Laboratory Safety Training

Environmental Health & Safety
University of Massachusetts Amherst

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Laboratory Safety Training Objectives

- Understand UMass specific policies and processes for work in laboratories
- Understand fundamental safe work practices and proper personal protective equipment
- Understand where to get further information
- Understand UMass specific procedures for emergency response

Regulations, Best Practices, Policies

- Regulation – Occupational Safety & Health Standard
  - OSHA 1910.1450 Occupational exposure to hazardous chemicals in laboratories.
- Best Practices
  - National Academy Publication 2011
  - Professional Organizations’ Recommendations
- UMass specific requirements
  - Laboratory Health and Safety Manual / Chemical Hygiene Plan

Roles & Responsibilities for Safety

- Chancellor
- EH&S Director
- Faculty Safety Committees
- Faculty responsible for the safety of their laboratory
- Dept. Safety Coordinator
- Everyone is expected to maintain a safe work and learning environment

Potential Hazards in the Lab

- Chemicals
- Biological
- Radiological
- Gas Cylinders
- Cryogenic Liquids
- Ultraviolet Light
- Lasers
- Electro-magnetic Radiation
- Physical Hazards
  - Failure of glass vessels from Heating / Cooling
  - Hot surfaces / vessels
  - Electrical
  - Sharps

EH&S Safety Training

- It is university policy that the appropriate safety training is required by personnel prior to starting work in a laboratory (including visiting researchers)
- Classroom trainings required once every 5 years
  - Laboratory, Fire, Biological, Radiation, Laser, X-ray
  - Fire Safety is a separate class and is required
- Online refresher trainings required every 1 year
  - Laboratory, Right-to-Know, Hazardous Waste, Biological, Radiation, Bloodborne Pathogen, Biosafety Cabinets, Autoclave, Worker Protection Standard, Motor Vehicle Idling
- EH&S and Departmental Training Managers monitor training compliance monthly
Lab Specific Training

- Faculty or senior lab member must provide training on specific chemicals and procedures in the lab
- Written protocols must be provided to you for all procedures
  - Do not perform an experiment without a written protocol
  - If you are unsure – ASK!
- Use a lab notebook to document all of your experiments and their variations.
- High hazard operations must be approved by the Institutional Chemical Safety Committee
  - Highly Toxic
  - Highly Reactive
  - Unknown Toxicity/Reactivity

Massachusetts Right to Know Law

- A law for public employees in Massachusetts
  - Includes students & employees at public colleges
- Based upon the Federal Occupational Safety and Health Administration (OSHA) Hazard Communication Standard
- Requires information such as Safety Data Sheets (SDS) on hazardous substances be distributed to employees and students working in labs in a manner that can be understood
- Also requires labeling and training on hazards

GHS – Globally Harmonized System

- GHS is an international system for standardizing and harmonizing the classification and labeling of chemicals as well as the format and content of safety data sheets.
- All chemical labels now contain a pictogram, signal word, hazard statement, and precautionary statement

GHS Pictograms and Hazard Classes

- SDS Sections
  1. Identification
  2. Hazard(s) identification
  3. Composition/information on ingredients
  4. First-aid measures
  5. Fire-fighting measures
  6. Accidental release measures
  7. Handling and Storage
  8. Exposure controls/personal protection
  9. Physical and chemical properties
  10. Stability and reactivity
  11. Toxicological information
  12. Ecological information
  13. Disposal considerations
  14. Transport information
  15. Regulatory information
  16. Other information

Where to Obtain the SDS

- Delivered with chemicals
- Directly from company supplying chemical
- Beware of internet searches – check percentages
- Massachusetts Right to Know law requires UMass to maintain SDS’s for every chemical on-site and accessible to all individuals
- SDS’s for all chemicals are stored in Chemical Environmental Management System (CEMS) which can be accessed by a quick link on the EH&S website
CEMS Stores SDS’s

http://www.umass.cems.sr.unh.edu

No login required
Click “Search SDS”

Labeling of Hazardous Substances In the Lab

- The chemical name must appear on containers of all hazardous substances including chemical constituents
- All working solutions transferred into other containers MUST be labeled (even if only water)
- Mixtures must be clearly labeled and the hazards should be indicated (no formulas or acronyms)

<table>
<thead>
<tr>
<th>Correct</th>
<th>Incorrect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>H₂O</td>
</tr>
<tr>
<td>Sulfuric acid</td>
<td>H₂SO₄</td>
</tr>
<tr>
<td>10% potassium hydroxide in water</td>
<td>10% KOH</td>
</tr>
<tr>
<td>Ethanol</td>
<td>ETOH</td>
</tr>
<tr>
<td>Acetonitrile</td>
<td>ACN</td>
</tr>
</tbody>
</table>

Lab Hazard Identification and Communication

Door Card
Posted at each lab door for a quick review of hazards present and key contact names

NFPA vs New GHS ratings

Health, physical and environmental hazards of chemicals categorized using a numerical scale

Proper Use of Chemical (Fume) Hoods

- Use for anything that poses an inhalation hazard
- Check to assure air is flowing before use and that certification sticker date < 1yr, otherwise contact EH&S
- Work 6 inches back from hood face
- Bottom of hood sash at half-height or lower
- There should be no long term storage of chemicals or apparatus in the hood.
- Keep hoods uncluttered.
- Shut the sash when no one is actively working at the hood for energy conservation

Reduce the Risks

1. Elimination or Substitution
   Use less hazardous chemicals or processes
2. Engineering Controls
   Fume hoods, biosafety cabinets, glove boxes, gas cabinets, room ventilation
3. Work Practice Controls
   Training; Chemical Hygiene Plan; Standard Operating Procedures (SOPs); Enforcement
4. Personal Protective Equipment (PPE)
   You personally control wearing proper PPE
Disrupting Air Flow in a Chemical Hood

- This chemical hood working surface is too crowded
- Air flow is restricted
- Flammable material cabinet is open
- CAUSES TURBULENCE
- Vapors could escape
- Vapors could recirculate back to your face even with sash lowered

Emergency Room and Hood Purge

- Room Purge: For spills inside the room
- Chemical Hood Purge: For spills inside the chemical hood

Know the location of and how purge buttons work in your lab

General Lab Rules

No Food or Drink in the Laboratory

- No water bottles
- No food related containers in lab trash
- No cosmetics
- No hand creams
- No chewing gum
- No handling contact lenses

Wear Appropriate Clothing

- Long pants
- Closed toe shoes
- Cotton shirt
- Tight clothing can trap chemicals next to the skin
- Very loose and dangling items can get caught on items and cause accidents
  - Tie back long hair
  - No shorts, no sandals
  - No cell phone use, no ear buds
- Remember that synthetic materials are flammable

Maintain a Neat and Orderly Workspace

- Never leave razor blades, needle & syringes, and other sharps on open bench.
- Place in covered container

Glassware

- Cuts from broken glassware is the most common injury
- Never push hard against glass – it will fail
- When washing glassware it becomes slippery
- Hold glass pipettes close to the bulb when attaching
- Use tongs or a brush and dust pan to pick up broken glass and place in “Glass Only” box
Heating Flasks
- Use aluminum blocks, sand baths, or metal beads instead of oil.
- If you must use oil, use only silicone oil (not mineral oil) and change it frequently so that it is not discolored.
- Use only alcohol thermometers – no mercury thermometers allowed.
- Keep thermal gloves readily available.

Chemical Compatibility and Handling
- Check chemical compatibility:
  - For proper storage (i.e., do not store acids with bases, no oxidizers with flammables or organics, etc.).
  - Before Handling and Combining.
  - Before combining used chemicals in waste containers.
- Refer to the UMass “Lab Safety Manual / Chemical Hygiene Plan” (EH&S Website) to check chemical compatibility.
- Oxidizers Do Not Go With Flammables.
- See Handout for Example of Compatibility Chart.

All Containers Must Be Covered
- Containers need to have lids, caps, stoppers, parafilm, watchglasses, etc. when not in use.
- 5 gal. pail pumps should have adapter caps.

Acutely toxic compounds
- Be aware of common lab chemicals with acute toxicity:
  - Acrolein.
  - Potassium cyanide, sodium cyanide, copper cyanide.
  - Hydrogen fluoride (HF).
  - Nitrogen dioxide (NO₂).
  - Osmium tetroxide (OsO₄).
  - Sodium azide (used as a preservative).
- Handle with great care in a fume hood and always wear a lab coat, gloves and safety glasses.
- Follow written protocol approved by ICSC.
- Be aware of any special emergency procedures (e.g., calcium gluconate for HF).

Peroxide Formers
- Certain chemicals can form explosive peroxides with long storage and exposure to light and air.
- Check SDS’s for descriptions such as “Forms explosive peroxides”.
- Do not store longer than 3 months to 1 year after opening.
  - Containers should be marked with the date received, opened, and an expiry date.
  - Dispose of promptly after expiry.
  - Check for crystals – if present DO NOT OPEN (Call EH&S for disposal).
  - Test for formation of peroxides with test strip every 3 months.

Examples of Peroxide Forming Chemicals on Campus
- Most ethers:
  - Diethyl Ether.
  - Tetrahydrofuran (THF).
  - Dioxane.
  - Methyl Acetylene.
  - Acetaldehyde.
  - Vinyl Acetate.
  - Methyl Isobutyl Ketone.
  - Tetrafluoroethylene.
  - Chlorohexene.
  - Acetal.
  - Butadiene.
  - Acrylonitrile.
  - Vinyl Acetate.
  - Methyl Isobutyl Ketone.
  - Tetrafluoroethylene.
  - Chlorohexene.
  - Chloroprene.
ABC’s of Safety with Dilutions

**Acid or Base**

- Pour Slowly
- Into
- Container of Water
- More Concentrated
- Less Concentrated

Moving chemicals

- Use a cart with side rails and secondary containment

Personal Protective Equipment (PPE)

Select the proper Personal Protective Equipment:

- At a minimum properly sized:
  - Safety glasses or goggles
  - Lab coat
  - Correct gloves for the hazard
- Additional PPE:
  - Respirator
  - Face shield
  - Cryogenic gloves
  - Thermal gloves
  - Apron

Lab Coats

- All lab personnel must wear a lab coat when working in the lab with hazardous materials
- EH&S will size and fit you for a proper lab coat
- Labs with a fire potential must use a blue, flame retardant lab coat (Polymer Science, Chemistry)
- Lab coats can be laundered by dropping off in designated location in each building. Courtesy coats are available for use until your coat is returned.
- Each PI/Department/College must pay the initial cost of the lab coats; laundering is free.

Examples of Gloves Types

- Use the correct gloves for the chemical & task and inspect before use
- Contact EH&S if you need help selecting the proper glove or experience sensitivity
- Do not reuse disposable gloves
Improper Glove Use

Don't wear gloves outside the lab

Hand Washing

- Single most important way to prevent infection and contamination
- Avg. person touches face 60 times per hr.
- Always wash hands
- After removing gloves and before leaving the laboratory

PPE: Respirators

- EH&S must evaluate your work environment to assess the need for a respirator prior to use.
- If one is needed University Health Services will evaluate your physical ability to use a respirator
- EH&S will provide a fit test to ensure proper fit and training to ensure proper use.
- Contact EH&S to discuss your needs

Special Hazards: Gas Cylinders

- Cylinders must be securely fastened to an immovable object or table at all times (storage and in use)
- Leak check the system using a soap solution
- Toxic gases must be in vented gas cabinets or hoods
  - E.g., carbon monoxide, hydrogen sulfide, ammonia, chlorine, ethylene oxide, nitrogen dioxide

Gas Cylinder Video

Cryogenic Liquids - Nitrogen, Helium

- Hazards from contact with very cold liquid or vapor
  - Freezing of tissue (frostbite)
  - Asphyxiation due lack of oxygen from rapid expansion of liquid to gas
    - 1 L of liquid = 700 L of gas
  - Symptoms as Oxygen level decreases might include
    - Decreased ability to work strenuously, impaired coordination, light headedness when bending, mental fatigue, feeling confused
    - Rapid breathing, poor judgement, lips turn blue
    - Nausea, vision impairment
  - Loss of consciousness
  - If you experience ANY symptoms – EVACUATE
  - Wear eye protection, face shield, protective glove, lab coat or cryogenic apron,往年 closes to 2 feet
  - First aid for frostbite is to gently soak the affected area in warm water for 15 mins. Always seek medical attention
Equipment for Use with Cryogenics

- Stainless steel flex hose
- Dewar plug
- **Transport** in insulated Dewar only specifically designed for cryogenic liquids. Do not use a screw top container (e.g., Thermos bottle).
- **Store** in well ventilated area

Ultraviolet (UV) Light

Overexposure to UV light can cause:
- Redness and Irritation of the eyes and skin
- Gritty feeling in eye
- Corneal and skin burn
- Cataracts and Cancer

Devices that emit UV light
- Transilluminator
- Crosslinker
- Biosafety cabinets
- Glass marked “UV Resistant” may not block UV

Use proper safety glasses that indicate UV protection
Protect skin with long sleeves and gloves

Laser Safety

- Training is required for those using Class III and IV lasers; Special training is available for carbon dioxide cutting lasers upon request
- Laser safety manual can be found on EH&S Website

No Matter What, Always Protect Yourself!

- Know hazards of what you are working with
- Follow proper work practices
- **Do not work alone** in the lab when working with hazardous materials or processes
- Use hoods correctly
- Know the location of:
  - shut-off valves (gas, water, compressed air)
  - electrical breakers / “kill” switches
- Wear Personal Protective Equipment (PPE)

  Remember things can and do go wrong!

Examples of Emergencies

- Thermal, cryogenic, or chemical burns
- Cuts, puncture wounds from glass, metal or needles that may be contaminated
- Chemical exposures, such as skin or eye contact
- Chemical inhalation or ingestion
- Vapors that irritate eyes
- Chemical spills

Emergency Response Equipment

- Fire Alarm
- Drench Shower
- Eye Wash Station
- Fire Extinguisher
- First Aid Kit

Know where this area is and how equipment works before you need it

Keep this area free from obstructions so you can reach emergency equipment
Exposure

- If exposed to chemical, biological, or radiological material stop work immediately and wash the affected area for at least 15 minutes
  - Do not ignore an exposure, particularly to hydrofluoric acid (HF)
- Use eyewash and drench showers whenever needed or when in doubt
  - Do not worry about making a mess on the floor but be careful about the slipping hazard
- Tell an authority the exact chemical being used so an SDS can be provided to medical personnel
- Also tell the fire department or EH&S if there is a chemical spill/release

Proper Use of Eye Wash

- Have someone call 911
- Activate the eye wash
- Hold eyes open and place in water stream and move eyes in all directions. Help the victim position their head and hold their eyes open.
- Flush eyes for 15 minutes

Eye wash should be activated and flushed for 3 minutes weekly so that it is ready for use. Mark the date of the flushing on the log sheet.

Proper Use of Drench Shower

- Have someone call 911.
- Stand under drench shower.
- Pull chain or bar to activate the drench shower and let go.
- Begin to remove clothing.
  - Assist if needed. Make sure it’s safe to do so.
- Flush affected area for 15 minutes.
  - EH&S will bring something to cover you.
  - Be careful as water on the floor is a SLIPPING HAZARD.
  - Don’t worry about cleaning up water, EH&S will have it cleaned up.

Exposure and Possible Injury

- Always seek medical treatment for post-exposure evaluation and/or treatment within 2 hours of incident
- Don’t hesitate, just go!
  - Go to University Health Services (UHS)
    - Tell the UHS front desk that you had a lab exposure.
    - UHS will not make you wait in line for a lab exposure.
  - Get transported to an Emergency Room by ambulance
  - Do not drive to the hospital yourself; CALL 911
    - The cost of ambulance transport to the hospital is covered
    - A ride back to campus can be arranged by UHS

Cleaning Up a Chemical Spill with No Exposure

- Contact EH&S at 413-545-2682 when any chemical spill occurs
- It may be appropriate for lab workers to clean up very small spills of less hazardous materials if instructed by EH&S
- EH&S can provide appropriate materials and can assist in spill clean-ups
- Any release of chemical to a drain MUST be reported to EH&S

Fire

- Alert all persons nearby
  - If your clothing is on fire – STOP, DROP, & ROLL
  - Evacuate the area and close the door
  - Pull the fire alarm – it will immediately bring help
  - If you can safely use a fire extinguisher – do so
  - Evacuate the building
- Call 911 or dial 413-545-3111 for UMass Police
  - Give name of building and UMass Amherst
  - DO NOT hang up until told to do so by the operator
- Go to a designated meeting place a safe distance from the building
  - Try to account for all lab members
  - DO NOT LEAVE CAMPUS
Notify EH&S & Supervisor of All Lab Incidents

- Report any event that results in a spill or release of a hazardous material
- Report any event that results in any injury
- Inform lab supervisor and/or faculty PI of all events
- Call EH&S to report incidents/accidents immediately
- Complete and submit the Lab Incident Report form to EH&S within 24 hr: http://www.ehs.umass.edu/lab-incidents-and-lab-incident-report-form
- If injured, complete and submit the Notice of Injury (NOI) form to Human Resources (HR) within 48 hours of the incident: http://www.umass.edu/humres/notice-injury-form

Satellite Accumulation Areas (SAAs)

- All Hazardous Waste must be stored in an SAA in secondary containment
- Must be located in the same room/floor where waste is generated
- Store in proper storage cabinets or in a designated area within the lab
- Use tape, placards or signs to demarcate a designated satellite accumulation area

 Managing Satellite Accumulation Areas

Each SAA Must Be Inspected Weekly!

Use dry-erase marker to write on this plastic coated form. When full, erase oldest entry and start over.

Labeling of Hazardous Waste Containers

- Mark all containers with words: Hazardous Waste
  - Use pre-made labels to avoid issues
- Indicate the hazards on each container
  - Ignitable
  - Flammables and Oxidizers
  - Corrosive • High or Low pH
  - Reactive • Reacts with water, contains cyanide or sulfide
  - Toxic

Labeling of Hazardous Waste Containers

- Chemical names must be spelled out. Chemical formulas are NOT acceptable.
- Check chemical compatibility before adding waste to a container.
- EHS has experienced exothermic reactions due to either a lack of, or an improper description of contents
- EH&S must have accurate information on materials in containers in order to make reasonable decisions on methods of disposal.
### Labeling of Hazardous Waste Containers

- If reusing original containers for hazardous waste, the original label must be removed or defaced.
  - Remove the barcode label as well and adhere it to disposal sheet record.
- If discarding material in the original container do not deface the label, but DO put a hazardous waste label on it.

### Containers Used For Hazardous Waste Storage

- The waste must be compatible with the container
- The container must be in good condition
  - No dents, cracks, broken or loosened caps
  - Pressure Venting Caps are available from EH&S for items that may evolve gases on storage (i.e., aqua regia, piranha)
- Containers must be closed except when adding waste

### Containers: Head Space

**Don't Overfill Containers!**

Refer to the Hazardous Waste Poster in the Lab for more information on how to properly fill waste containers

### Hazardous Waste Storage

- Adequate secondary containment
  - Must hold 110% of volume of largest container
- Spilled material in containment must be cleaned
- Store incompatible chemicals in separate secondary containment
- A maximum of one container per waste stream
- Keep other products and non-hazardous waste out

### Other Types of Waste That Are Treated As Hazardous Waste

- Some waste may require specific disposal
  - e.g. Silicon wafers, silica gel, ethidium bromide.
- Dispose in thick walled, plastic container with a cover
  - Or double bag waste
- Label contents
- Use hazardous waste label and describe the contents but write “non–hazardous” in “Other”
Other Types of Waste That Are Treated As Hazardous Waste

Household chemicals are classified as industrial chemicals in the laboratory.

If it is in a lab,
Do Not Dump It Down The Sink

Contact EH&S with questions regarding proper disposal of chemicals

“In Process” Containers

- In-process Hazardous Waste collection (e.g., GCs, HPLCs)
  - Label as “Working Container” include contents and hazard.
  - Stopper the flasks to prevent evaporation. Special caps available from EH&S.
  - If not in SAA, move to SAA and put hazardous waste label on when full. Call for pickup.
  - Venting EMPTY containers.
    - Evaporating hazardous waste to the atmosphere for disposal is illegal!

Solid Waste: Empty Bottles and Glass Only

- NO LIQUIDS!
  - Laboratory glassware and empty bottles should go into Glass Only box.
  - Box should have plastic liner.
  - Do not overfill.
  - Deface labels on chemical bottles.
  - Glass Only boxes are available from EH&S.
  - Request online in CEMS.
    - http://www.ehs.umass.edu/lab-supplies

Dispose of Sharps Safely

Sharps Include
  - Needles
  - Syringes
  - Razor blades
  - Lancets
  -Slides
  -Scalpels
  -Glass Pipettes
  -Micropipettes
  -Broken plastic or glassware
  -Other devices capable of cutting or piercing the skin

Don’t place needles or sharps in ordinary lab waste containers – use puncture resistant sharps containers

For disposal, request a pick-up on the EH&S website:
http://www.umass.cems.unh.edu/CEMS/RequestRemoval
Lastly, Enjoy Your Time in UMass Laboratories

- Research and learning are important, fun and exciting
- EH&S is happy to help you do it safely
- Check our website for further information  
  [www.ehs.umass.edu](http://www.ehs.umass.edu)
- Contact us at any time with questions  
  **413-545-2682**  
  (put it in your phone)