Laboratory Safety and Hazardous Waste Training

Outline of initial training required for persons in labs in CBS.
Designed to provide individuals with the initial training required under MERTKA (Minnesota Employee's Right to Know Act), the Laboratory Safety Standard (Occupational Safety and Health Administration, OSHA), and Hazardous Waste Management Standard (Minnesota Pollution Control Agency, MPCA).

This training does NOT cover training required under the Bloodborne Pathogen Standard (OSHA), Infectious Waste Control Standard (Minnesota Department of Health, MDH), the Radiation Protection Standard (Nuclear Regulatory Commission, NRC), or training for using Controlled Substances.

Training fact sheets are available from the Department of Environmental Health and Safety (DEHS) at 626-6002. They are also on the DEHS web site:
http://www.dehs.umn.edu/training/facts.html

Personal Safety

For more information: DEHS 626-2330; 626-6002
DEHS website: http://www.dehs.umn.edu
American Chemical Society website: http://www.acs.org
Emergency chemical spill response:
626-6002 during business hours; 911 at other times
Post these numbers at your lab phone
(On cell phone: you can reach campus 911 with 612-623-0303)

1. Review of hazards in the lab and some examples of each:

   chemical hazards

      health hazard -- internal (e.g. neurotoxin) vs. external (e.g. strong acid)

      flammability (and flash points)

      reactivity (what chemicals should not be mixed)

   biological hazards:

      Allergens, hazardous plant material, hazardous animals, opportunistic pathogens

      If you work with infectious agents or with human blood, tissues, etc., you will need further training on these topics. Ask your lab supervisor or call the Department of Environmental Health and Safety (DEHS) at 626-5621. You may

need to complete training covered under the Bloodborne Pathogen Standard (OSHA) and Infectious Waste Control (Minnesota Department of Health, MDH).

physical hazards
sharps and broken glass
electrical
fire
rotary
heat and steam
slippery floor surfaces

radiation hazards:
non-ionizing radiation hazards (e.g. ultraviolet light)
Ionizing radiation hazards: If you work with radioisotopes, you will need further training on this topic under the Radiation Protection Standard (Nuclear Regulatory Commission, NRC). Ask your lab supervisor or call Radiation Safety (a division of DEHS) at 626-6764.

2. How to prepare for and protect yourself in the lab:

know the hazards

Overall help: Research Safety Officers (RSOs):
- College: Jane Phillips janep@umn.edu
- BMBB and BTI: Mark von Keitz vonkeitz@cbs.umn.edu
- GCD: Kristen Evenson, evens024@umn.edu, 4-9726
- EEB: Jacques Finlay jfinlay@umn.edu
- PBio: Kate VandenBosch vande102.umn.edu
- General Biology: Richard Peifer rwpeifer@umn.edu
- Itasca: Jon Ross: rossx008@umn.edu
- Cedar Creek: Dale Krueger: krueger@lter.umn.edu

for chemicals:

finding out about the hazards and how to work with them:

Laboratory Safety Standard, Laboratory Safety Plan, MSDS, labels, reference books AND where each of these can be found in the College, department, and individual laboratory

Prudent Practices in the Laboratory: Handling and Disposal of Chemicals. 1995. National Research Council. Available from National Academy Press, 2101 Constitution Avenue NW, Washington, DC 20418. $55. For 5-24 copies shipped to one address, 15% discount. For 25-500 copies shipped to one address, 25% discount.

If you are using the same chemical you have been using before, but it is in a new protocol (e.g. adding different reagents to it, using a different temperature) or a SCALED-UP protocol, be sure you review the hazards of the chemicals.

important items to note:

Dose-response relationship

the physical and health hazards of chemicals (i.e. what the hazard's effect is on humans e.g. neurotoxic, teratogenic, irritable to skin or mucous membranes; this information can be found on MSDS sheets)

PELs (Permissible Exposure Limits) and TLVs (Threshold Limit Values) defines inhalation exposure permissible for 15 minutes and 8 hours

values can be helpful as a measure of relative inhalation hazards of chemicals

e.g. pyridine has a PEL of 5 ppm; it is detected as a nauseating odor at 0.23-1.9 ppm (individual differences), but does cause olfactory fatigue. So if you smell it, you are probably in danger of over-exposure.

Compound	PEL (ppm)	odor detection (ppm)
pyridine	5	0.23 -1.9
formaldehyde	1	1
toluene	200	0.16-37
phenol	5	0.06
acetone	1000	33-700

toxicity measurements: e.g. LD_{50}, ED_{50}

Compound	LD_{50} (mg/kg) oral, rat
Sodium azide	27
acrylamide	124 **
phenol	317
formaldehyde	500
carbon tetrachloride	2350
toluene	2650-7530
acetone	5800
ethanol	7060
DMSO	14,500
ethidium bromide	not thoroughly investigated

**So, for a 150 lb (68 kg) person, the LD_{50} is 68 X 124 mg = 8.4 g. But the dose at which SYMPTOMS may occur is much lower (ED_{50} much lower)

Relative Toxicity Rating vs. LD50 values (from MSDS values)	
High toxicity	<500 mg/kg
Moderate toxicity	500-<7500 mg/kg
Low toxicity	7.5-15 g/kg
Non-toxic	>15 g/kg

signs and symptoms associated with exposures (acute vs. chronic)

Again, using pyridine as an example, early exposure symptoms are irritation of the respiratory system and involvement of nervous system (so headaches, nausea, vomiting, dizziness, nervousness). Long term exposure leads to liver and kidney damage.

methods to detect presence/release of chemical in lab

If you routinely use pyridine, you would be wise to invest in a personal monitoring badge which detects pyridine vapors (available from vendors such as Lab Safety Supply; 800-356-0783). There are badges available for a wide variety of volatile compounds. Some badges detect specific chemicals, some more respond more broadly (e.g. to organic chemical exposure); DEHS can do time-weighted air sampling

for equipment: read warning labels on equipment

measures to protect yourself in the lab

do not block emergency equipment in your lab

reduce duration and frequency of exposure (including using smaller volumes)

use protective devices

safety glasses/goggles, gloves (and what kind), fume hoods, pipetting devices

Some points to remember about fume hoods:

1. Use the fume hood for all toxic, volatile, and flammable chemicals.
2. The fume hood only works well if the sash is between you and what you are working on. Never use the sash above its sash lock. The override is only there so you can move large equipment into and out of the hood.
3. Even though the fume hoods are checked regularly by DEHS, a fan belt can break anytime. Therefore you should check that there is airflow into the hood before each use. One way to do this is to keep a strip of tissue taped to the bottom ledge of the hood. A working fume hood should keep that tissue fluttering upward.
4. Air currents disrupt the efficiency of the fume hood – so put hands in and wait before beginning work, remove hands slowly so you do not draw the toxic material out with you, don't have people walking behind you or opening/closing doors around you as you are using the hood.

check protective devices (quarterly fume hood inspection by DEHS,
annual safety shower inspection by DEHS;
weekly eyewash inspection by laboratory personnel;
annual fire extinguisher inspection by DEHS)

follow standard operating procedures (general and specific SOP's and where to find them)

plan lab carefully, work attentively

no food or drink is allowed in labs

Autoclave safety:

Liquids:

- use self-venting closures
- use heat-safe containers (e.g. Pyrex, Kimax)
- never fill the container with more than 80% of its total volume (allows room for expansion as the temperature increases)
- always use the liquid cycle (slow exhaust) for liquids

- never move a container in which the liquid is boiling or bubbling as the movement may cause the liquid to explosively boil over

Steam and hot materials

- Wear safety goggles when opening the autoclave
- Allow the autoclave's steam to vent out the open door before you put your hand/arm in
- Handle all hot materials with appropriate protective gloves

Don't work with hazardous materials when you are alone. Be sure someone is within earshot of any trouble.

3. Proper storage of chemicals

Compatible and incompatible chemicals (complex)

Use of containment trays
(e.g. Stores: CX18999 $10 per tray, will hold four 1 gallon bottles.)

Volatile chemicals must be stored where there is proper ventilation

4. How to handle an accident

for all, first evaluate severity

what is (or should be) available; where to get help; emergency numbers should be posted at the phone in each lab.

Specific examples:
chemical spill

large spill:
evacuate (alert others, leave)
confine (close doors, isolate the area, keep people out)
report (6-6002; 911)
secure (post warning signs, post staff)

biological hazard spill

physical injury

radiation injury

dual hazards... how to deal with them

General principles of working safely besides chemical use:

- Drive safely, wear your seatbelt
- Clean up wet floors
- Be careful around hot materials (autoclaves, hot water baths, ovens)
- Do not try to lift more than you can
- Use solid supports for reaching items above your head (never step on a chair with wheels)
- Look at electrical cords and get them replaced if frayed
- Separate electricity and water (or use ground fault circuit interrupters)
- Work safely with fire or use an alternative.

5. When an accident occurs:

   Reporting an accident: incident forms are available in department offices; fill them out with your "supervisor" as soon as you can, turn them into department office

   Getting medical care: Boynton Health Services, your health care provider, and workman's compensation issues (see http://www.fpd.finop.umn.edu/groups/controller/documents/main/rmi_contents_wc.cfm)

6. What are the hazards you will be faced with in your laboratory?

   This is specific to EACH lab, supervisor must be involved in this discussion. See attached sheet for some questions you may want to ask during this discussion.

7. Annual retraining requirements

Environmental Safety (hazardous waste handling)

For more information: CWP 626-1604

(hazwaste training slide show: http://www.dehs.umn.edu/training/hwd/generator/)

Emergency chemical spill response:
626-6002 during business hours; 911 at other times
Post these numbers at your lab phone

1. Definition of hazardous waste: Review and a few examples

   Hazardous by characteristic (e.g. flammable, oxidizer, corrosive, reactive, lethality, toxicity)

   Examples of hazardous waste:
   - laboratory chemicals
     - ethidium bromide; EtBr-contaminated gels -- see attached sheets on EtBr disposal
     - acrylamide and polyacrylamide
     - strong acids and bases
     - metals (Ag, Hg, Cu)
     - mixed wastes (such as wastes from protein assays) "Mixed" has a SPECIFIC meaning here... it means that the waste includes chemicals with different DDC (drum designator code) numbers.
   - mercury (especially thermometers)
   - photo-fixer, photo-developer, film
   - rinsewater from "Chromerge" solutions
   - batteries
   - circuit boards and color monitors
   - fluorescent and HID lamps
   - paint, wet paint filters
   - oil, oil filters, antifreeze
   - paper and cloth rags containing solvents
   - sharps
   - contaminated media (petri plates, broths) -- see attached flow chart for infectious waste

2. Hazardous waste management procedures

   General guidelines:

   Minimize waste by changing protocols
   Get help from colleagues, literature, professional societies, Waste Abatement Committee(6-6216), Minnesota Technical Assistance Program (MnTAP, 612-627-4646)

   Use chemicals no longer needed by others... Chemical Recycling Program: See DEHS Gopher (available from their website), Environmental Protection folder

Do not dispose of hazardous chemicals to the sewer unless you have WRITTEN permission to do so (DEHS 626-1604 for approval). Ethanol (and no other alcohols) may be disposed of in the sewer if its concentration is less than 5% by volume in water. You cannot dilute ethanol to reach this concentration.

Do not dispose of hazardous waste in the normal trash. If you are unsure if something is hazardous, call CWP at 6-1604 for help (or e-mail hazwaste@umn.edu)

Some items of non-hazardous waste should be specially treated before disposal (e.g. yeast extract is non-hazardous, yet it poses a respiratory dust hazard... so mark bottle as non-hazardous, but double-bag it before putting into trash.)

Do not dispose of volatile hazardous waste by evaporating it in the hood.

Chemical Waste

University of Minnesota Hazardous Chemical Waste Management Guidebook
If you do not have the 5th edition (1996), you can order it from Stores (free!) number GS99973.

Choosing hazardous waste containers

size -- allow for expansion of liquids

material -- must be compatible with hazardous waste

closure -- must be compatible AND leakproof
-- container must be closed at all times except when adding or removing waste. It is NOT okay to leave the container open
with a funnel in it for additions.

where to purchase -- Stores has a variety of containers available, as do the scientific supply companies. You can also reuse empty containers (e.g. empty acid containers) after they have been washed.

Labeling of hazardous waste storage containers

Must be labeled with words "Hazardous Waste"
Must contain description of the waste, including all inert ingredients; also list pH and presence of any precipitate, sludge, etc.
Must have accumulation START date on it
Must have FILL date on it – 90 days recommended; 1 year maximum
Must contain the Name and Phone number of the waste generator
Must have Department and Building number (see appendices X and XI)
Biosci is 411, Snyder is 352, Ecology is 438, Gortner is 410, Cargill MPG is 439, MCB is 186, BSBE is 178.
Department number is three digit CUFS code

FREE labels available, call DEHS at 624-6060 or you can make your own.

Unused portions of reagents or unopened reagent containers do not need HazWaste label. Package these like waste, but check the "Recy?" box on the manifest. They will be redistributed to labs that want them.

Special Waste Processing: See the guidebook or call 6-1604 for special help with wastes which are unlabelled, compressed gasses, water reactive (DDC code ends in WS), shock sensitive (DDC code ends in SS), pyrophoric (PYR in comments section), cyanide generating (DDC code ends in CN), or peroxide generating (PRX in comment section)

Storage and secondary containment of hazardous waste containers

compatible vs. incompatible wastes

segregate wastes by DDC (drum designator codes) found in Guidebook

secondary waste containers/containment trays

specifications

must be large enough to completely contain the material in the waste container(s) in it should container leak or spill

must be compatible with the hazardous waste

where to purchase

Stores: e.g. CX18999 $10 per tray, will hold four 1 gallon bottles. More info, call Stores at 4-4878. Or you can use photo trays, RubberMaid trays – whatever.. just be sure it is compatible with waste being contained AND is large enough to contain the entire volume of the spill.

Container inspections

Any containers that are "offsite" (e.g. not in the lab you work in daily), must be inspected WEEKLY for leaks, spills, proper labeling, compatibility, and secondary containment. These inspections (and any problems and corrections) must be DOCUMENTED. Call DEHS for sample inspection forms (626-7744).

Packing and disposing of hazardous waste

1. Segregate wastes by DDC number (drum designator codes) found in Guidebook

2. Get boxes and packing (e.g. newspaper from the recycling bins) for packing the wastes.... you can pack containers with the same DDC number in the same box, but you CANNOT pack containers with different DDC numbers in the same box. Following this logically, when you have mixed waste (e.g. from a chemical reaction) in a bottle, it will have to be packed separately from all other waste bottles.

3. Package the waste upright in a sturdy box, with no glass-to-glass contact (use newspaper or foam to separate)

4. Fill in waste manifest forms (available from DEHS). Be sure you have put in your department NUMBER (three digit CUFS code)

   One form needed per box of waste

5. Pack in boxes by DDC number

6. Tape blue copy of manifest onto the box. Attach copy of MSDS sheets for all trade chemicals (don't have the MSDS sheet? Call the manufacturer for one.. next time get the MSDS sheet BEFORE you use the chemical so you know all the facts about safe use of it.)

7. Put boxes in appropriate area (e.g. hood or ventilated cabinet such as that below the hoods if there are volatile wastes.) Boxes containing liquid wastes must also be in secondary containment trays.

8. You might want to make a copy of the manifest (for the occasional "lost in campus mail" event... otherwise you'll have to untape the blue copies and make copies then...)

9. Send top two copies of the Waste Manifests to Chemical Waste Program office (address is on the manifest)

10. Wait for them to pick up.

11. If they have not picked up in a month... call Chem Waste to find out why not....

<u>Other hazardous waste and where/how to dispose of it</u>

batteries -- loading docks, inquire in department office

fluorescent light bulbs -- put out for custodial staff to take

contaminated media -- see attached sheet on infectious waste

sharps -- needles, syringes, scalpels, pasteur pipettes contaminated with human tissue or fluids must be put into a "sharps" container. Sharps containers available from Stores CX40248, p. 147.

infectious waste -- see attached flow chart

broken glass – broken glass container (sturdy cardboard box with heavy plastic bag insert. Box labeled "broken glass"). Can also purchase containers from vendors. When full, tape shut and put next to regular trash.

3. Spill procedures

Be sure your lab has appropriate materials and protocols for cleaning up spills (see Prudent Practices in the Laboratory for help). Basically, the response should be:

If the spill is within your capabilities to clean up:

Alert all workers in the area
Confine the spill
Clean-up the spill
Dispose of the clean-up material appropriately (e.g. through HazWaste procedures)

If the spill is beyond your capabilities to clean up:

Alert all workers in the area
Evacuate the area
Confine the area (close the doors; if your lab ventilation system is working correctly, the fumes should NOT come out under the door.)
Report the spill (6-6002 during business hours; 911 from campus phone at other times)
Secure the area (keep people from going back into the lab by posting signs and staff)
Wait for DEHS/CWP to complete the clean-up

4. Lab audits

5. What are the hazardous wastes generated in your lab and who is responsible for their ultimate disposal?

6. Annual retraining requirements

Your Research Laboratory -- Questions to Ask

1. What is the location and use of safety equipment (e.g. fire extinguishers, chemical hoods, personal protective devices, safety showers, eyewashes, first aid, circuit box if power must be cut, phone for calling 911)?

2. Who is responsible for answering any safety-related questions I may have while working here?

3. What is the fastest route out of this building in case of fire? What is an alternative route?

4. What are the lab's procedures for discard of hazardous waste (chemical, radiation, and biological)?

5. Do I have to take any additional training courses (e.g. radioisotope training, infectious materials handling, bloodborne pathogen training) before beginning work?

6. Is there a list of equipment and materials with locations indicated for this lab? If not, who should I talk to when I am looking for something?

7. What are the lab's procedures for use of common equipment and clean-up of shared space, equipment and materials?

8. What and where are the water sources in this lab (i.e. distilled, deionized, ultrapure, tissue-culture grade)?

9. Are there any other lab rules, policies, or procedures I should be aware of?