Environmental Health and Safety (EHS)

CHEMICAL HYGIENE PLAN

Table of Contents

Chapter 1
Introduction

The Occupational Safety and Health Administration's (OSHA's) standard for occupational exposure to hazardous chemicals in laboratories (29 CFR 1910.1450) requires that all laboratories have a written Chemical Hygiene Plan (CHP) which includes laboratory specific hazards and safety information. The Principal Investigator must also designate a Chemical Hygiene Officer (CHO) who is responsible for implementing the provisions of the CHP as well as updating the CHP. (If a CHO is not designated for the laboratory group, the Principal Investigator is the CHO by default.)
[NOTE: A general overview of this Laboratory Standard is available at: http://www.osha.gov/SLTC/laboratories/. After going to this link, you may scroll down and double click on "1910.1450" to view the full standard.]

This CHP applies to all University of Massachusetts Lowell laboratory personnel who handle and may be exposed to hazardous materials in research laboratories at the University of Massachusetts Lowell. This CHP also addresses the physical hazards of hazardous materials such as mixing incompatible acids causing an explosion. For those laboratories that do not have hazardous chemicals, the CHP will be used as their laboratory safety manual. Although the CHP is not required for undergraduate students and visitors, the CHP can still be utilized as an administrative control to protect all employees, students, and visitors from potential health hazards and physical hazards associated with the handling, use, and storage of hazardous materials in the laboratories. The CHP does not cover work with radioactive materials or biological agents. Please refer to the EHS (Environmental Health and Safety) Radiation Safety Manual, the EHS Biosafety Manual https://www.uml.edu/docs/iv%20biosafety%20manual_tcm18-269076.pdf and/or the EHS Exposure Control Plan https://www.uml.edu/docs/i%20exposure%20control%20plan_tcm18-269048.pdf for safety information regarding these materials.

The University of Massachusetts Lowell's CHP consists of two main parts: the CHP and the CHP Notebook. The CHP describes general laboratory policies and procedures. It sets forth procedures, equipment, personal protective equipment, and work practices to protect employees from the health hazards and physical hazards presented by hazardous materials and hazardous equipment used in the laboratory.

The CHP Notebook must be customized by the laboratory group. It includes the specific work practices, procedures and policies that are used to ensure that employees are protected from all potential hazards in their specific work area. It also contains documentation for training records and internal laboratory inspections.

Chapter 2

Safety Responsibilities

The Principal Investigator

Each Principal Investigator has the overall responsibility to protect their personnel from occupational hazards. This is an important responsibility and cannot be delegated. The Principal Investigator must assure that the laboratory safety requirements listed below are followed:

- Contact EHS if starting a new lab on campus or if you are part of a new lab group moving on campus so that the lab can be commissioned.
  - Assist EHS with filling out a risk card for the door of your new lab. Find out more information about risk cards on campus here - https://new-acc-space-2280.ispring.com/app/preview/dc5d8020-70bb-11ed-8fcc-86c788c21c16.
  - EHS delivers a UML CHP to the PI when meeting the new PI for a commissioning of the new lab.
- Train all lab workers on the contents of the Chemical Hygiene Plan (CHP) and the CHP Notebook.
- Take the EHS online lab safety training located at www.uml.edu/eem/ehs/lab-safety on an annual basis.
- Designate a Chemical Hygiene Officer (CHO) for the laboratory group. If no CHO is designated, the Principal Investigator (PI) is the CHO by default.
- Develop laboratory-specific written standard operating procedures (SOPs). There are generic SOPs available on the EHS website at https://www.uml.edu/eem/ehs/lab-safety/standard-operating-procedures.aspx. These generic SOPs can be customized for your lab group. Each hazard in the lab must be addressed with a SOP.
- Enforce safe work practices and oversee day-to-day safety in the laboratory. This includes housekeeping. A messy lab can cause an incident to occur in the lab such as a chemical exposure or lab injury.
  - Check fume hoods to make sure lab workers are not storing paper towels or KimWipes close to the baffles and airfoil so that they do not unintentionally get pulled up through the ductwork. Also, only items needed in the fume hood should be placed there. Do not store hazardous waste or hazardous materials in the fume hood. Blocked baffles can cause air turbulence which could result in hazardous vapors entering a lab worker's breathing zone.
- Verify that the lab worker has received EHS online lab safety training by asking the lab worker to provide their EHS lab safety training certificate. EHS lab safety training is required annually for all lab workers, including the PI. Printed copies of the EHS lab safety certificate can be filed in section 8 of the CHP Notebook.
- Verify the lab worker has received EHS silica hazard awareness training by asking the lab worker to show you this certificate if the lab worker will be handling silica containing materials such as concrete mixes, ceramic powders, clay, rocks (cutting or grinding them), etc.
- Train all occupants of the laboratory on the specific hazards and controls in their work environment. Document lab-specific training in section 8 of the CHP Notebook. Training must include reading the safety data sheets for hazardous materials, reading the standard operating procedures as well as hands-on training.
- Provide appropriate personal protective equipment (PPE) for all laboratory workers as well as specific training on the PPE. Review your lab's PPE assessment and update as necessary, located in section 12 of the CHP Notebook. Ask EHS for assistance in filling this out if needed.

- EHS provides lab coats only. Provide this link to lab workers for ordering - https://www.uml.edu/eem/ehs/hazardous-materials/lab-coats/. The PI is responsible for providing appropriate types of gloves, safety glasses, safety goggles, face shields, aprons, coveralls, etc.
- Perform internal laboratory safety inspections on a regular basis. Correct any deficiencies and document all the internal inspections along with any corrective actions taken. Document this in section 9 of the CHP Notebook.
- Discuss safety issues during regular research group meetings. These safety discussions can be documented in section 11 of the CHP Notebook.
- Fill out new equipment installation requests for EHS/Facilities approval before purchasing new equipment. Go to https://www.uml.edu/facilities/service-requests/form/ and scroll down to the bottom of this webpage to find the electronic request form.
  - Refer to the 3D printers SOP located at https://www.uml.edu/eem/ehs/lab-safety/standard-operating-procedures.aspx for more information regarding the hazards and safety controls for this equipment. Go to attachment one for instructions on how to procure a 3D printer here at UML which includes filling out the new equipment installation request form.
- Maintain all records in the CHP Notebook. (Some of the CHP Notebook sections may not be applicable to all lab groups. If this occurs, please write “Not Applicable” on the appropriate page.)
- Verify that your CHO or one of your lab workers is testing your emergency eyewash stations weekly.
- Contact HR if planning to have a minor such as a high school student work in your lab over the summer. Paperwork from HR must be filled out and signed by yourself as well as the minor’s parents before the minor is allowed to work in a UML lab.
- Contact EHS if you are moving out of your lab so the lab can be decommissioned.

NOTE: The involvement of the Principal Investigator inside the research lab demonstrates a deep concern for safety. When the Principal Investigator’s attitude towards safety is indifferent, careless attitudes can develop within the laboratory group and this can lead to accidents. Also, if the Principal Investigator’s attitude towards good housekeeping in the lab is poor, then there is no accountability for keeping the lab neat and this can also lead to a lab incident.

The Chemical Hygiene Officer (CHO)

- Develop, implement, and document specific portions of the CHP Notebook such as making sure all safety data sheets are up to date and there is a written standard operating procedure for each hazard in the lab.
  - If SOPs are needed, reach out to the PI to discuss, and also reach out to EHS with any questions or concerns.
  - If safety data sheets need to be printed out, contact the manufacturer for the most up to date copy of the safety data sheet or find it online. EHS has some sites listed for obtaining safety data sheets at https://www.uml.edu/eem/ehs/lab-safety/sds.aspx.
- Enforce safe work practices and oversee day-to-day safety in the laboratory.
  - Report safety concerns to your PI.
- Consult with Environmental Health and Safety (EHS) as necessary for assistance with matters of health and safety.

- Keep all lab group members informed of the results of any lab safety inspections or air monitoring results issued by EHS.
- Investigate accidents and report near misses/incidents to the Principal Investigator as well as to EHS at https://www.uml.edu/eem/ehs/accident-near-miss-reporting-form.aspx.
- Test emergency eyewash station weekly or designate a lab worker to do this weekly testing. Go to www.uml.edu/eem/ehs/lab-safety under forms to print out the emergency eyewash station weekly testing form to post by each eyewash station in your lab(s).

The Employee (the lab worker)

- Know and understand the hazards associated with your work as well as all necessary controls (engineering, administrative, and personal protective equipment) that must be used to protect themselves from these hazards.
- Training (baseline laboratory safety training offered by EHS and laboratory-specific training offered by the Principal Investigator or lab manager) must be received before starting to work in the lab.
    - Here is a link to the EHS online lab safety training - https://www.uml.edu/eem/ehs/lab-safety/.
    - Lab-specific training documentation along with the Chemical Hygiene Plan Awareness form that must be signed by each employee is in section 8 of the CHP Notebook.
    - If working with silica generating materials such as in the ceramics room at Dugan or in the concrete mixing lab at the Falmouth Annex, go to https://www.uml.edu/eem/ehs/ehs-training/ to take the silica hazard awareness training.
- Review and know the location of the Chemical Hygiene Plan inside the lab.
- Review safety data sheets for all hazardous materials that will be handled by the lab worker.
- Be aware that each specific hazard in the lab must be addressed by a written standard operating procedure as well as lab-specific training. If you notice there is a standard operating procedure that is needed before you start your experiment, notify your CHO and PI.
    - Contact EHS if need assistance with writing a standard operating procedure (SOP). The SOP template is available on the EHS website at https://www.uml.edu/eem/ehs/lab-safety/standard-operating-procedures.aspx.
- Review your lab group's personal protective equipment assessment located in section 12 of the CHP Notebook.
- Report all accidents, injuries and illnesses to the Principal Investigator as well as to EHS at https://www.uml.edu/eem/ehs/accident-near-miss-reporting-form.aspx.
- Report chemical barcode information to EHS when each container of a hazardous material is empty. (There is a barcode sticker on each container of hazardous material.) Email hazardous_receiving@uml.edu with this information or place barcode stickers on a piece of paper and keep this by the satellite accumulation area (SAA) for EHS to take when visiting the lab for the weekly inspection of the SAA. The purpose of this is to keep the chemical inventory up to date for your lab group.) Go to https://www.uml.edu/eem/ehs/hazardous-

materials/chemical-inventories/ to read more information regarding chemical inventories on campus.

Environmental Health & Safety (EHS)

- Assist departments and individual laboratories with lab safety which includes implementing and complying with this CHP.
- Provide formal, comprehensive lab inspections for your lab group upon request.
  - Include a personal protective equipment (PPE) assessment if there is a new hazard introduced into the lab or if the PPE assessment needs to be updated.
- Inspect labs unannounced to determine if any corrective actions regarding lab safety need to be addressed in the lab.
- Schedule lab inspections for buildings and/or departments.
- Conduct risk assessments for high hazard materials to verify all safety controls are in place or to see if a less hazardous substitute can be utilized.
- Approve all requisitions for hazardous materials on campus including purchases of chemicals from outside companies such as M2D2.
- Review and approve new equipment installation requests for labs along with Facilities. This form can be found here - https://www.uml.edu/facilities/service-requests/form/.
- Maintain the risk card database by updating PI names and hazards when required. Print and post new risk card signs for lab doors when updates need to be made.
- Maintain the UML chemical inventory for the campus. See https://www.uml.edu/eem/ehs/hazardous-materials/chemical-inventories/ for more information on this.
- Schedule air monitoring when required.
- Test and certify fume hoods and snorkels annually.
- Test and certify emergency shower and eyewash stations annually.
- Provide lab coats and laundering services to all lab workers. See https://www.uml.edu/eem/ehs/hazardous-materials/lab-coats/.
- Provide N-95s or half face respirators when required due to temporary lack of an engineering control following guidelines set in the UML respiratory protection plan.
  - For example, N-95s can be voluntarily worn when mixing concrete (silica hazard) under a snorkel. If the snorkel needs to be repaired, wearing N-95s would temporarily be mandatory until the engineering control is fixed.
- Deliver hazardous materials to each lab after entering hazardous material information into the chemical inventory for each lab.
- Inspect satellite accumulation areas (SAAs) weekly.
- Pick up hazardous waste from lab upon request. Email hazardous_receiving@uml.edu.
- Provide online EHS lab safety training as well as other trainings on the EHS training website – www.uml.edu/eem/ehs/ehs-training.
  - Assist with lab-specific training upon request when necessary.
  - EHS silica hazard awareness training, located in the link above, is required prior to working with ceramic powders and sculptures in B1 Dugan and the concrete mixing lab in 103 Falmouth Annex. If your lab work requires cutting or sanding rocks, handling concrete mix, or any other silica producing materials; silica hazard awareness training is also required.

The University of Massachusetts Lowell Safety Committee

- Review incident reports submitted to EHS, including near miss incident reports.
- Review lab incidents/work related incidents submitted to HR.
- Support EHS when corrective actions need be taken in a lab to prevent future accidents or exposures.
    - If corrective actions are not corrected within a certain specified timeframe, department chairs and deans will be notified by EHS.
- Discuss departmental safety concerns, including housekeeping, and current safety culture in labs.
    - Determine methods to improve housekeeping and safety culture when determined to be a concern.
- Disseminate information regarding lab safety to your respective departments when requested by EHS.

Chapter 3

Emergency Procedures

Accidents and Emergencies

All accidents within the University, including work-related injuries, must be reported. An emergency phone extension from a campus phone, **4-4911**, has been established for this purpose and is staffed 24 hours a day in the University Police Office located at 220 Pawtucket Street, University Crossing. Another line is also available 24 hours a day for non-emergency calls to the University police: 978-934-2394. The EHS incident report form must be filled out as well. EHS will assist the individual or group of individuals with this task. If there is a work-related injury, specific forms from Human Resources **must be filled out within 48 hours of the injury** in order to be eligible for workers' compensation. Call Human Resources (HR) at 4-3560 to receive the forms.

If you receive an injury within the lab, stay in the lab (if safe to do so) and call 4-4911 from a campus phone or 978-934-4911. Do not leave the lab area and go to Student Health Services/The Wellness Center. The Student Health Services staff are not equipped to manage chemical exposures and other types of lab injuries. The University has emergency medical service provided by University of Massachusetts Lowell Emergency Medical Services. The emergency medical technicians (EMTs) will be called by UMass Lowell Dispatch and will administer first aid and, if needed, the injured individual will be transported via ambulance to Lowell General Hospital.

UMass Lowell Student Health Service is equipped to handle MINOR injuries and illnesses for students that occur outside of a lab setting. The Health Service Office is located at 220 Pawtucket Street, University Crossing. The phone extension is 4-6800. Please see this link - https://www.uml.edu/student-services/health/ - for hours of operation. When the Health Service Office is closed, students may be seen at the following clinics:

Occupational Clinic

1. Circle Health Urgent Care - Dracut
   9 Loon Hill Road, Dracut, MA 01826
2. Circle Health Urgent Care – Westford
   198 Littleton Road, Westford, MA, 01886
3. Lowell General Hospital
   Occupational Medicine
   10 Research Place, Suite 200, North Chelmsford, MA 01863
   Chelmsford Campus

Scheduling Line: 978-458-6868 (8am-5pm)
Inquiry Line: 978-418-9547

Staff members are directed to emergency departments described below as are students when the above-mentioned clinics are closed:

Lowell General Hospital (Saints Campus)
1 Hospital Drive, Lowell MA 978-458-1411

Lowell General Hospital
295 Varnum Avenue 978-937-6000

There are Emergency Call Boxes (blue phones) located in the lobbies of buildings on all campuses. These telephones and boxes reach the University Police directly. For the most effective response, do not call outside agencies directly (i.e. fire department and ambulance). The University Police will coordinate the necessary response.

In case of FIRE, engage the nearest pull station to activate fire alarm system and call 4-4911 from a safe area outside of building. Be prepared to give the location and extent of the fire. Stay on the line until all questions are answered.

EMERGENCY RESPONSE PROCEDURES FOR HAZARDOUS SUBSTANCE SPILLS

The following describes appropriate actions to be taken by the University staff, faculty, and students when spills of hazardous substances occur.

In general, hazardous spills regardless of size, will be cleaned up by the University Emergency Response/HazMat team.

RESPONSE PROCEDURES: "LARGE SPILLS" (DEFINED AS GREATER THAN ONE LITER) or "Small Spills" (defined as less than one liter) when a spill involves a toxic substance.

1. Evacuate immediately and, if conditions allow, secure room (i.e. close doors which separate the room from the rest of the building.)

2. Call the University Police Department at 4-4911 from a "safe" area and provide the following information:

    a. Your name
    b. Building name and room number affected by the spill
    c. Section of the room affected by the spill
    d. Person(s) injured and type of injury sustained
    e. Name of substance spilled/released
    f. Approximate amount of substance spilled/released
    g. Name of person who may be knowledgeable concerning the room's contents or the substance released

NOTE: The University Police will contact the University Emergency Response/Hazmat Team.

3. Meet with the Emergency Response Personnel and the University Police Department at the front entrance to the building. Identify yourself.

For additional information or training concerning this procedure, please contact EHS at 4-2618.

EMERGENCY FIRE RESPONSE PROCEDURES

Regardless of the size or scope of a fire, the primary focus should be on the prevention of injury. Proper response by individuals will assure the safety of others and minimize damage caused by fire and smoke. The following actions should be utilized when a fire is discovered, or the fire alarm activates.

VISIBLE SMOKE OR FIRE

1. Activate the fire alarm pull station and evacuate the building.

2. Do not use the elevators. Proceed to the nearest exit and leave the building. Always be familiar with at least two means of egress (exits) from your area.

3. When safe to do so, call the University Police at 4-4911 from a campus phone or 978-934-4911 to report the incident.

A PORTABLE FIRE EXTINGUISHER SHOULD ONLY BE USED WHEN:

1. You have been trained to use a fire extinguisher.
2. The fire alarm has been activated.
3. The proper type of extinguisher is available.
4. The fire is small and in its early stages of development.

SMELL OF SMOKE OR ODORS, BUT NO VISIBLE FIRE

1. If conditions become unsafe, evacuate the building.
2. Call the University Police Department at 4-4911 from a campus phone or 978-934-4911.
   a. Give the location.
   b. Describe the situation.
   c. Meet and identify yourself when personnel respond.

3. Notify your supervisor and inform them of actions that have been taken.

4. Be alert and suspicious of the area until response personnel arrive.

WHEN THE FIRE ALARM ACTIVATES

1. Evacuate the building. **Do not use the elevators.**

2. Proceed to the nearest exit and leave the building.

EVACUATIONS FOR THOSE WITH DISABILITIES OR ACCESS & FUNCTIONAL NEEDS:

Be aware of mobility or sight impaired individuals in your area. Upon identifying the need to evacuate, all building occupants should proceed to the nearest exit stair and leave the building. If unable to navigate the stairs, as able, the individual should proceed to the nearest stairway and, when safe to enter, enter the stairway and remain inside the stairway. As a last resort, the individual should consider sheltering in place keeping doors and windows closed. If possible, the individual should call University Police at 4-4911 or (978) 934-4911 and tell the dispatcher where they are located so emergency personnel can be notified. People who are evacuating and notice those requiring additional evacuation assistance, should immediately notify the on-site fire department officials and/or University Police of their location so proper evacuation by professionally trained safety personnel can be provided.

RE-OCCUPANCY OF THE BUILDING:

The local Fire Department, UMass Lowell Environmental Health and Safety Department or UMass Lowell Police Department will advise when you may re-enter the building. Please stay in an area (outside the building) that will not interfere with fire response personnel.

FOR FURTHER INFORMATION OR CLARIFICATION OF THESE PROCEDURES, PLEASE CONTACT THE OFFICE OF LIFE SAFETY & EMERGENCY MANAGEMENT AT 4-2618.

Bomb Alert Procedures

If any member of the University community receives a bomb threat, the person who receives the threat should notify the University Police immediately by calling extension 44911. **Please do not call the Lowell Police or the Lowell Fire Department.** Call the University Police immediately, and they will take appropriate action, including notifying the appropriate authorities.

All bomb threats are evaluated by the University Police, Environmental Health and Safety, and public safety personnel via guidelines set forth by the United States Department of Treasury, Division of Alcohol, Tax and Fire Arms, Arson Bomb Squad Division.

Similarly, if a member of the University community discovers a suspicious object that appears threatening; do not handle or disturb that object. Call the University Police at extension 44911; they will notify emergency response personnel and take appropriate action.

A bomb threat can be building-specific or generalized (no specific location given). In either type of bomb threat, the University Police and Environmental Health and Safety staff members, in consultation with other public safety agencies and with other officers of the University, will jointly decide which steps should be taken to ensure public safety. From that time forward, all members of the University community are expected to respond promptly to the directions provided by the University Police.

Emergency Communications

Communicating important messages to our students and employees always presents a challenge. Whether it is due to the geographical layout of our campus, the busy schedules or the significant volume of email, key messages are sometimes lost.

UMass Lowell has taken steps to address this matter by communicating with the University community (students, faculty, staff) when emergencies occur or there is a disruption to the classes or vital facility services, through the RAVE Emergency Alert Notification System. To receive phone calls or text messages, visit https://www.getrave.com/login/umlhttp://www.uml.edu/myalert and update your profile. For those who do not have a UMass Lowell email address (uml.edu), you may receive emergency text messaging by texting UMLALERTS to 226787 to subscribe.

Chapter 4

CHEMICAL HAZARD MANAGEMENT

The four most important principals to follow in a lab when handling chemicals are the following:

1) Plan ahead.
2) Minimize exposure.
3) Do not underestimate risks.
4) Be prepared for accidents.

Here is an example for how to apply all four principals to your work in the lab.

You are in a new lab and you are asked to start a new experiment with two hazardous chemicals.

Step 1 – Plan ahead.

Before starting an experiment, determine the potential hazards. First, read the safety data sheets (SDSs) for the two chemicals. SDSs provide information about precautions for protecting against hazards of the chemicals. SDSs include useful information on physical, chemical, and toxicological properties along with information on transporting and disposing of the chemicals. Since SDSs are the best general source of information, SDSs should always be reviewed when conducting a hazard assessment for new experiments.

After consulting the SDSs, write a standard operating procedure (SOP) regarding the new experiment. In the SOP, write detailed steps on how to conduct the procedure and include information on the hazards involved in the experiment. To verify that all hazards have been addressed, review the safety data sheets for the two hazardous chemicals used in the experiment. Receive laboratory-specific training and review the written SOP with the Principal Investigator. (The SOP can be used as a training tool for all new employees to read before conducting the experiment.) If a lab worker has further concern regarding his or her safety and health, this can be addressed with the Principal Investigator, the chemical hygiene officer (CHO), and/or the EHS department before starting the experiment. Remember - take your time and plan ahead before conducting the actual experiment.

Step 2 – Minimize exposure.

What are the hazards of the two chemicals in this new experiment and how can you minimize exposure? If both chemicals are an inhalation hazard, all work must be done in a fume hood. The fume hood is an engineering control that, when used correctly, will prevent hazardous vapors from entering into your breathing zone. The best type of engineering control, however, is eliminating the hazard through substitution. Is there a non-hazardous chemical that can be used instead of the hazardous chemical for your experiment? If not, is there a less hazardous chemical that can be used to minimize the hazards? Other types of controls that must be in place, besides engineering controls, are administrative controls and personal protective equipment. In step 1, administrative controls were discussed. Examples of administrative controls are reading the safety data sheets, reading the SOP, and receiving laboratory-specific training. Although administrative and engineering controls are important to keep you safe in the lab, you still need to protect your skin and eyes by wearing proper personal protective equipment (PPE). Examples of proper PPE would be safety glasses or safety goggles, lab coat, and proper gloves. If a splash hazard exists, please wear safety goggles and protect your face by wearing a face shield over the safety goggles. If you are pipetting small quantities of a chemical and there is no splash hazard, safety glasses can be worn instead of safety goggles. For all chemicals, please make sure to wear proper gloves. You may go to an on-line glove compatibility chart to look up what type of glove would be best for your work in this new experiment. Here are some links to on-line glove compatibility charts:

http://www.ansellpro.com/specware/guide.asp

https://www.coleparmer.com/safety-glove-chemical-compatibility

https://newpig.scene7.com/is/content/NewPig/pdfs/NORTH_NITRILE.pdf

https://www.mapa-pro.us/

Remember – your safety comes first!

Step 3 – Do not underestimate risks.

Are the two chemicals you will be mixing together compatible? The Chemical Reactivity Worksheet located at this link - https://response.restoration.noaa.gov/oil-and-chemical-spills/chemical-spills/response-tools/chemical-reactivity-worksheet.html - is a quick and simple tool that was developed by the National Oceanic and Atmospheric Association (NOAA) that can be used to find out the dangers that could arise when mixing a chemical with other chemicals and/or materials. To prevent "unexpected" reactions such as heat generation which can cause pressurization in a container, first check the chemicals you are mixing on this worksheet before mixing them together.

As a rule, always treat a mixture of chemicals more toxic than its most toxic component.

Step 4 – Be prepared for accidents.

Where is the nearest emergency eyewash station and/or emergency shower station? Do you know where to go if you are exposed to one of these chemicals in order to be evaluated by a doctor? Make sure to always work with a buddy. Do not work alone in the laboratory. If a corrosive liquid gets in your eye, who is going to call 44911 and make sure you receive help until the ambulance arrives? If you are temporarily blinded by the exposure of chemicals in your eyes, you do not want to be struggling to find the emergency eyewash station and campus phone. With a buddy on-site, you can receive the help you will need. If you receive chemical contamination on your clothes from a corrosive or toxic chemical, you will need to take the clothes off before rinsing down with the emergency shower station. Do you have an extra change of clothes located near the lab in case this happens? These are just a few examples of some scenarios that you may encounter. The lab is a hazardous work environment, and you must be prepared for accidents before they occur.

One Hundred Most Commonly Found Explosive and Shock-Sensitive Materials

1.Acetylides of heavy metals

2.Aluminum ophorite explosive

3. Amatol

4. Ammonal

5. Ammonium nitrate

6. Ammonium perchlorate

7. Ammonium picrate

8. Ammonium salt lattice

9. Butyl tetryl

10. Calcium nitrate

11. Copper acetylide

12. Cyanuric triazide

13. Cyclotrimethylenetrinitramine

14. Cyclotetramethylenetetranitramine

15. Dinitroethyleneurea

16. Dinitroglycerine

17. Dinitrophenol

18. Dinitrophenolates

19. Dinitrophenyl hydrazine

20. Dinitoresorcinol

21. Dinitrotoluene

22. Dipicryl sulfone

23. Dipicrylamine

24. Erythritol tetranitrate

25. Fulminate or mercury

26. Fulminate of silver

27. Fulminating gold

51. Mercury tartrate

52. Mononitrotoluene

53. Nitrated carbohydrate

54. Nitrated glucoside

55. Nitrated polyhydric alcohol

56. Nitrogen trichloride

57. Nitrogen tri-iodide

58. Nitroglycerine

59. Nitroglycerine

60. Nitroguanidine

61. Nitroguanidine

62. Nitroparaffins

63. Nitronium perchlorate

64. Nitrourea

65. Organic amine nitrates

66. Organic nitramines

67. Organic peroxides

68. Picramic acid

69. Picramide

70. Picratol

71. Picric acid

72. Picryl chloride

73. Picryl fluoride

74. Polynitro aliphatic compounds

75. Potassium nitroaminotetrazole

76. Silver acetylide

77. Silver azide

28. Fulminating mercury
29. Fulminating platinum
30. Fulminating silver
31. Gelatinized nitrocellulose
32. Guanyl nitrosamino guanyl tetrazene
33. Guanyl nitrosamino guanylidene hydrazine
34. Heavy metal azides
35. Hexanite
36. Hexanitrodiphenylamine
37. Hexanitrostilbene
38. Hexagen
39. Hydrazinium nitrate
40. Hydrozoic acid
41. Lead azide
42. Lead mannite
43. Lead mononitroresorcinate
44. Lead picrate
45. Lead salts
46. Lead styohnate
47. Trimethylolethane
48. Magnesium ophorite
49. Mannitol hexanitrate
50. Mercury oxalate
78. Silver styphnate
79. Silver tetrazene
80. Sodatol
81. Sodium amatol
82. Sodium dinitro-ortho-cresolate
83. Sodium nitrate-potassium nitrate explosive mixture
84. Sodium picramate
85. Syphnic acid
86. Tetrazene
87. Tetranitrocarbazole
88. Tetrytol
89. Trimonite
90. Trinitroanisole
91. Trinitrobenzene
92. Trinitrobenzoic acid
93. Trinitrocresol
94. Trinitro-meta-cresole
95. Trinitronaphthalene
96. Trinitrophenetol
97. Trinitrophloroglucinol
98. Trinitroresorcinol
99. Tritonal
100. Urea nitrate

Peroxidizable Compounds

A peroxide is a chemical that contains a peroxo (O-O) unit and has the chemical formula of O_2^2. Peroxide-forming chemicals have the ability to form shock-sensitive explosive peroxide crystals. Diethyl ether and tetrahydrofuran are two of the more common peroxide-forming chemicals used in laboratories. If peroxidizable compounds are in your laboratory, it is important that a standard operating procedure is written regarding the identification, handling, storage, and disposal of these chemicals. There is a generic SOP for handling peroxide forming chemicals online at https://www.uml.edu/eem/ehs/lab-safety/standard-operating-procedures.aspx. This SOP can be customized for your lab group. Laboratory-specific training must be conducted and documented before laboratory workers are allowed to handle these compounds.

Under normal storage conditions, the materials listed on the next page have the potential to generate and accumulate peroxide crystal formations. These crystal formations may violently detonate when subjected to heat, light, exposure to air, moisture, and mechanical shock.

NOTE: Peroxide crystals may form on the container cap or on the threads of the lid and could detonate when the lid is opened. Do not open a liquid organic peroxide or peroxide-forming chemical if crystals or a precipitate are present. Instead, call EHS immediately at 4-2543.

Remember to write the date of receipt and date of opening on each container of peroxidizable compounds and be cognizant of the shelf life of the container. Also, for routine control of ethers such as diethyl ether, tetrahydrofuran and dioxane, please use a peroxide test. The peroxide test detects inorganic and organic compounds which contain a peroxide or hydro-peroxide group. These peroxide tests can be ordered from Grainger by calling 1-800-GRAINGER (1-800-472-4643).

Examples of Peroxidizable Compounds

The following materials should be discarded after three months due to peroxide hazards on storage;

Divinyl acetylene	Potassium metal
Divinyl ether	Sodium amide
Isopropyl ether	Vinylidene chloride
Potassium amide	

The following materials should be discarded after one year due to peroxide hazard on concentration:

Acetal
Cumene
Cyclohexene
Cyclooxyene
Cyclopentene
Diacetylene
Dicyclopentadiene
Diethyl ether
Diethylene glycol dimethyl ether (diglyme)
Dioxane
Ethylene glycol dimethyl ether (glyme)
Furan
Methyl acetylene
Methylcyclopentane
Methyl isobutyl ketone
Tetrahydronaphtalene (Tetralin)
Tetrahydrofuran
Vinyl ethers

The following materials should be discarded after one year due to peroxide initiation of polymerization:

Acrolein	
Acrylic acid	Styrene
Acrylonitrile	Tetrafluoroethylene
Butadiene	Vinyl acetylene
Chloroprene	Vinyl acetate
Chlorotrifluoroethylene	Vinyl chloride
Methyl methacrylate	Vinyl pyridine

Although most of the above listed materials are sold with inhibitors, some materials such as ethyl ether and tetrahydrofuran are sold without inhibitors. These materials should be tested and you may want to discard the peroxides that are not sold with inhibitors after six months, depending on how the materials are stored. (Best management practices for all peroxide formers is to store them in a cool, dark place such as a flammable storage refrigerator.)

Peroxide test strips, which change color to indicate the presence of peroxides, may be purchased through most laboratory reagent distributors. Laboratory workers can monitor for the presence of peroxides once the container is opened, upon each use, or monthly. If there is any suspicion that peroxides are present, do not open the container or otherwise disturb the contents. Call EHS at 42543 for disposal.

Chapter 5

HAZARDOUS WASTE MANAGEMENT

Federal and state law regulates storage, labeling, packaging, and disposal of hazardous waste. Each generator of hazardous waste at UMass Lowell is responsible for the proper management of their hazardous wastes.

Hazardous waste is defined as "a waste with properties that make it dangerous or capable of having a harmful effect on human health or the environment."

Hazardous waste can be liquid, solid, gas, or sludge. They can be research reagents, experimental waste, cleaning supplies, or pesticides. Hazardous waste shall be categorized as one or more of the following:

- Characteristic Waste: A waste that exhibits at least one of four characteristics defined as; Ignitability, Corrosivity, Reactivity, Toxicity.
- Listed Wastes: "Wastes from common manufacturing and industrial processes, specific industries and can be generated from discarded commercial products."
- Universal Waste: Wastes that are widely produced by households and many different types of businesses. Including fluorescent lamps, mercury containing devices, and certain batteries such as lithium, nickel-metal hydride, and nickel-cadmium.
- Mixed Waste: Hazardous waste that is mixed with radioactive waste.

Characterizing Waste:

Waste characterization is one of the core facets of hazardous waste management. A generator is any person whose act or process produces hazardous waste or whose act first causes a hazardous waste to become subject to regulation. The generator is primarily responsible for correct and proper characterization of their waste. It is their responsibility to ensure materials are properly segregated, labeled, classified, and stored. A material is considered a waste when the lab user discards it, intends to discard it, or is required to discard it. A hazardous waste determination is the procedure used to determine whether a waste is a hazardous waste. If the waste is not listed, the generator must determine if it exhibits any of the four characteristics of a hazardous waste: ignitability, corrosivity, reactivity, and toxicity.

Ignitable

"Ignitable wastes can create fires under certain conditions, are spontaneously. combustible, or have a flash point less than 60 °C (140 °F)" (40 CFR §261.21)

Examples: Methanol, Ethanol, Isopropanol

Corrosive

"Corrosive wastes are acids or bases (pH less than or equal to 2, or greater than or equal to 12.5) and/or are capable of corroding metal containers, such as storage tanks, drums, and barrels." (40 CFR §261.22)

Examples: Hydrochloric Acid, Citric Acid, Sodium Hydroxide

Reactive

"Reactive wastes are unstable under 'normal' conditions. They can cause explosions, undergo violent reactions, generate toxic fumes, gases, or vapors or explosive mixtures when heated, compressed, or mixed with water." (40 CFR §261.23)

Examples: Sodium Azide, Potassium Cyanide

Toxic

"Toxic wastes are harmful or fatal when ingested or absorbed (e.g., containing mercury, lead, etc.) When toxic wastes are land disposed, contaminated liquid may leach from the waste and pollute ground water." (40 CFR §261.24)

Examples: Lead, Benzene, Arsenic

If you need assistance classifying your hazardous waste, please contact EHS or HazOps at https://www.uml.edu/eem/ehs/hazardous-materials/contact.aspx.

Some waste is considered “acutely” hazardous. Acute hazardous waste is defined as materials that in its virgin form can cause serious illness, disabling personal injury, or death. These wastes are also known as “P-Listed” wastes and are more hazardous than ordinary waste.

- A full list of P-Listed waste can be found located at the end of this chapter.
- Empty bottles once containing a P-Listed waste must be disposed of as a hazardous waste.

Importantly, hazardous waste cannot be disposed of down the drain. To assume compliance with the wastewater discharge license from the City of Lowell, no hazardous waste may be poured down the drain. To determine whether your waste is hazardous, please fill out a non-hazardous waste determination form (located at the end of this chapter). If the waste is determined to be non-hazardous, the form will be signed by EHS and submitted to the Principal Investigator.

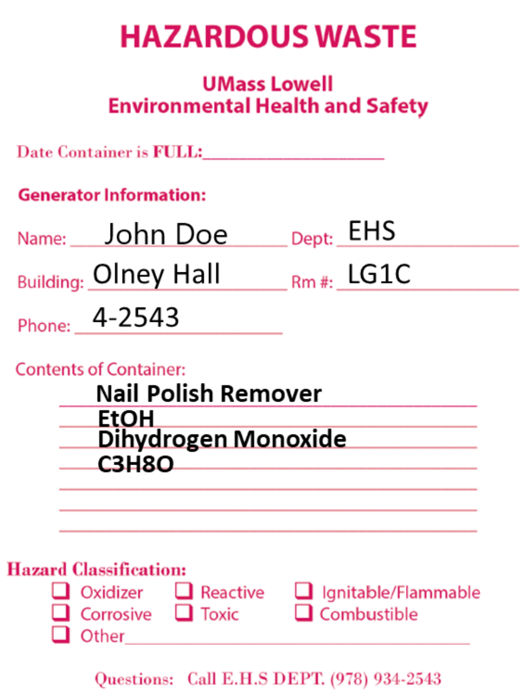
<u>Labeling Waste:</u>

Each generator is responsible for ensuring waste containers are properly labeled using UMass Lowell’s hazardous waste label. Additional labels can be acquired by contacting HazOps.

- Each container must have a hazardous waste label.
- The specific chemical constituent must be identified on the label in the section “contents of container”. Avoid abbreviations, trade names, chemical formulae, and acronyms.
- Labeling must be clear and legible.

Below is an example of two hazardous waste labels. One written correctly, and one incorrectly.

Incorrect


HAZARDOUS WASTE

UMass Lowell
Environmental Health and Safety

Date Container is FULL:

Generator Information:

Name: John Doe Dept: EHS

Building: Olney Hall Rm #: LG1C

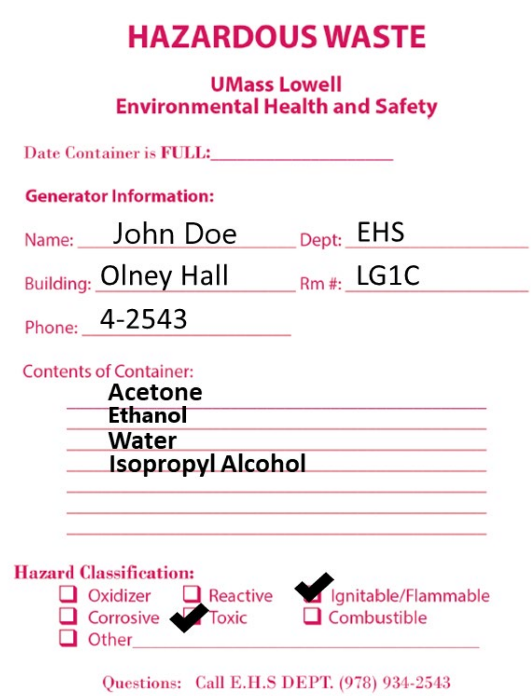
Phone: 4-2543

Contents of Container:
Nail Polish Remover
EtOH
Dihydrogen Monoxide
C3H8O

Hazard Classification:
☐ Oxidizer ☐ Reactive ☐ Ignitable/Flammable
☐ Corrosive ☐ Toxic ☐ Combustible
☐ Other

Questions: Call E.H.S DEPT. (978) 934-2543

Correct


HAZARDOUS WASTE

UMass Lowell
Environmental Health and Safety

Date Container is FULL:

Generator Information:

Name: John Doe Dept: EHS

Building: Olney Hall Rm #: LG1C

Phone: 4-2543

Contents of Container:
Acetone
Ethanol
Water
Isopropyl Alcohol

Hazard Classification:
☐ Oxidizer ☐ Reactive ☑ Ignitable/Flammable
☐ Corrosive ☑ Toxic ☐ Combustible
☐ Other

Questions: Call E.H.S DEPT. (978) 934-2543

Storing Hazardous Waste:

- All hazardous waste shall be stored within a labeled satellite accumulation area (SAA).
- SAAs shall be placed at the point of waste generation. (310 CMR 30.351(4))
- All bottles containing liquid hazardous waste must be kept within a secondary spill tray.
- The surface underlying the containers shall be free of cracks, gaps and sufficiently impervious to contain leaks. (310 CMR 30.340 (1)(f))
- Waste containers must be in good condition. (Free of rust and/or structural damage)
- Containers must be compatible with waste stored inside them. (310 CMR 30.684)
- Hazardous waste labels must be visible and facing outward.
- Containers must be closed during storage. (310 CMR 30.685(1))
- Only one container per waste stream may be in use at any one time. (310 CMR 30.351 (4)(c)).
- Containers must be spaced so they can be inspected. (310 CMR 30.685(4))
- The maximum capacity of containers is as follows: 55 gallons of hazardous waste and/or 1 quart of acutely hazardous waste. (310 CMR 30.351 (4)(c)(1,2))
- Containers may be stored indefinitely until they are filled.
- Waste containers within the same secondary containers must be compatible.
- The satellite area must be inspected weekly. (310 CMR 30.686)

Removing Waste:

- Once a waste container is full it must be dated and transferred from the SAA to the MAA within three calendar days.
- When a container is full, it shall be dated immediately and within 3 days, moved to the main storage area and come into compliance with all regulations pertaining to that area. (310 CMR 30.351 (4)(d))
    - A pickup request shall be submitted via the HazOps website: https://www.uml.edu/eem/ehs/hazardous-materials/hazardous-materials-handling/pickups.aspx
- This information can also be found on the accumulation area sign located at every SAA.

SATELLITE ACCUMULATION AREA (SAA)

Do you know how to effectively manage, label, store, and inspect your **hazardous waste**? If not, please contact Environmental Health and Safety (EH&S) at extension 4-2618 with any questions or concerns.

The following requirements are needed to ensure compliance with environmental regulations and safe handling procedures for hazardous waste.

CONTAINER LABELING:

All hazardous waste containers must be labeled with a University of Massachusetts Lowell – hazardous waste label (white with red lettering) and must include the following information:

1) Generator information: name, department, building, room#;
2) Contents of container: (no formulas, abbreviations, or trade names);
3) The associated hazards of the waste (e.g., ignitable, corrosive, reactive or toxic).
4) The date the container becomes **full**. (Hand write specific date on the hazardous waste label and contact: Hazardous_Recieving@uml.edu for a pickup or scan the QR code below.)

STORAGE:

1. Hazardous waste containers must be closed at all times, except when waste is being added or removed.
2. All liquid hazardous waste containers must be stored within a designated secondary containment tray or spill control pallet.
3. All hazardous waste in a secondary container must be compatible.
4. Dated containers must be removed from the SAA within **three days (72 Hours)**. EHS will move the waste container from the SAA to the Main Accumulation Area (MAA).
5. The SAA must be inspected once per week by a trained lab worker.

IN CASE OF A SPILL OR EMERGENCY PLEASE CALL
Campus Police @ 978-934-4911

The Importance of Avoiding Unknown and Abandoned Chemicals:

Unknown/unlabeled chemical containers can pose a serious concern in research laboratories. For this reason, it is important to ensure that researchers are properly labeling their samples and reagent containers. Before an unknown/unlabeled chemical container can be disposed of, it’s hazardous characteristics must be identified.

Raw material chemical containers must have manufacturer labeling. Transfer containers, flasks, beakers, bottles, and vials must have handwritten information regarding the name of chemical contents. Labels and product information shall be;

- replaced immediately if defaced or deteriorated.
- placed on the body of the container, not the cap.
- handwritten with the full chemical name when possible.

If a material is considered to be a waste it <u>must</u> be clearly identified and labeled with a UML hazardous waste label. If you are unsure how to label a material, please refer to the section on labeling waste or contact EHS.

Principal Investigators (PIs) must ensure that bottles are disposed of prior to a researcher leaving their lab. If several small vials are archived into one box, the box must be labeled with the chemical constituents.

If a lab finds a potentially unknown chemical, EHS shall be notified. The PI and EHS will attempt to gather as much information about the material as possible. If all attempts to identify the material fail, it must be removed by EHS as an unknown.

Acutely Hazardous Waste

Code	Chemical
P026	1-(o-Chlorophenyl)thiourea
P081	1,2,3-Propanetriol, trinitrate (R)
P042	1,2-Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]-, (R)-
P067	1,2-Propylenimine
P185	1,3-Dithiolane-2-carboxaldehyde, 2,4-dimethyl-, O- [(methylamino)- carbonyl]oxime
P004	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa- chloro-1,4,4a,5,8,8a,-hexahydro-, (1alpha,4alpha, 4abeta,5alpha,8alpha,8abeta)-
P060	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa- chloro-1,4,4a,5,8,8a-hexahydro-, (1alpha,4alpha, 4abeta,5beta,8beta,8abeta)-
P002	1-Acetyl-2-thiourea
P048	2,4-Dinitrophenol
P051	2,7:3,6-Dimethanonaphth [2,3-b]oxirene, 3,4,5,6,9,9 -hexachloro-1a,2,2a,3,6,6a,7,7aoctahydro-, (1aalpha,2beta,2abeta,3alpha,6alpha,6abeta,7 beta, 7aalpha)-, & metabolites
P037	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9- hexachloro-1a,2,2a,3,6,6a,7,7aoctahydro-, (1aalpha,2beta,2aalpha,3beta,6beta,6aalpha,7 beta, 7aalpha)-
P045	2-Butanone, 3,3-dimethyl-1-(methylthio)-, O-[methylamino)carbonyl] oxime
P034	2-Cyclohexyl-4,6-dinitrophenol
P001	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1- phenylbutyl)-, & salts, when present at concentrations greater than 0.3%
P069	2-Methyllactonitrile
P017	2-Propanone, 1-bromo-
P005	2-Propen-1-ol
P003	2-Propenal
P102	2-Propyn-1-ol
P007	3(2H)-Isoxazolone, 5-(aminomethyl)-
P027	3-Chloropropionitrile
P047	4,6-Dinitro-o-cresol, & salts
P059	4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro- 3a,4,7,7a-tetrahydro-
P008	4-Aminopyridine
P008	4-Pyridinamine
P007	5-(Aminomethyl)-3-isoxazolol
P050	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10- hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide
P127	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-, methylcarbamate
P088	7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid
P023	Acetaldehyde, chloro-
P057	Acetamide, 2-fluoro-
P002	Acetamide, N-(aminothioxomethyl)-
P058	Acetic acid, fluoro-, sodium salt
P003	Acrolein
P070	Aldicarb
P203	Aldicarb sulfone
P004	Aldrin
P005	Allyl alcohol
P046	alpha,alpha-Dimethylphenethylamine
P072	alpha-Naphthylthiourea
P006	Aluminum phosphide (R,T)

P009	Ammonium picrate (R)
P119	Ammonium vanadate
P099	Argentate(1-), bis(cyano-C)-, potassium
P010	Arsenic acid H3AsO4
P012	Arsenic oxide As2O3
P011	Arsenic oxide As2O5
P011	Arsenic pentoxide
P012	Arsenic trioxide
P038	Arsine, diethyl-
P036	Arsonous dichloride, phenyl-
P054	Aziridine
P067	Aziridine, 2-methyl-
P013	Barium cyanide
P024	Benzenamine, 4-chloro-
P077	Benzenamine, 4-nitro-
P028	Benzene, (chloromethyl)-
P046	Benzeneethanamine, alpha,alpha-dimethyl-
P014	Benzenethiol
P188	Benzoic acid, 2-hydroxy-, compd with (3aS-cis)- 1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethylpyrrolo [2,3-b]indol-5-yl methylcarbamate ester (1:1)
P028	Benzyl chloride
P015	Beryllium powder
P017	Bromoacetone
P018	Brucine
P021	Calcium cyanide Ca(CN)2
P189	Carbamic acid, [(dibutylamino)- thio]methyl-, 2,3-dihydro-2,2-dimethyl- 7-benzofuranyl ester
P191	Carbamic acid, dimethyl-, 1-[(dimethyl-amino) carbonyl]- 5-methyl-1H- pyrazol-3-yl ester
P192	Carbamic acid, dimethyl-, 3-methyl-1- (1-methylethyl)- 1H-pyrazol-5-yl ester
P190	Carbamic acid, methyl-, 3-methylphenyl ester
P127	Carbofuran
P022	Carbon disulfide
P095	Carbonic dichloride
P189	Carbosulfan
P023	Chloroacetaldehyde
P029	Copper cyanide
P029	Copper cyanide Cu(CN)
P030	Cyanides (soluble cyanide salts), not otherwise specified
P031	Cyanogen
P033	Cyanogen chloride
P033	Cyanogen chloride (CN)Cl
P016	Dichloromethyl ether
P036	Dichlorophenylarsine
P037	Dieldrin
P038	Diethylarsine
P041	Diethyl-p-nitrophenyl phosphate
P043	Diisopropylfluorophosphate (DFP)
P044	Dimethoate
P191	Dimetilan
P020	Dinoseb
P085	Diphosphoramide, octamethyl-
P111	Diphosphoric acid, tetraethyl ester
P039	Disulfoton

P049	Dithiobiuret
P050	Endosulfan
P088	Endothall
P051	Endrin
P051	Endrin, & metabolites
P042	Epinephrine
P031	Ethanedinitrile
P194	Ethanimidothioc acid, 2-(dimethylamino)-N- [[(methylamino)carbonyl]oxy]-2-oxo-, methyl ester
P066	Ethanimidothioic acid, N-[[(methylamino)carbonyl]oxy]-, methyl ester
P101	Ethyl cyanide
P054	Ethyleneimine
P097	Famphur
P056	Fluorine
P057	Fluoroacetamide
P058	Fluoroacetic acid, sodium salt
P198	Formetanate hydrochloride
P197	Formparanate
P065	Fulminic acid, mercury(2+) salt (R,T)
P059	Heptachlor
P062	Hexaethyl tetraphosphate
P068	Hydrazine, methyl-
P116	Hydrazinecarbothioamide
P063	Hydrocyanic acid
P063	Hydrogen cyanide
P096	Hydrogen phosphide
P060	Isodrin
P192	Isolan
P196	Manganese dimethyldithiocarbamate
P196	Manganese, bis(dimethylcarbamodithioato-S,S')-,
P202	m-Cumenyl methylcarbamate
P065	Mercury fulminate (R,T)
P092	Mercury, (acetato-O)phenyl-
P082	Methanamine, N-methyl-N-nitroso-
P064	Methane, isocyanato-
P016	Methane, oxybis[chloro-
P112	Methane, tetranitro- (R)
P118	Methanethiol, trichloro-
P198	Methanimidamide, N,N-dimethyl-N'-[2-methyl-4- [[(methylamino) carbonyl]oxy]phenyl]-
P199	Methiocarb
P066	Methomyl
P068	Methyl hydrazine
P064	Methyl isocyanate
P071	Methyl parathion
P190	Metolcarb
P128	Mexacarbate
P073	Nickel carbonyl
P073	Nickel carbonyl Ni(CO)4, (T-4)-
P074	Nickel cyanide
P074	Nickel cynaide Ni(CN)2
P075	Nicotine, & salts
P076	Nitric oxide
P078	Nitrogen dioxide

P076	Nitrogen oxide NO
P078	Nitrogen oxide NO2
P081	Nitroglycerine (R)
P082	N-Nitrosodimethylamine
P084	N-Nitrosomethylvinylamine
P040	O,O-Diethyl O-pyrazinyl phosphorothioate
P085	Octamethylpyrophosphoramide
P087	Osmium oxide OsO4, (T-4)-
P087	Osmium tetroxide
P194	Oxamyl
P089	Parathion
P024	p-Chloroaniline
P199	Phenol, (3,5-dimethyl-4-(methylthio)-, methylcarbamate
P020	Phenol, 2-(1-methylpropyl)-4,6-dinitro-
P009	Phenol, 2,4,6-trinitro-, ammonium salt (R)
P048	Phenol, 2,4-dinitro-
P034	Phenol, 2-cyclohexyl-4,6-dinitro-
P047	Phenol, 2-methyl-4,6-dinitro-, & salts
P202	Phenol, 3-(1-methylethyl)-, methyl carbamate
P201	Phenol, 3-methyl-5-(1-methylethyl)-, methyl carbamate
P128	Phenol, 4-(dimethylamino)-3,5-dimethyl-, methylcarbamate (ester)
P092	Phenylmercury acetate
P093	Phenylthiourea
P094	Phorate
P095	Phosgene
P096	Phosphine
P041	Phosphoric acid, diethyl 4-nitrophenyl ester
P094	Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl] ester
P039	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester
P044	Phosphorodithioic acid, O,O-dimethyl S-[2- (methylamino)-2-oxoethyl] ester
P043	Phosphorofluoridic acid, bis(1-methylethyl) ester
P071	Phosphorothioic acid, O,O,-dimethyl O-(4- nitrophenyl) ester
P089	Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester
P040	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester 3
P097	Phosphorothioic acid, O-[4-[(dimethylamino)sulfonyl]phenyl] O,O-dimethyl ester
P204	Physostigmine
P188	Physostigmine salicylate
P110	Plumbane, tetraethyl-
P077	p-Nitroaniline
P098	Potassium cyanide
P098	Potassium cyanide K(CN)
P099	Potassium silver cyanide
P201	Promecarb
P203	Propanal, 2-methyl-2-(methyl-sulfonyl)-, O-[(methylamino)carbonyl] oxime
P070	Propanal, 2-methyl-2-(methylthio)-, O-[(methylamino)carbonyl]oxime
P101	Propanenitrile
P069	Propanenitrile, 2-hydroxy-2-methyl-
P027	Propanenitrile, 3-chloro-
P102	Propargyl alcohol
P075	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, (S)-, & salts
P204	Pyrrolo[2,3-b]indol-5-ol, 1,2,3,3a,8,8a-hexahydro- 1,3a,8-trimethyl-, methylcarbamate (ester), (3aS-cis)-
P114	Selenious acid, dithallium(1+) salt

P103	Selenourea
P104	Silver cyanide
P104	Silver cyanide Ag(CN)
P105	Sodium azide
P106	Sodium cyanide
P106	Sodium cyanide Na(CN)
P108	Strychnidin-10-one, & salts
P018	Strychnidin-10-one, 2,3-dimethoxy-
P108	Strychnine, & salts
P115	Sulfuric acid, dithallium(1+) salt
P110	Tetraethyl lead
P111	Tetraethyl pyrophosphate
P109	Tetraethyldithiopyrophosphate
P112	Tetranitromethane (R)
P062	Tetraphosphoric acid, hexaethyl ester
P113	Thallic oxide
P113	Thallium oxide Tl2O3
P114	Thallium(I) selenite
P115	Thallium(I) sulfate
P109	Thiodiphosphoric acid, tetraethyl ester
P045	Thiofanox
P049	Thioimidodicarbonic diamide [(H2N)C(S)]2NH
P014	Thiophenol
P116	Thiosemicarbazide
P026	Thiourea, (2-chlorophenyl)-
P072	Thiourea, 1-naphthalenyl-
P093	Thiourea, phenyl-
P185	Tirpate
P123	Toxaphene
P118	Trichloromethanethiol
P119	Vanadic acid, ammonium salt
P120	Vanadium oxide V2O5
P120	Vanadium pentoxide
P084	Vinylamine, N-methyl-N-nitroso-
P001	Warfarin, & salts, when present at concentrations greater than 0.3%
P121	Zinc cyanide
P121	Zinc cyanide Zn(CN)2
P122	Zinc phosphide Zn3P2, when present at concentrations greater than 10% (R,T)
P205	Zinc, bis(dimethylcarbamodithioato-S,S')-,
P205	Ziram

Chapter 6

Waste Minimization and Asset Management

UML has a well-developed Recycling and Waste Diversion program in place. Go to https://www.uml.edu/office-sustainability/waste-recycling/ for more information regarding zero sort recycling, battery and small electronics drop off recycling, and composting.

Please go to https://www.uml.edu/office-sustainability/asset-management-surplus/ to learn more information about the asset management program here at the university.

Helpful Forms and Links:

- Asset Decommission/Surplus Form to be used whenever a capital asset is deemed no longer of use to the department and can be removed from inventory.
- Sustainability and Environmental Management Service Request Guide Job-aid (pdf) to assist you with submitting a sustainability service request form for the pickup / disposal of electronics, furniture, toner and ink cartridges, light bulbs, computer accessories, small appliances, and other miscellaneous items.

Chapter 7

Safety Training

Laboratory safety training is available online at www.uml.edu/eem/ehs/lab-safety. This training is required annually for all paid employees that work in UMass Lowell laboratories.

Along with this baseline training, all paid employees must receive laboratory-specific training before working in the lab. The Principal Investigator or laboratory manager must train the employees of their lab(s) on the specific hazards in the lab(s), controls in place to reduce exposure to hazardous materials as well as good laboratory practices. The employee must also review the CHP and know its location. Please keep documentation of this training in section 8 of the CHP Notebook.

If you work with ceramics in the art and design department or with cement in the concrete mixing lab used by the concrete canoe team, you must take the EHS online silica hazard awareness training as well as the UML laboratory safety training. Go to www.uml.edu/eem/ehs/ehs-training to take the silica hazard awareness training. EHS also created other lab-specific training PowerPoint presentations on this link such as welding safety training and formula SAE team safety training.

NOTE: It is the responsibility of the Principal Investigator to make sure that all of his or her employees have received the UML laboratory safety training as well as the laboratory-specific training.

Train-the-trainer resources are available. Please contact EHS at 42618 if interested.

Chapter 8

Safe Laboratory Practices

Basic Safety Rules

1. Know the hazards of the chemicals and equipment in your laboratory.
2. Read and understand the safety data sheets for chemicals that you will be using.
3. Receive base-line training on laboratory safety from EHS.
4. Receive laboratory-specific training for all hazardous procedures performed in the laboratory.
5. Read and understand the standard operating procedures (SOPs) for all hazardous procedures performed in the laboratory. (A SOP must be written by PI if one is not available.)
6. Plan, ahead of time, what to do in different emergency situations in your laboratory.
7. Wear proper personal protective equipment.
8. Wear pants and closed toe shoes. (Do not wear flip flops, sandals, or shorts in the laboratory.)
9. Do not eat, drink, or use tobacco products in the laboratory.
10. Wash hands before leaving the laboratory with soap and water.
11. Avoid working alone in a laboratory.
12. Confine loose hair and loose clothing.
13. Clean work surfaces regularly.
14. Keep lab doors closed.
15. Aisle ways and exits must be kept clear.
16. Be sure that the fume hood works properly.
17. Become familiar with the location of emergency shower and eye wash stations, fire extinguishers, spill kits, first aid kits, and fire blankets in your area.
18. Do not use floors, stairways, or hallways as storage areas.
19. Utilize break-resistant secondary containers when transporting chemicals through hallways.
20. Do not wear gloves outside of the laboratory. (Place chemicals in a secondary container before transferring to another laboratory to avoid the need for gloves.)
21. Write the date received and the date opened on all containers of peroxide-forming chemicals such as diethyl ether and tetrahydrofuran (THF).
22. Do not store chemical containers on the floor.
23. Label secondary containers of chemicals with the full chemical name and primary hazard.
24. Remove barcode labels from primary containers and report the information to EHS.
    a. Place barcode stickers from empty primary containers on a piece of paper and leave the paper by the SAA for EHS.
25. Principal Investigators cannot purchase chemicals with a Procard.

Basic Safety Rules for Handling Compressed Gases

1. Read safety data sheets for compressed gas cylinders and read the SOP for handling compressed gas cylinders. The generic SOP is available at https://www.uml.edu/eem/ehs/lab-safety/standard-operating-procedures.aspx.
2. Secure full and empty compressed gas cylinders in an upright position with a chain, bracket or other restraining device.
3. Do not store compressed gas cylinders near excessive heat, highly combustible materials, and other areas where they could be damaged or knocked over.
4. Store compressed gas cylinders of oxidizers at least 20 feet from compressed gas cylinders of flammables. (The 20 feet rule does not apply if there is a noncombustible wall separating the flammables and oxidizers. The wall cannot be less than 5 feet high and must have a fire-resistance rating of ½ hour.)
5. Place valve protection caps on all compressed gas cylinders unless they are in use.
6. Label the cylinder status as “full” or “empty”.
7. The name of the compressed gas (i.e. oxygen, nitrogen, etc.) and the primary hazard must be on the cylinder.
8. Utilize flash arrestors to prevent flash-back in a line containing a flammable gas.
9. Check all tubing periodically for integrity. (Remove tubing from service if it is damaged, cracked or missing.)
10. Store cylinders in a dry, well-ventilated area.
11. Do not store cylinders in hallways, corridors, stairwells or near elevators.
12. Cylinders must be accessible at all times.
13. When transporting a cylinder, the cylinder must be strapped to a transport cart. The valve protection cap must be on the cylinder.
14. Do not transport cylinders between floors on an elevator when there are passengers on the elevator.

Basic Safety Rules for Handling Cryogenic Liquids

1. Read the SDS and laboratory-specific SOP for handling cryogenic liquids. The generic SOP for handling cryogenic liquids is available at https://www.uml.edu/eem/ehs/lab-safety/standard-operating-procedures.aspx.
2. To minimize exposure during use, wear proper personal protective equipment. (Typical personal protective equipment worn when handling cryogenic liquids are safety goggles, insulated gloves, lab coat and a face shield. Gloves should be loose when worn so that they are easy to take off if there is a spill.)
3. Use fume hoods when working with cryogenic liquids, if possible.
4. Use tongs when handling objects in cryogenic liquids.

5. Use only approved materials with cryogenic liquids. (Unapproved materials such as rubber, plastic, and carbon steel will become brittle and shatter. Hollow tubes become over-pressurized.)
6. Inspect equipment periodically.
7. Remove ice and frost from openings to prevent over-pressurization.
8. Report any leaks or improperly set relief valves to the manufacturer.
9. Do not use a corrosive cleaning material to clean equipment since it can damage the metal jacket.
10. Use at least two people when transporting cryogenic liquids.
11. Use handcarts equipped with brakes for large dewars and cylinders.
12. Do not transport cylinders between floors on an elevator when there are passengers on the elevator. (Try to avoid traveling in an elevator with a dewar since the elevator is a small space. If the cylinder failed or leaked, there would be a displacement of oxygen inside the elevator which could cause asphyxiation.)
13. When pouring a cryogenic liquid into a secondary container, pour slowly to avoid splashes.
14. Do not overfill when pouring into a secondary container.
15. Use a phase separator, if available, to control vapor path during pouring.
16. Store dewars in well-ventilated rooms.
17. Do not store cryogenic liquids with flammable or corrosive chemicals.

Proper Use of a Fume Hood

A fume hood or other type of engineering control such as a snorkel or glove box must be used when handling hazardous materials with an inhalation hazard. A fume hood that is operating correctly and used properly will protect the laboratory worker from breathing in hazardous vapors. Labels and arrows are placed on the face of the fume hood by EHS. The labels indicate the specific sash height that should be used to maintain a sufficient face velocity to protect workers from breathing in hazardous vapors. Work should be conducted with the sash positioned at the sash stop or lower. If the hood doesn't have a sash stop, keep the sash below the height indicated by the sticker and arrow. The sash of the fume hood also provides a safety shield for the face and upper body. Do not put your head in the fume hood since this may result in exposure to hazardous vapors. Also, please remember to close the sash when the hood is not in use to conserve energy. (Note: The use of perchloric acid *may* require a special hood. Read the handling perchloric acid SOP located at https://www.uml.edu/eem/ehs/lab-safety/standard-operating-procedures.aspx.)

EHS inspects the fume hoods annually to verify that the fume hoods are running at between 90 and 110 feet per minute. (The average face velocity criteria for a fume hood is between 90 and 110 feet per minute.) During the inspection, the fume hood is divided into 6 equal areas and the face velocity is measured in the center of each of these areas using a velometer. These six readings are averaged. If the face velocity average is less than 100 feet per minute, the sash height that produces a 100 feet per minute average will be found. The hood will be labeled with a line that shows the maximum safe operating sash height. If the fume hood does not pass the inspection, then it is labeled with a "DO NOT USE" sign.

All hazardous materials and equipment should be placed at least 6 inches away from all sides of the fume hood. Also, for proper air circulation,

1. the rear baffle openings must be kept clear.
2. large objects should be placed 2 to 3 inches above the work surface.
3. nearby windows and doors must be shut.
4. pedestrian traffic must be kept to a minimum.

Laboratory fume hoods are not to be used as permanent storage for chemicals or equipment. Chemicals should be covered, properly labeled as to the contents, and removed from the hood when not in use. Do not place shelves in the fume hood since this would encourage the storage of materials in the hood and impede proper airflow.

Proper Use of a Laminar Flow Hood

Do not use hazardous materials inside a laminar flow hood. The laminar flow hood is designed to protect the product or sample from contamination and does not protect the laboratory worker. The laminar flow hood is also called a "clean bench." It provides uniform non-mixing air stream through a high efficiency particulate air (HEPA) filter.

Proper Use of Biological Safety Cabinets (BSCs): HEPA filters are effective at trapping particulates and thus infectious agents but do not capture volatile chemicals. According to Biosafety in Microbiological and Biomedical Laboratories (BMBL) 5th edition, only Type A2 exhausted or Types B1and B2 BSCs exhausting to the outside should be used when working with volatile toxic chemicals, but amounts must be limited. See the table below for additional information. (NOTE: The numbers following wording under the applications column in the table refer to footnotes 1 and 2.)

Characteristics of Biosafety Cabinet Classes

BSC Class, Type	Face Velocity (fpm)	Airflow Pattern	Applications	
			Nonvolatile Toxic Chemicals and Radionuclides	Volatile Toxic Chemicals and Radionuclides
I	75	In at front through HEPA to the outside or into the room through HEPA (Figure 1)	Yes	When exhausted outdoors 1,2
II, A1	75	70% recirculated to the cabinet work area through HEPA; 30% balance can be exhausted through HEPA back into the room or to outside through a canopy unit	Yes (minute amounts)	No
II, A2	100	Similar to II, A1, but has 100 linear fpm intake air velocity and plenums are under negative pressure to room (Figure 2); exhaust air can be ducted to outside through a canopy unit (Figure 3)	Yes	When exhausted outdoors (minute amounts) 1,2
II, B1	100	30% recirculated, 70% exhausted. Exhaust cabinet air must pass through a dedicated duct to the outside through a HEPA filter (Figure 4)	Yes	Yes (minute amounts)1,2
II, B2	100	No recirculation; total exhaust to the outside through a HEPA filter	Yes	Yes. (small amounts) 1,2
III	N/A	Supply air is HEPA filtered. Exhaust air passes through two HEPA filters in series and is exhausted to the outside via a hard connection (Figure 5)	Yes	Yes (small amounts) 1,2
Footnotes:				

[1] Installation may require a special duct to the outside, an in-line charcoal filter, and a spark-proof explosion- proof) motor and other electrical components in the cabinet. Discharge of a Class I or lass II Type A2 cabinet into a room should not occur if volatile chemicals are used.

[2] In no instance should the chemical concentration approach the lower explosion limits of the ompounds.

Source: adapted from BMBL, fifth edition, Appendix A, Table 2.

EHS inspects biological safety cabinets annually. This work is contracted out through a certified company.

Chapter 9

Standard Operating Procedures

It is the responsibility of the Principal Investigator of each laboratory to write and/or review the SOPs and ensure that the personal protective equipment and other controls outlined in the SOP are in place. Laboratory-specific SOPs must include specific work practices, procedures, and policies used to protect employees from laboratory hazards. *Special consideration should be given to working with carcinogens, mutagens, highly toxic chemicals, and reproductive toxins.* A template to help you write an SOP as well as SOPs written for specific chemicals are available to download and customize at https://www.uml.edu/eem/ehs/lab-safety/standard-operating-procedures.aspx.

Each Principal Investigator should identify and prepare a list of those materials and procedures in their lab for which special provisions will be applied. The OSHA Laboratory Standard suggests that these include reproductive toxins, highly (acutely) toxic materials, and "Select Carcinogens." (See definition listed below for "Select Carcinogens.") A list of these laboratory-specific substances should be placed in the CHP Notebook. The OSHA Laboratory Standard indicates that specific consideration should be given to:

- Establishment of a designated storage and work/use area
- Containment devices such as fume hoods or glove boxes
- Procedures for safe removal of contaminated waste
- Decontamination procedures

The OSHA Laboratory Standard defines a "Select Carcinogen" as any substance, which meets one of the following criteria:
(i) It is regulated by OSHA as a carcinogen

(ii) It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition) - https://ntp.niehs.nih.gov/whatwestudy/assessments/cancer/index.html

(iii) It is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest editions).

(iv) It is listed in either Group 2A or 2B by IARC or under the category,"reasonably anticipated to be carcinogens" by NTP.

More information on carcinogens can be found on the OSHA Safety and Health Topics for Carcinogens webpage - http://www.osha.gov/SLTC/carcinogens/index.html. On this website, there is also a list of links to OSHA standards that apply to substances classified as carcinogens or potential carcinogens by the NTP. Another list of the NTP and IARC known and probable carcinogens is available on the American Cancer Society webpage - http://www.cancer.org/Cancer/CancerCauses/OtherCarcinogens/GeneralInformationaboutCarcinogens/known-and-probable-human-carcinogens.

Chapter 10

Personal Protective Equipment (PPE)

Summary of Types of PPE

1. Eye and Face Protection

Safety glasses with side shields are required to be worn when working in the laboratory. The safety glasses must conform to the American National Standard Institute (ANSI) standard Z87.1-1989. However, safety glasses do not protect eyes from chemical splashes or aerosols since they do not fit tightly over the eyes. If you are working in an experiment with chemicals where a splash hazard exists, it is important to wear safety goggles instead of safety glasses. The safety goggles provide a seal around the eyes. If there is a potential for your face to be exposed to a chemical splash, it is important to wear a face shield over the safety goggles.

2. Foot Protection

Sandals, flip flops, clogs, and cloth/canvas shoes do not provide adequate protection for your feet when there is a chemical spill. It is important to wear closed toe shoes in the laboratory. Shoe covers may be required for work in some labs. For instance, when source loading arsenic chunks into a molecular beam epitaxy chamber, there is the potential for arsenic contamination. It is prudent to wear shoe covers in this type of laboratory to avoid tracking arsenic outside of the laboratory. (The shoe covers would be placed on when entering the laboratory and they would be removed before leaving the laboratory.)

3. Hand Protection

It is important to wear gloves that will provide appropriate protection from the hazard. Some examples of hazards encountered in a laboratory are handling hazardous chemicals, sharp-edged objects, and very hot or very cold objects or materials. Please inspect the gloves for discoloration, punctures and tears before use. In summary, here are the factors to consider when choosing the best type of glove to wear:

- Type of chemical/physical hazard: You will need to determine the best type of glove to wear for working with a chemical by looking at a glove compatibility chart (available from most manufacturers). This chart will give you the breakthrough time for different types of gloves and chemicals. What is the breakthrough time? It is the time that has elapsed from initial contact of a chemical with the outside surface of the glove till the time at which the chemical is detected on the inside surface of the gloves.

  If there is a physical hazard such as skin burns from hot or cold objects, you will need to wear thermal or cryogenic gloves. Leather gloves can be worn to protect your hands from abrasions or laceration hazards.

- Dexterity: You will receive better chemical protection with a thicker glove since the glove will be more resistant to physical damage; however, the thicker glove may impede your research if more dexterity is needed.
- Length of gloves: Depending on type of research, a wrist length glove will provide adequate protection. There are instances, such as when immersing hands in a large container of a hazardous chemical, that elbow length gloves will provide better protection.
- Double gloving will increase the breakthrough time of the gloves. Remember to remove and change the top layer of gloves whenever there is visible contamination.

For incidental contact with hazardous chemicals, double gloving with nitrile gloves may be sufficient. It is important to check a glove compatibility chart to verify that disposable nitrile gloves will be a good barrier between your hands and the hazardous chemical. Keep in mind that nitrile gloves may not be appropriate when handling highly toxic chemicals or solvents. For example, when using methylene chloride, you will find that nitrile gloves do not provide sufficient protection for incidental contact. The breakthrough time for methylene chloride to permeate through a nitrile glove and be in contact with your skin is approximately 5 minutes. You may, in this case, still opt to use the nitrile gloves for dexterity reasons and plan to double glove, changing the top layer of gloves every 5 minutes and when there is visible contamination.

How do you properly remove disposable gloves? First, grab the cuff of the left glove with the gloved right hand. Be careful not to touch your skin when grabbing the cuff. Hold the left glove that was removed in your gloved right hand. Then, place your finger from your now bare left hand under the cuff of the right glove. Invert the right glove over the glove in the palm of your hand. Dispose of the gloves properly and then wash your hands with soap and water. Do not reuse disposable gloves.

*** **A note about disposable latex gloves**
The use of disposable latex gloves for chemical handling is discouraged because latex gloves do not provide good barrier protection from commonly used chemicals. The breakthrough time may be minutes or seconds.

4. Personal Clothing

Shorts and skirts are not allowed in laboratories where hazardous materials are used because it is inappropriate to leave large areas of skin exposed. Instead, pants must be worn in the laboratories as well as laboratory coats that are buttoned with the sleeves rolled down. Laboratory coats should be made of 100% cotton, especially in laboratories where flammable materials are used. (Laboratory coats made of 100% cotton will not burn readily. Laboratory coats made of polyester/cotton blends are more combustible.) However, the best type of laboratory coat to wear when working with flammable or pyrophoric chemicals is Nomex. Nomex has the highest fire resistance because the lab coat thickens, carbonizes, and remains intact under fire conditions. (Nomex is also resistant to acids, bases, and most solvents.) Please go to this link to order a lab coat to use in a UML lab: https://www.uml.edu/eem/ehs/hazardous-materials/lab-coats/,

Since acids react readily with cotton, plastic or rubber aprons may be worn over the laboratory coats. Please note that, although plastic aprons provide protection from corrosive liquids, the aprons accumulate static electricity. For this reason, the plastic aprons should not be used when working with flammable solvents, explosives sensitive to electrostatic discharge, or materials that can be ignited by static discharge.

Remember to leave your laboratory coat inside the lab before you leave and do not bring your laboratory coat home to clean. Please contact EHS to get information on laundering services available for washing laboratory coats.

Restrain long hair and do not wear loose clothing such as neckties in a laboratory. The hair or loose clothing could catch fire or be dipped in hazardous chemicals.

Respirators

In a typical laboratory setting, respirators will be unnecessary since a fume hood should be available to work with all materials that are an inhalation hazard. However, there are some exceptions when a laboratory worker may require a respirator. For instance, if the laboratory worker's experimental equipment cannot fit in the fume hood and snorkels are unavailable, the laboratory worker may want to wear a respirator while working on the countertop if an inhalation hazard is present. Please contact the Respiratory Protection Program Administrator at ehs@uml.edu for more information. EHS will come out to the work site to evaluate the hazards and determine if a respirator is necessary. Instructions will be given to the laboratory worker on the proper procedure for obtaining a respirator.

Choosing The Correct Type of PPE

To determine the correct personal protective equipment (PPE) to wear in the laboratory, it is important to first assess the hazards of all materials and/or equipment in the workspace. At a minimum, the following PPE should be worn in all laboratories where hazardous materials are handled and stored: lab coat, safety glasses, and proper gloves.

The safety data sheet (SDS) is one resource that is used to determine the hazards of the chemicals in use. The SDS will also list specific PPE to wear but it may not list the specific type of gloves to wear. If this is the case, please refer to a glove compatibility chart. Another resource may be the manufacturer's instructions for a piece of equipment. Typically, the manufacturer's instructions will have information on the hazards of the piece of equipment as well as controls in place to protect oneself from the hazards. For example, with use of a rotary evaporator, there is a risk of the glass components imploding. To minimize this hazard, it is important that the glass components are made of Pyrex or similar glass and the whole system should be enclosed by a shield. The type of glass will minimize the amount of flying glass if there is an implosion and the shield will protect the lab workers from becoming injured by the flying glass. With these controls in place, it is still important to wear a lab coat, safety glasses, and proper gloves. Lastly, the correct PPE may already be listed in a laboratory-specific standard operating procedure.

Certifying the PPE Assessment

After resources such as safety data sheets, standard operating procedures and manufacturer's instructions are reviewed, please fill out a personal protective equipment assessment which is located in section 12 of the CHP Notebook. This will be a good overview of the hazards in the lab and will provide laboratory workers with the specific PPE required for all hazardous tasks performed in the lab. If assistance is needed with filling out the PPE assessment, please contact EHS. Once all information in the PPE assessment is completed, the Principal Investigator must sign the document in order to certify the assessment.

Training

Training must be provided for all laboratory workers. The training must include the following topics:

- When and why PPE is necessary
- What PPE is necessary
- How to properly don, doff, adjust and wear PPE
- The limitations of the PPE
- The proper care, maintenance, longevity and disposal of the PPE.

Employees must be able to demonstrate an understanding of the PPE training and use the PPE properly before being allowed to perform work requiring the use of PPE.

Retraining

- When the Principal Investigator has reason to believe that any affected employee who has already been trained does not have the understanding and skills required, the Principal Investigator shall retrain that employee. Circumstances where retraining is required include, but are not limited to, situations where:
  - - Changes in the workplace render previous training obsolete
  - - Changes in the types of PPE to be used render previous training obsolete
  - - Inadequacies in an affected employee's knowledge or use of assigned PPE indicate that the employee has not retained the required understanding or skill

Chapter 11

Additional Topics

Required Signage

All laboratories are required to have a risk card sign posted on the outside of the laboratory doors. It is important that this information be filled out and posted on the doors to communicate hazards and to also have contact information available in the event of an emergency after hours. For example, the UMass Lowell police may need to contact the Principal Investigator of the lab after a power outage or flood. For more information about the required signage, please call EHS at 42543. (The actual sign is shown on the next page.)

Risk Card Awareness Information

EHS determines entryway into hazardous spaces, as such a door mounted risk card system is designed and implemented on campus to provide guidance and controls.

- Online risk information sign awareness module educates the UML community on our risk card sign system including topics such as how it is used on campus to communicate hazards and determine entry procedures.
- Risk information sign completion instructions allow Principal Investigators and facility space managers to properly identify the hazards within their spaces so EHS can assign a color and provide/post the sign.
- Risk Card Database is the online tool to track laboratories, hazards, PI's, and emergency contact information. This database will provide contacts to police for first response, facilities for the names of responsible party, and track associated hazards. To view the database, you must have UML credentials and have been provided access to the risk card database. To request access, email EHS@uml.edu, include "risk card database access" in the email subject line, include your name, department, and reason for access in the body of the email.

Waste Minimization

Here are some ideas to minimize the generation of hazardous waste in your labs.

1. Perform chemical reactions on a smaller scale.
2. Use less solvent to rinse equipment. (For example, rinse equipment several times with small volumes of solvents rather than rinsing once or twice with larger volumes.)
3. Substitute nonhazardous or less hazardous chemicals when possible.
4. Recycle and reuse materials when possible. (For example, coordinate laboratory work with colleagues at UMass Lowell who may be using some of the same chemicals.)
5. Include, in experiments, the reaction work-up steps that deactivate hazardous materials or reduce the toxicity of the hazardous materials.

Green Chemistry

Green chemistry is the use of environmentally friendly, sustainable chemicals. By practicing green chemistry, labs may minimize or eliminate hazardous waste generation which ultimately leads to less pollution in our environment.

Here are the twelve principals for green chemistry taken from the EPA website at the following link- https://www.epa.gov/greenchemistry/basics-green-chemistry.

Twelve Principles of Green Chemistry

1. **Prevention**
   It is better to prevent waste than to treat or clean up waste after it has been created.
2. **Atom Economy**
   Synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final product.
3. **Less Hazardous Chemical Syntheses**
   Wherever practicable, synthetic methods should be designed to use and generate substances that possess little or no toxicity to human health and the environment.
4. **Designing Safer Chemicals**
   Chemical products should be designed to effect their desired function while minimizing their toxicity.
5. **Safer Solvents and Auxiliaries**
   The use of auxiliary substances (e.g., solvents, separation agents, etc.) should be made unnecessary wherever possible and innocuous when used.
6. **Design for Energy Efficiency**
   Energy requirements of chemical processes should be recognized for their environmental and economic impacts and should be minimized. If possible, synthetic methods should be conducted at ambient temperature and pressure.
7. **Use of Renewable Feedstocks**
   A raw material or feedstock should be renewable rather than depleting whenever technically and economically practicable.
8. **Reduce Derivatives**
   Unnecessary derivatization (use of blocking groups, protection/ deprotection,

temporary modification of physical/chemical processes) should be minimized or avoided if possible, because such steps require additional reagents and can generate waste.

9. **Catalysis**
   Catalytic reagents (as selective as possible) are superior to stoichiometric reagents.
10. **Design for Degradation**
    Chemical products should be designed so that at the end of their function they break down into innocuous degradation products and do not persist in the environment.
11. **Real-time analysis for Pollution Prevention**
    Analytical methodologies need to be further developed to allow for real-time, in-process monitoring and control prior to the formation of hazardous substances.
12. **Inherently Safer Chemistry for Accident Prevention**
    Substances and the form of a substance used in a chemical process should be chosen to minimize the potential for chemical accidents, including releases, explosions, and fires.

* Anastas, P. T.; Warner, J. C.; Green Chemistry: Theory and Practice, Oxford University Press: New York, 1998, p.30. By permission of Oxford University Press.

Reproductive Health in the Laboratory

Employees and students may contact EHS to schedule a reproductive health assessment. Please fill out the form on the page below to assist EHS with their assessment.

For further information regarding reproductive health, please read the National Institute of Occupational Safety and Health (NIOSH) publications listed below -

1. http://www.cdc.gov/niosh/docs/99-104/ - The Effects of Workplace Hazards on Female Reproductive Health
2. https://stacks.cdc.gov/view/cdc/21443 - The Effects of Workplace Hazards on Male Reproductive Health

You may also review the list of reproductive toxins from California's Proposition 65 - http://www.oehha.ca.gov/prop65/prop65_list/files/P65List031811links.pdf.

University of Massachusetts Lowell Reproductive Hazard Evaluation Form

This questionnaire is for men and women who frequently use chemicals or may be exposed to other hazardous conditions at work that may be reproductive hazards.

Name: ____ Department: _______________________
Address: ____ Phone Number: _____________________

Job duties with potential exposure(s) of concern:
____
____

1. Please indicate which of the following agents you may be exposed to while performing the job duties with potential exposure(s) of concern:

Agent	Yes	No	Frequency of exposure?	Exposure duration or quantity?
Noise				
Temperature Extremes				
Radiation				
Infectious Agents				
Hazardous chemicals				

2. Please list the infectious agents, hazardous chemicals or radiation sources you may be exposed to, if applicable:
____
____

3. Indicate the type of **ventilation** used while performing the job duties with potential exposure(s) of concern:
_____ Fume hood or other local exhaust system
_____ General mechanical ventilation (building heating/ventilation/air-conditioning system)
_____ Natural ventilation (outside air through windows or doors)
_____ Other (please describe:____)

4. Please describe **administrative controls** in place (laboratory-specific training, standard operating procedures, etc):
____
____

4. Please describe the types of **personal protective equipment (PPE)** you use while performing the job duties with potential exposure(s) of concern (PPE may include eye/face/hearing protection, gloves, respirator, lab coat, etc.): ____

5. Additional Concerns or Comments:

EHS Safety Specialist Signature: __ ______________________________ Date:_____________

Ergonomics in the Laboratory

Employees may contact EHS to schedule an ergonomic assessment. A self-assessment form is provided on the next page to assist you with creating proper ergonomic design within your workspace.

Ergonomics is the study of designing equipment and devices to fit the human body, its movements, and its cognitive abilities. Proper ergonomic design is important to prevent musculoskeletal disorders such as carpal tunnel syndrome. Some examples of how injuries may be avoided are the following:

1. Take breaks from repetitive tasks.
2. Choose tools that fit best. (For example, use pipettes that fit comfortably in the user's hands.)
3. Maintain physical fitness.
4. Use adjustable workstations.
5. Fit the work to the worker. (For example, keep samples and equipment within easy reach.)

Please go to the link – www.uml.edu/eem/ehs/ergonomics - to find information on conducting your own self ergo assessment, stretches to do at work, and other ergonomic information.

Laboratory Ergonomics

University of Massachusetts Lowell Self-Assessment Checklist

(Responses with an asterisk * require you to work with your supervisor to reduce ergonomic stresses.)

Computer Workstations

Yes No* 1. Is a seat provided?

Yes No* 2. Is the seat height adjustable?

Yes No* 3. Is lumbar back support provided?

Yes No* 4. Is a footrest provided?

Yes No* 5. Is there ample leg room?

Yes No* 6. Are all adjustable features easy to use?

Yes No* 7. Is there ample room to accommodate a keyboard and a computer mouse so the employee can rest their arms at their side and forearms parallel to the floor?

Yes No* 8. Is there ample room to place the monitor at arm length's distance?

Yes No* 9. Is the monitor at the recommended height?

Yes No* 10. If documents are frequently used, is there a document holder?

Laboratory Benches

Yes No* 1. If the worker stands, is anti-fatigue matting supplied?

Yes No* 2. Is the height of the bench appropriate for the work that is performed?

Yes No* 3. Is there adequate leg room?

Yes No* 4. Do contact stressors exist such as bench tops with sharp edges?

Laboratory Chairs

Yes No* 1. Can all laboratory chairs be adjusted to accommodate all of the employees who need to use the chairs?

Microscopes

Yes* No 1. Do the shoulders appear rounded and/or is the worker hunched over?

Yes* No 2. Is there excessive neck flexion (>25 degrees)?

Yes* No 3. Are there contact stresses between sharp edges and the forearms?

Yes No* 4. Is the microscope pulled out to the edge of the workbench?

Yes No* 5. Are armrests or padding provided?

Yes No* 6. Is there sufficient leg room?

Yes* No 7. Does the worker rest their feet on the lab stool?

Yes No* 8. Is there a footrest provided?

Yes No* 9. Has the individual been trained how to properly sit at a microscope workstation?

Yes No* 10. Are microscope work breaks provided?

Pipetting

Yes* No 1. Are manual pipettors used?

Yes No* 2. Are electronic pipettors provided?

Yes No* 3. Are latch-mode pipettors provided?

Yes No* 4. Is the pipettor designed to reduce contact with sharp edges?

Yes No* 5. Has the individual been trained how to properly operate the pipettor (e.g., pickup tips, eject tips, program electronic pipettor, etc.).

Yes* No 6. Does the worker pipette more than 2 hours per day?

Yes No* 7. Are frequent breaks provided?

Yes No* 8. Is the pipettor computer-controlled to allow for computer-activated multiple dispensing instead of finger-activated dispensing?

Fine Motor Skills

Yes	No*	1.	Are vials with the fewest amount of threads allowable used?
Yes *	No	2.	Does the worker perform dissection or micro-manipulation with forceps more than 5 hours per week?
Yes	No*	3.	Are frequent micro breaks provided?
Yes *	No	4.	Do contact stresses exist between the forearm and workbench?

Microtome and Cryostat

Yes *	No	1.	Does the worker use excessive wrist flexion and extension when operating the microtome or cryostat?
Yes	No*	2.	Is the workstation at a height that reduces arm abduction as much as possible?
Yes	No*	3.	Does the worker have access to an automatic microtome/cryostat?
Yes	No*	4.	Are frequent breaks provided?
Yes	No*	5.	Is a fully adjustable chair provided?

Chapter 12

CHP Notebook

INTRODUCTION

The CHP Notebook is site-specific for each laboratory group at UMASS Lowell. It is customized by the Principal Investigator, Chemical Hygiene Officer, and the laboratory group. All laboratory-specific information required under OSHA's Laboratory Standard such as standard operating procedures and emergency procedures will be filed in this notebook. The contents of the CHP Notebook must be reviewed by all new employees and all training documentation must be stored here. The notebook can be used as an ongoing reference manual for all laboratory workers. Please remember to review the CHP Notebook at least annually to see if any updates need to be made.

For Your Lab Group (The PI or CHO): Complete this page, annually, after each CHP Notebook review or revision.

NOTE: All laboratory chemical use areas must maintain a customized CHP (the CHP Notebook) which conforms to the requirements of the OSHA Laboratory Standard 29 CFR 1910.1450.

Name (print)	Signature	Date

Table of Contents

Section 1 – Safety Program Key Personnel

Please add your department's safety program key personnel to this list. Here's a link to EHS' team with contact information: https://www.uml.edu/eem/ehs/meet-our-team/.

Section 2 – Laboratory Details

This CHP Notebook pertains to the following Principal Investigator(s):

List all rooms under the responsibility of the Principal Investigator(s) including temperature-controlled rooms, storage closets, and animal facilities.

Section 3 – Laboratory Specific Information and Emergency Phone Numbers

(NOTE: The emergency phone numbers cannot be only UMass Lowell office numbers. You may not be in your office at the time of the emergency! Please also list cell phone numbers and/or home phone numbers.)

Name of Principal Investigator (PI):
____

Emergency Phone Numbers:
(Day)________________________________
(Evening)____________________________
(Cell)________________________________

Name of Lab CHO *(if different than the PI)*:
____

Emergency Phone Numbers:
(Day)________________________________
(Evening)____________________________
(Cell)________________________________

Names of Other Lab Personnel:	Emergency Phone Numbers:

Section 4 – Emergency Procedures

WHAT YOU CAN DO TO PREPARE:

- Place emergency supplies (i.e. first aid kit, flashlights, bottled water, batteries, and a portable radio) in your office or lab.
- Post emergency phone numbers by phone in your office and lab.
- Become familiar with shortest exit routes from your lab and office.
- Locate the nearest fire alarm pull station.
- Review basic on-line fire extinguisher training – www.fireextinguishertraining.com
- Post an evacuation plan in your lab or be familiar with evacuation plan posted in the hallway near your lab. (You may insert a copy of the evacuation plan into this section of the CHP Notebook.)

Section 5 – Hazardous Chemical Inventory

The hazardous chemical inventory is maintained by EHS. It is available to the Principal Investigators for laboratories under their specific oversight, upon request, from ehs@uml.edu.

Section 6 – Safety Data Sheets

Laboratory groups should place copies of their safety data sheets in this section of the CHP Notebook or a separate binder for easy access.

There are links to sites to access safety data sheets on the EHS website under lab safety. Please follow this link - https://www.uml.edu/eem/ehs/lab-safety/sds.aspx.

Section 7 – Standard Operating Procedures

Principal Investigators (PI) have the responsibility for overall oversight of the laboratory which includes operations, compliance, safety, and security. Standard operating procedures must be written for all procedures that pose a risk to the health and safety of the laboratory personnel. When conducting a procedure such as the use of hazardous materials in an experiment, the PI or a designated lab employee must prepare a written standard operating procedure (SOP) that outlines the hazards of the procedure as well as the controls that must be implemented to conduct the research safely.

NOTE: An SOP does not need to be written for each individual experiment. Procedures with the same hazards can be combined into one SOP.

An SOP template is provided below.

The SOP Title Here

Standard Operating Procedure

Your Name Here

Date

Write a brief description of what this process is used for here.

1.0 Material Requirements:

1.1 Equipment needed for process:

List all of the equipment you need to successfully run this process. Be complete. If this is a new process that has not been done in the lab before, consult with lab staff to make sure that equipment you need is available.

1.2 Chemicals needed for process:
Include a complete list of the chemicals needed. If specific concentrations, purities, or grades are necessary cite them here.

1.2.1 Hazards associated with chemicals:
Include a subsection for each component chemical and if necessary a subsection for the chemical produced. Hazards will be found in the SDS. Look for information on whether the chemical is flammable, corrosive, toxic, carcinogenic, pyrophoric, an irritant, etc.

1.3 Engineering controls:
Where will you run this process? If this process is to be run in a specific location in the lab be explicit. Options include fume hoods, vented ovens, furnaces, glove boxes, wet benches. If this is a new process and the appropriate engineering controls do not seem to be available in the lab, discuss with lab staff whether the process can be done and how to obtain what is needed. If no engineering controls are needed, please cite this fact. Some of this information will be in the SDS.

1.4 Protective equipment needed:
What do you wear to protect yourself while performing the process? Check SDS, but be aware that the protective equipment standards cited in these documents frequently refer to handling the chemical outside of approved engineering controls. If you do not know what protective equipment to use or what types of gloves are compatible with the chemicals you will be using, consult lab staff.

2.0 Procedure:

Include detailed instructions on mixing the component chemicals and or use of the gas. Information you should cite will include temperature settings, flow rates/pressure, concentrations, volumes and weights, appearance (if applicable), what the process is supposed to do, how to tell if the process was successful, and what to do with the hardware, chemicals, and equipment after the process is completed.

3.0 Storage:

Where will you store this in the lab (e.g., solvent, acid, or base cabinet, refrigerator, etc.)? Be aware of incompatibility with other chemicals already in use in the lab. For example, one chemical might react violently with another. In this case you would want to avoid storage in a cabinet with this second chemical. Information will be found in the SDS.

4.0 Waste Products:

How do you dispose of the waste products used in making the material, after using the material or after the material is depleted or gets old. Be specific and describe the specific disposal procedure to be used <u>within the lab</u> (i.e., do not write “Dispose of in accordance with applicable regulations”). Ask members of the laboratory staff for assistance if you do not know how the waste chemical should be handled.

5.0 Accident Procedures: (Found in the SDS)

5.1 Contact (include a subsection for each component chemical)

5.1.1 Skin:

5.1.2 Eyes:

5.1.3 Inhalation:

5.1.4 Ingestion:

5.2 Spill or leak: How do you deal with a small spill? Are there specific absorbents that should be used? Is the disposal procedure you cited in section 4 valid in case of a spill? If it is a gas leak, what do you do when the detectors go off? Be specific. Do <u>not</u> include the chemical manufacturer’s emergency numbers here.

5.3 Fire: Are there specific concerns to be considered in the event of a fire? For example, some chemicals are water reactive, and using water on a fire where these chemicals are involved will make the problem worse.

For emergencies, call UMASS Lowell Police at 44911 from a campus phone. An “outside” line is also available 24 hours a day for calls to the UMASS Lowell police. It is 978-934-2394.

NOTE: All work-related injuries must be reported immediately to Human Resources (HR) by calling extension 43560. (HR has some forms that will need to be filled out within 48 hours after the incident.) An Incident/Injury Report Form must be filled out and faxed to EHS at 978-934-4018. [The Incident/Injury Report Form is available on-line at http://www.uml.edu/ehs. Please double click on the link, under quick links, for permits and forms.]

Section 8 – Training Records for Employees

Records of training must be kept in the CHP Notebook. In this section, there are a number of different forms that may be used to document training. There is also a training checklist that can be used as a guide by the Principal Investigator and/or Chemical Hygiene Officer when conducting laboratory-specific training. Copies of laboratory safety certificates and other certificates provided by the Environmental Health and Safety Department must also be placed in this section of the CHP Notebook.

CHEMICAL HYGIENE PLAN
AWARENESS CERTIFICATION

The Occupational Safety and Health Administration (OSHA) requires that laboratory employees be made aware of the Chemical Hygiene Plan at their place of employment (29 CFR 1910.1450). After reviewing the CHP and CHP Notebook, complete the information below and place a copy of this form in section 8 of the CHP Notebook.

By signing below, you acknowledge that you are aware of the Chemical Hygiene Plan and the policies and procedures applicable to the OSHA standard (29 CFR 1910.1450). You are also aware of all the lab-specific information contained in your lab group's CHP Notebook.

Please type or print legibly.

Name ___________________________ Department ___________________

Campus Location __________________Campus Phone_________________

Supervisor or PI ____________________

Signature:______________________________Date:_______________

APPROVED

Principal Investigator's Signature:_______________________Date:_______________

LAB-SPECIFIC TRAINING FORM FOR EMPLOYEE

Name _________________________ Department __________________

Campus Location _________________

Campus Phone # ________________

Supervisor or PI ___________________

The OSHA Laboratory Standard requires that the employee's supervisor provide training on all hazardous procedures. This training must be provided at the time of the employee's initial assignment, on a refresher basis at least annually and upon updating procedures.

NOTE: See attached training checklist.

Document laboratory-specific employee training below:

Type of Training	Date	Provided By	Employee Signature

Training Checklist

This checklist may be used to assist Principal Investigators with the laboratory-specific training requirements outlined in the Laboratory Safety Standard.

Review basic safety rules ☐

Review location of Chemical Hygiene Plan (CHP) and CHP Notebook ☐

Review location of safety data sheets ☐

Read CHP and CHP Notebook ☐

Read laboratory-specific standard operating procedures (SOPs) ☐

Read safety data sheets for all chemicals used by employee ☐

Review locations of emergency equipment ☐

Review emergency procedures ☐

Review hazardous waste handling procedures ☐

Review procedures for chemical procurement, distribution, and storage ☐

Review procedures for use of compressed gas cylinders ☐

Review personal protective equipment (PPE) used in lab
Discuss selection of proper gloves and how to use a glove compatibility chart. ☐

Housekeeping, maintenance, and safety inspections ☐

Ventilation and other engineering controls
Discuss proper use of fume hoods and other mechanical ventilation systems. ☐

Medical program
Discuss the need for any medical surveillance such as for respirator use, working with certain potentially hazardous materials or adverse environmental (lab) conditions. ☐

Training Program
Discuss mandatory laboratory-specific training sessions as well as the general laboratory safety training that is also mandatory and offered by EHS on a monthly basis. ☐

*****Additional Safety Session Topics*****
Review accidents and injuries as well as corrective actions taken to prevent reoccurrences.
Review hazards and controls on new equipment, procedures, and/or materials.
Review results of recent formal or internal inspections as well as plans for correcting deficiencies.

Section 9 – Inspections and Exposure Monitoring Records

This section should contain information on formal and internal laboratory inspections and exposure monitoring reports. This section should also contain records of corrective actions. The EHS laboratory safety inspection checklist (see below) can be used for your own internal laboratory inspections.

	INSPECTION INFORMATION			
	Building: **Lab Number:** **Date:**			
	Responsible Faculty/Staff:			
	Name of person completing survey:			
	Primary Function; Academic / Research / Services			
	GENERAL SAFETY REQUIREMENTS	**Yes**	**No**	**N/A**
1	Is an updated emergency risk card posted on the lab entrance door?			
2	Is the UML Chemical Hygiene Plan (CHP) accessible to all lab personnel?			
3	Have lab personnel taken the EHS lab safety training located at www.uml.edu/eem/ehs/lab-safety?			
4	Is there an evacuation route posted in the lab or in the hallway outside of the lab?			
5	Is there a working phone in the lab?			
6	Do lab personnel know who to call in the event of a spill?			
7	Is the general lab ventilation working?			
8	If a drench shower is available, is it accessible?			
9	Has the drench shower been inspected?			
10	If eyewash station is available, does it function properly?			
11	Has the eyewash station been inspected?			
12	Is the eyewash station accessible and free of clutter?			
13	Is a first aid kit easily accessible and stocked in the lab?			
14	Are doors closed and secured during and after occupancy?			
15	Are movable parts guarded on equipment as appropriate?			
	ELECTRICAL SAFETY			
16	Is the electrical panel accessible?			
17	Are plugs, cords, and outlets in good condition?			
18	No overloaded outlets or daisy chained power strips?			
19	Extension cords do not pose trip hazards (taped down)?			
20	Power strips kept away from liquids?			
21	No power cords found under doors, carpets or through ceilings?			
	LABORATORY SAFETY			
22	Do lab personnel know where to find safety data sheets?			
23	Are applicable standard operating procedures available to lab users?			
24	Is there documentation of lab-specific training in the CHP?			
25	Are beakers, test tubes and flasks clearly labeled to identify contents?			
26	Are chemical storage cabinets clearly labeled? (i.e., flammables, corrosives)			
	HOUSEKEEPING			
27	Is the lab neat and orderly?			
28	Is there minimal glassware on bench tops?			
29	Is there minimal glassware in the sink?			
30	Is there minimal glassware in the fume hood?			
31	Are exits, aisles, and corridors not blocked and is the minimum width 24 inches?			
32	Are chemicals stored off the floor?			
33	Is the glass window on the lab entrance door free from obstruction?			

34	Are lab users complying with the no eating and drinking policy in the lab?			
35	Are refrigerators/freezers being used and labeled for storage of chemicals only?			
	FIRE SAFETY			
36	Are there fire extinguishers in the lab?			
37	Have the fire extinguishers been inspected within the past year?			
38	Are fire extinguishers fully charged?			
39	Are fire extinguishers clearly identified with a sign?			
40	If lab uses propane, is there no more than 2 pounds of propane in the lab?			
41	Is storage clearance from ceiling 18" with sprinklers or 24" without sprinklers?			
42	Is there a fire blanket and is it easily accessible in the lab?			
43	Are the majority of flammable liquids stored in a flammable liquid storage cabinets?			
44	Minimal combustible materials in space ie., cardboard, paper, books, curtains?			
	COMPRESSED GAS CYLINDERS			
45	Are contents of gas cylinders clearly labeled?			
46	Are gas cylinders firmly secured to walls or lab benches or are they properly secured with floor stands? (This includes lecture size compressed gas cylinders.)			
47	Are valve protection caps placed on cylinders not in use?			
48	Are empty gas cylinders properly secured and marked as empty?			
49	Are gases properly segregated?			
	PERSONNAL PROTECTIVE EQUIPMENT			
50	Are closed toe shoes and long pants worn by lab personnel?			
51	Are lab coats worn by lab personnel?			
52	Are gloves worn by lab personnel while handling chemicals?			
53	Is eye protection being worn by lab personnel?			
	FUME HOODS			
54	Has the annual calibration been performed on each fume hood?			
55	Is the proper sash height indicated?			
56	Is the sash at or below the marked approval level?			
57	Does the fume hood lighting work properly?			
58	Are audible/visual alarms functional?			
59	Functional fume hoods not being used for long term storage?			
60	Are experiments at least 6" inside the hood?			
	CHEMICAL SAFETY			
61	Is there less than 10 gallons of flammable liquids stored outside of flammable liquid storage cabinets?			
62	Is an explosion proof refrigerator available for chemical storage?			
63	Are incompatible materials properly segregated?			
64	Are chemicals stored safely away from the edges of counters and shelves?			
65	Are ethers and other peroxide formers dated upon receipt and when opened?			
66	Are water reactive chemicals stored inside cabinets?			
67	Are pyrophoric chemicals stored inside cabinets?			
68	Are chemical containers in good condition?			
69	Are storage cabinets and shelves in good condition?			
	CHEMICAL WASTE DISPOSAL			
70	Is there an SAA sign demarcating the waste storage area in the lab?			
71	Are satellite waste containers labeled with a UML hazardous waste label?			

72	Are the appropriate hazard boxes checked on the hazardous waste label?			
73	Is each chemical constituent written out without abbreviation or formulas?			
74	Are waste containers stored in secondary containment?			
75	Are waste containers kept closed unless being worked with?			
76	Are wastes properly segregated by hazard class?			
77	Are lab users complying with the UML "NO" pour down the drain policy?			
78	Are hazardous waste labels easy to read?			
79	Are stock chemicals stored separately from waste chemicals?			
80	Are full satellite waste containers dated and removed within 72 hours?			
81	Are secondary containment bins free of spilled chemical waste?			
82	Are satellite waste containers in good condition?			
83	Are rigid cardboard boxes available for the collection of lab glass?			
84	Are the lab glass waste boxes in good condition?			
85	Are sharps (broken glass, pipettes, needles, razors etc.) being disposed of properly?			
86	Are sharps containers less than 3/4 full?			

Section 10 – Incidents, Injuries, and Corrective Actions

Note: An incident and near miss reporting form is on the EHS website at www.uml.edu/eem/ehs. This form is submitted to EHS online after it is filled out. It can also be printed out to file in this section of the CHP.

Section 11 – Safety Program Correspondence

Please insert any letters or memos of correspondence from EHS into this section. You may also insert documentation of safety topics discussed during lab meetings.

Section 12 – Personal Protective Equipment Assessment

Date:______________________________ Principal Investigator:____________________

Department:__________________________ Analysis By:__________________________

Location:____________________________ Signature:____________________________

Task	Potential Hazards	PPE Recommended

Here is an example of a PPE assessment that has been filled out for a lab group. Once you check the manufacturer's glove compatibility chart, please list the specific type of glove to wear under "PPE Recommended." If it is best to double glove, this information can also be placed in the "PPE Recommended" section.

PERSONAL PROTECTIVE EQUIPMENT

CERTIFICATION OF HAZARD ASSESSMENT

Tasks	Potential Hazard	PPE Recommended
Working with small volumes of corrosive liquids < 1 liter	Skin and eye damage	Safety glasses (safety goggles if splash hazard) Appropriate gloves* (check manufacturer's glove compatibility chart) Lab coat, closed shoes, pants
Working with small volumes of organic solvents < 1 liter	Skin and eye damage Slight poisoning potential through skin absorption	Safety glasses (safety goggles if splash hazard) Appropriate gloves* Lab coat, closed shoes, pants
Working with non-human/non-primate cells classified as biosafety level 1 (BSL1) work	BLS1 work are strains of viable microorganisms not known to consistently cause disease in healthy adult humans. Many agents not ordinarily associated with disease processes in humans are, however, opportunistic pathogens and may cause infection in the young, the aged, and immunodeficient or immunosuppressed individuals.	Lab coat and gloves Safety glasses if there is a splash hazard
Working with acutely toxic hazardous powders	Great potential skin and eye damage. Great potential for poisoning through skin absorption.	Safety goggles Appropriate gloves* Lab coat, closed shoes, pants Coveralls and booties if necessary
Working with hazardous powder – Trypan Blue	Suspect carcinogen. May cause heritable genetic	Safety goggles Appropriate gloves* Lab coat, closed shoes, pants

	damage. Suspect teratogen. Eye and skin irritant.	
Working with hazardous powder - acrylamide	Suspect carcinogen and suspect teratogen. Severe neurotoxin. Eye, skin, and respiratory irritant.	Safety goggles Appropriate gloves* Lab coat, closed shoes, pants Coveralls and booties if necessary
Working with cryogenic liquids	Major skin, tissue and eye damage	Safety glasses or safety goggles for large volumes or splash hazards Face shield Heavy insulated gloves Lab coat, closed shoes, pants
Working with very cold materials and equipment (freezers, dry ice)	Skin damage	Safety glasses Insulated gloves Lab coat, closed shoes, pants
Working with hot liquids, equipment and/or open flames (autoclave, Bunsen burner, water bath, oil bath)	Skin damage Eye damage	Safety glasses or goggles for large volumes or splash hazards Insulated gloves Lab coat, closed shoes, pants
Glassware washing	Skin lacerations	Heavy rubber gloves Lab coat, closed shoes, pants

*Please reference the specific glove manufacturer's selection chart for proper selection of all gloves based on the specific hazard.