIATION SAFETY					
Notify EHS 30 days before terminating work with any radionuclides.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-3607
All equipment that has been subject to radioisotope exposure must be inspected and formally released by EHS.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-3607
Ensure that all equipment that has been subject to radioisotope exposure is inspected and formally released by EHS.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-3607
ELECTRICAL SAFETY					
Bleed any stored energy from electrical equipment bound for the trash.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-4761
Have any electrical or computer equipment for disposal approved by Purchasing. http://www.unh.edu/purchasing/surplus/surplus_scrap.html.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-3526

Submit completed form to: **OEHS, 11 Leavitt Lane**

LABORATORY CHECK-IN FORM	Status			Date Completed	Questions
GENERAL					
Read the ***UNH Laboratory Safety Plan***; it is available at http://www.unh.edu/research/chemical-safety-plans-and-programs	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-5038
Take Laboratory and Chemical Safety Training and assign training to lab staff and students in UNHCEMS.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-5038
Create an account in UNHCEMS™. http://cems.unh.edu.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-1510
Request that your initial chemical inventory (if any) is verified and accurate in UNHCEMS™ and your laboratory door caution signs are updated.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-1510
Following procedures for ordering chemicals in the Chemical Ordering Instructions: http://www.unh.edu/research/chemical-ordering-instructions-0	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-5038
Ensure that lab personnel know where ***Safety Data Sheets*** (SDS) are located (https://cems.unh.edu).	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-5038
Ensure that appropriate personal protective equipment is worn in the laboratory.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-5038
HAZARDOUS WASTE					
Read the ***UNH Hazardous Waste Management Plan***. This document is available online at http://unh.edu/research/hazardous-chemical-waste.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-3526
Take Hazardous Waste Handler Training in UNHCEMS™.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-3526
Contact EHS to establish hazardous waste ***Satellite Accumulation Areas (SAAs)***.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-3526
Contact EHS for biological/infectious waste containers and to establish collection schedule.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-3526
BIOLOGICAL SAFETY					
Clean and certify all biological safety cabinets prior to usage. (An outside vendor is used to certify biological safety cabinets at UNH. Call OEHS for more information.)	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-0197
Ensure that personnel have completed appropriate level of Biosafety Training prior to beginning any laboratory activities.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-0197
Register all use of infectious material, human cell lines, materials, tissue, blood, and recombinant DNA with the UNH IBC at http://unh.edu/research/biological-safety.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-0197
Submit protocols using vertebrate animals to UNH ***IACUC*** for review prior to commencing. http://www.unh.edu/research/iacuc-application-resources	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-2003
Submit protocols using human subjects to UNH ***IRB*** for review prior to commencing. http://www.unh.edu/research/institutional-review-board-protection-human-subjects-research-irb-0	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-2003
RADIATION SAFETY					
If you want to use radioactive materials, complete the ***Radiation Permit Application*** available at http://unh.edu/research/radiation-safety-resources.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-3607
HAZARDOUS MATERIAL SHIPPING SAFETY					
If lab will be shipping chemical, biological, or radiological samples or materials, responsible lab personnel must complete ***Shipping Training***.	☐ Yes	☐ No	☐ N/A	____ / ____ / _____	603-862-5038

Submit completed form to: **OEHS, 11 Leavitt Lane**

Appendix H - Centrifuge Procedures

Follow the guidelines below to help extend the centrifuge's lifespan and to reduce accidents in the laboratory, including potential exposure to hazardous materials, leaks, and mechanical failures:

- Standard Operating Procedures (SOPs) must be developed for each centrifuge which presents a significant risk of injury or physical damage. Examples of centrifuges that require a SOP are: large high-speed centrifuges such as Beckman Avant J series, ultrafuges, and geotechnical centrifuges. Centrifuges which do not require a SOP are small benchtop general use centrifuges or microcentrifuges. All centrifuges must be used according to manufacturer instructions. If unsure about whether a centrifuge is required to have a SOP, contact OEHS for an assessment.
- Centrifuge operators must be trained in the proper use, handling, and storage of the unit.
- The centrifuge lid should be locked whenever the rotor is in motion.
- The centrifuge lid must never be opened when in operation; opening the lid while the unit is in operation may result in severe injury.
- Modern centrifuges cannot be opened while the rotor is spinning; older centrifuges that do not have this safety feature should be replaced.
- Follow the appropriate safety precautions when working with hazardous materials.
- Use the centrifuge in a properly ventilated area, especially when loading and unloading hazardous materials.
- Wait at least 10 minutes to open the centrifuge whenever an aerosol may be generated.
- Centrifuge safety cups must be used with infectious organisms and recombinant products. Fill and seal centrifuge safety cups in a certified biological safety cabinet. After centrifugation, open centrifuge safety cups within the certified biological safety cabinet.
- Create, review, and rehearse steps to be taken in the event of a spill or leak. Notify the principal investigator or laboratory manager and follow established protocols; be sure to know where clean up materials are located.

The following safe operating techniques will help reduce the chances of improper centrifuge operation:

- Ensure that the rotor and tubes are thoroughly clean and dry before centrifuge use.
- Do not overfill centrifuge tubes; overfilling centrifuge tubes may cause unwanted leaks and spills.
- Centrifuge tubes should never be filled more than three-fourths full. Whenever possible, especially with the use of hazardous materials, aspirate the solution out of the tubes instead of pouring.
- Use a fume hood or safety cabinet if aerosols are anticipated or suspected.
- Be sure to balance the tubes against each other and within the rotor when loading the centrifuge. For example, when spinning only two tubes, place them on opposite sides of the rotor. Do not place them next to each other. Also, be sure the densities of the materials in the tubes are similar.
- Do not open the lid until the rotor has stopped spinning.

Understanding the basic mechanics of a centrifuge and how to maintain it is important to overall safety. Damaged centrifuges can put operators and bystanders at risk.