



ENVIRONMENTAL HEALTH & SAFETY

<http://www.dartmouth.edu/~ehs/>

ESSENTIAL INFORMATION ON LABORATORY SAFETY AT DARTMOUTH COLLEGE

Emergencies

Always call from a safe location

Fire or Medical 911

(DMS@DHMC/Hospital Complex dial 5555)

Biological, Chemical or Radiological: 646-1762

Emergency Pager for Nights and Weekends: (603) 442-1058

After the pager prompt, enter all seven digits of the phone number you want us to call in return and wait for the pager confirmation.

Remain near the phone and an EHS staff member will call as soon as possible.



In the Event of a Fire

If you see smoke or flames...

Use C.A.R.E.

Contain the fire by closing all doors.

Activate a fire alarm. Fire alarm stations are located near all exits out of the building.

Report the fire by dialing 911 (DMS@DHMC/Hospital Complex dial 5555).

Evacuate or extinguish. In most cases, it is best to leave the building using the nearest fire exit.

Only use a fire extinguisher when ...

- you are trained and capable.
- there is limited smoke or flames.
- you have the proper extinguisher for the type of fire you are fighting.
- you have your back to an unobstructed exit.
- everyone has safely left the area.

Never fight a fire if it has left its source of origin. Never fight a fire if you are unsure of the type of extinguisher available or you lack a safe exit should your efforts fail. If you cannot extinguish the fire in less than 30 seconds, then immediately abandon your efforts, close the door(s), activate the alarm, report the fire and evacuate immediately.

EVACUATION

On the **main campus and in all other research buildings not part of the DHMC/Hospital complex**: leave the building when you hear the alarm.

In the **DHMC/Hospital complex**: the public address system provides emergency announcements. Flashing strobes indicate that the alarm is in your immediate area. If the light strobes are flashing, then listen for further announcements and be prepared to evacuate. If the alarm sounds but the strobes are not flashing, please remain alert until an "all clear" announcement.

Note to Principal Investigators: each office, lab or work group must develop an evacuation plan. An effective plan includes primary and a secondary evacuation routes with a designated meeting area outside the building. Please make sure everyone knows the gathering spot and discuss it periodically during staff meetings. This location must be far enough away from the building to ensure personnel safety and avoid blocking building access by emergency personnel.

Your evacuation plan must also include a way to account for everyone when leaving the building. This must also include pre-planning for individuals needing assistance out of the building.

EMERGENCY AND EVACUATION REMINDERS

- Do not "investigate" the source of a potential fire or hazardous material emergency by opening doors or lingering. If you suspect an emergency, report it! In any emergency, reporting is the first essential step to protecting yourself and others.
- As you leave, **close all doors behind you** to limit the movement of smoke, flames or noxious odors.
- Walk to the nearest safe exit out of the building.
- Do not use an elevator to exit a building during a fire alarm.
- Gather at your designated area. Do not block entrances.
- Supervisors should account for all staff members.
- Do not re-enter the building for any reason once you have left. (Emergency personnel will let you know when it is safe to re-enter.)
- Ensure at least two directions of travel out of any point in the laboratory--especially around chemical fume hoods and dangerous equipment.

FIRE PREVENTION

The best defense against fire is vigilance and prevention. There are a number of things you can do prevent fires.

- Do not use space heaters.
- Smoke only in designated areas-outside and well away from the building. Properly extinguish all smoking materials.
- Do not block exits or fire extinguishers. Maintain a one (1) meter clearance.
- Do not obstruct sprinkler heads or fire detection devices.

- Maintain a minimum clearance distance-one (1) meter-around fire extinguishers, overhead fire sprinklers and smoke/heat detectors.
- Limit the use of extension cords and power strips.
- Shut off electrical equipment at the end of the day and when not in use.
- Check for frayed wires and missing grounding plugs on all equipment.
- Label and date damaged equipment "Out of Service". Use heavy-duty tape to cover electrical plugs in order to prevent further use by others.
- Plug large equipment such as refrigerators and microwave ovens directly into a wall outlet. Never use extension cords or power strips for high current devices.
- Store flammable liquids in an approved flammable storage cabinet (UL® or FM® listed).
- Store all combustible material(s) such as paper or plastic at least one meter away from a heat or ignition source.

FIRE EXTINGUISHER TRAINING

Fire extinguisher training covers fire safety basics along with an emphasis on the types of fire extinguishers and their proper use. This training involves the "hands on" use of extinguishers with a controlled fire.

To schedule fire extinguisher training for your group contact EHS at 646-1762.

LABORATORY SAFETY AND COMPLIANCE TRAINING - MANDATORY REQUIREMENTS

For all lab personnel including:

• PI's • Technicians • Post-docs • Graduate Students
Undergraduates Working in Research Laboratories • Visiting Scientists • Volunteers

Training is required under various Federal and State Rules and Regulations.
Computer based training modules are all available through the EHS web site:

<http://www.dartmouth.edu/~ehs/>

Biomedical [Molecular Biology] Lab Safety

Mandatory for all personnel working in a biomedical/molecular biology laboratory. (This includes all DMS laboratories, Biology, Biotechnology Groups in Chemistry or Thayer School.) An introductory program on laboratory safety in a biomedical/molecular biology lab at Dartmouth College. Note: This program is a prerequisite for the Biological Safety Level 2 course.

General Laboratory Safety

Mandatory for all personnel working in a laboratory in the Arts and Sciences (Chemistry, Earth Sciences, Physics, Environmental Studies) and Thayer School of Engineering. This course does not emphasize molecular biology.

Management, Minimization and Disposal of Hazardous Chemicals

Provided via the EHS web site. This course is mandatory for all individuals working with chemicals in a laboratory. This training must be current within three years.

Radiation Safety-Basic

This training is for all individuals who will be working with radioactive materials or other sources of ionizing radiation.

Radiation Safety-Retraining

Provided via the EHS web site. This is an annual training requirement for all personnel working with radioactivity. This training is not a substitute for the basic radiation safety training.

Radiation Safety--X-Ray Users

Provided via the EHS web site. For all individuals working with equipment that generates ionizing radiation. The Radiation Safety-Basic course is a prerequisite.

Laser Safety Training

Provided via the EHS web site. For all individuals working with Class II and above lasers.

Biological Safety Level 2 Training

This training is for all individuals who will be working with human blood or other potentially infectious materials at Biosafety Level 2 (BSL2). This also includes recombinant DNA (rDNA) experiments that require registration and prior (or simultaneous) approval of the College's Institutional Biosafety Committee. Note: you must complete the Biomedical [Molecular Biology] Lab Safety course prior to attending this course.

Biological Safety Level 2-Retraining

Provided via the EHS web site. This is an annual training requirement for all personnel working at Biological Safety Level 2. This training is not a substitute for the introductory BSL2 lecture.



Essential Information on Regulatory Compliance:

- Register your laboratory with EHS
 - Biological (rDNA and pathogens)
 - Chemical
 - Radiological/Laser
- Complete the necessary training
- Manage hazardous materials wisely
- Ensure new personnel are trained
- Maintain good housekeeping
- Call EHS whenever questions arise

IN THE EVENT OF A HAZARDOUS MATERIAL INCIDENT

Isolate the problem!

If you know or suspect a spill has occurred, isolate the problem by closing doors and keeping others away.

If the problem is (1) known, (2) limited and (3) within your ability to clean-up, then use the spill kits provided by EHS.

If the problem is unknown or beyond your ability, isolate the area and request assistance.

Leave the immediate area, close the door(s) and contact EHS. In the event of a fire or medical emergency, dial 911 (DMS@DHMC/Hospital Complex dial 5555).

Biological Exposures (BSL2 agents/human blood and body fluids)

Wash skin thoroughly with Povidone Iodine (generic Betadine®) or antimicrobial soap and water.

Immediately irrigate the eyes and mucous membranes with large volumes of water. Seek medical attention and post-exposure follow-up. For less serious situations, render first aid and report the exposure to EHS. Complete an accident report.



Chemical Exposures

Immediately flush the area with large volumes of water. While flushing, remove contaminated clothing. Call 911 for medical assistance (DMS@DHMC/Hospital Complex dial 5555). For less serious situations, render first aid and report the exposure to EHS. Complete an accident report.

Radioactive Materials

For skin contamination, wash with soap and water--use care to avoid damaging the skin. Avoid spreading contamination. Notify EHS immediately. For detailed decontamination procedures go to the "Lasers & Radiation Safety" section of this calendar.



ESSENTIAL INFORMATION ON THE SELECTION AND USE OF CHEMICALLY RESISTANT GLOVES IN THE LABORATORY

Rule One All gloves are permeable!

- *Permeation* describes how a chemical(s) can pass through a glove material. Oftentimes this happens without a visible change in the glove or the sensation of a leak.
- *Breakthrough* describes the time lapsed between first contact outside the glove and detection of the chemical inside.
- *Permeation* depends on the chemical(s) handled and the composition, thickness and condition of the glove. Permeation also depends on the extent and length of contact with the chemical(s) and amount of hand/glove flexion.
- *Degradation* (a measure of a gloves tendency to swell, discolor or otherwise change due to chemical contact) is another factor to consider but secondary to permeation.
- Links to permeation data are found under Chemical Safety on the EHS Web Site.

Rule Two All gloves are not created equal!

- Plastic laminate gloves (such as Silver Shield®) offer protection against a wide range of hazardous chemicals. The potential limitations of laminate gloves include reduced dexterity, sensitivity, the ability to grip when wet and tear/puncture resistance.
- Sometimes the ideal glove is actually two gloves worn together. Wearing one pair of gloves (such as reusable nitrile, latex, neoprene, butyl or Viton®) over a flexible laminate combines the advantages of both. When using this approach -- be sure to use the smallest laminate size that will fit comfortably.

Rule Three Care for your reusable gloves!

- In the lab, most chemical handling does not require immersion or extensive/prolonged contact. It is usually not necessary to replace heavy-duty (reusable) gloves each time they are used but it is important to rinse them off and allow to dry. Contaminated gloves may be a potential source of chemical exposure rather than the intended means of protection.

- Before removing reusable gloves, rinse them off thoroughly with warm water, and hang to dry. Replace reusable gloves whenever they become discolored (a sign of degradation and inevitable permeation) or show signs of physical damage (cuts, tears or holes). If you suspect that reusable gloves are contaminated, then replace them immediately. Gloves contaminated with hazardous chemicals are hazardous waste--please bag and set aside for disposal through EHS.

Rule Four Know both the advantages and limitations of disposable gloves!

- Disposable gloves provide effective barrier protection when working with biological materials and radioisotopes. Disposable gloves are also great in helping to prevent the contamination of glassware and equipment. For routine tasks involving non-hazardous chemicals, disposable gloves allow dexterity, convenience and low-cost but offer only limited protection against chemical exposure.
- Hazardous or aggressive chemicals quickly attack disposable gloves-giving you little or no protection. If disposable gloves become contaminated-remove immediately, wash your hands thoroughly and put on new gloves.
- Do not use latex disposable gloves since they may cause sensitivity or allergic reactions.
- Do not re-use disposable gloves!
- Properly remove disposable gloves. Remove the first glove by grasping the outer cuff with your other gloved hand. Roll the first glove away from you and into a ball. Then, with your now ungloved hand, reach to the interior cuff of the second glove and roll it away from you into a ball.



ESSENTIAL INFORMATION ON THE SELECTION AND USE OF PROTECTIVE EYEWEAR

Glove Materials

• Reusable, Nitrile

Nitrile protects against a wide-range of chemicals with excellent puncture and abrasion resistance. Reusable nitrile gloves are ideal for a variety of lab applications -- from washing glassware to chemical protection -- the one glove type that every lab should have available.

• Reusable, Flexible Plastic Laminate (PE/EVOH)

Worn under a reusable glove, a plastic laminate provides an effective permeation resistant liner for work with particularly hazardous or aggressive chemicals. When in doubt, always wear a laminate beneath a reusable glove for maximum permeation resistance and chemical protection.

• Reusable, Neoprene

Neoprene provides a broad range of chemical resistance to many solvents and corrosives. Properly sized, neoprene gloves offer improved tactility and dexterity with excellent chemical protection.

• Reusable, Butyl

Butyl provides excellent gas and water vapor protection. Butyl is the best choice for esters and ketones.

• Reusable, Viton®

Viton® provides excellent protection against aggressive chemicals including most aromatic and chlorinated solvents.

• High(er) Quality Disposable Gloves (usually Nitrile or Neoprene)

Provide increased--but still limited--chemical resistance with improved puncture and tear resistance when compared to less expensive disposable gloves. Often hypoallergenic, these improved disposables provide a superior choice as barrier protection with potentially infectious materials.

Safety Glasses

- Polycarbonate safety glasses protect against flying objects and debris while providing limited splash and spray protection. Polycarbonate lenses provide some UV resistance. All safety glasses must be ANSI Z 87 compliant.
- Note: unless both the lenses and frames are Z 87 compliant, prescription glasses are not effective eye protection.

Splash Goggles

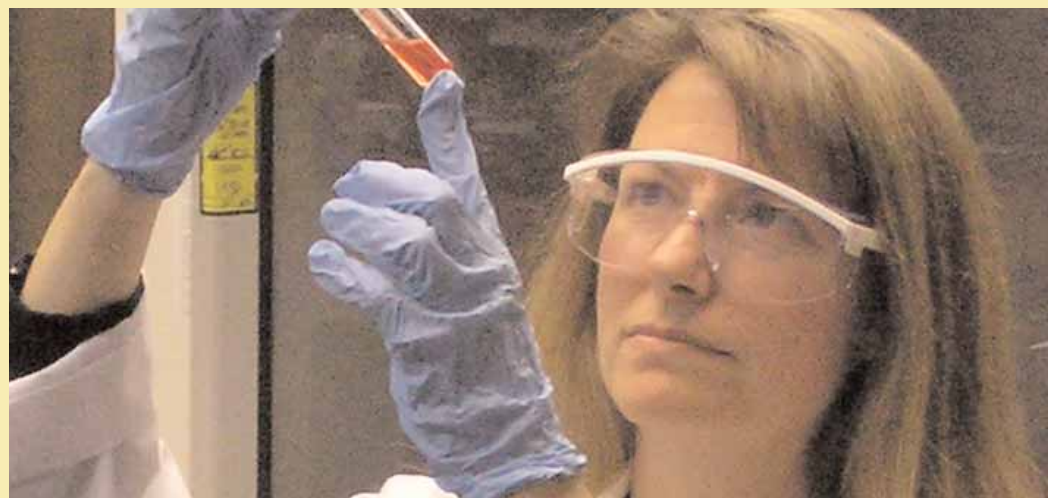
- ANSI Z 87 compliant splash goggles provide increased impact and splash protection by surrounding the orbit of the eye. When increased eye protection is needed, wear splash goggles.

Face Shields

- ANSI Z 87 compliant face shields provide an additional protection to the eyes and face.
- Note: a face shield alone is not adequate eye protection! You must also wear ANSI Z 87 safety glasses or splash goggles when using a face shield.

Specialty Eyewear

- The selection and use of laser eyewear depends on the laser type and wavelength. Contact the Radiation/Laser Safety Officer for assistance in selection and use.
- There are other forms of eye protection for special needs--simply call EHS for assistance.



Gloves/Eye/Face Protection

PHYSICAL HAZARDS



Electrical Safety

- Check for frayed wires and missing grounding plugs on all equipment. Have questionable cords repaired by a qualified person.
- Label and date damaged equipment "Out of Service". Tape electrical plugs to prevent connection to a power source.
- Extension cords are not a permanent wiring solution. Contact facilities to install a permanent outlet.
- Avoid power strip and extension cord combinations.
- Check electrical equipment at the end of the day and turn off equipment not in use.
- Do not block access to electrical panels-maintain at least one meter of clearance in all directions.

Cryogen Safety

- Prevent all contact with cryogenic liquids. Protect your eyes and exposed skin, including feet. Cryogenics freeze tissue on contact and can cause permanent damage.
- Handle and store cryogenics in well-ventilated areas. Cryogenics easily displace oxygen and pose an asphyxiation hazard.
- At a minimum, wear approved safety glasses for small volumes. Approved splash goggles provide better protection by surrounding the eyes. For greatest protection when pouring or transferring cryogenic liquids, wear splash goggles with an approved face shield. All eye/face protection should be ANSI Z.87 compliant.
- Wear heavy-duty leather gloves or special cryogen gloves. Use tongs to handle frozen objects.
- Never store cryogenics in sealed containers since this can cause a rupture or an explosion. Ensure pressure relief mechanisms are open and kept clear.





High/Low Pressure or Temperature Work

The failure of temperature, vacuum or pressure vessels can be sudden and catastrophic – so always prepare for the worst.

Use portable shields and fume hood sashes as a physical barrier and wear appropriate eye/face protection.

Never use glass containers above 100 psi. Glass should be plastic coated or taped/covered in the event of failure.

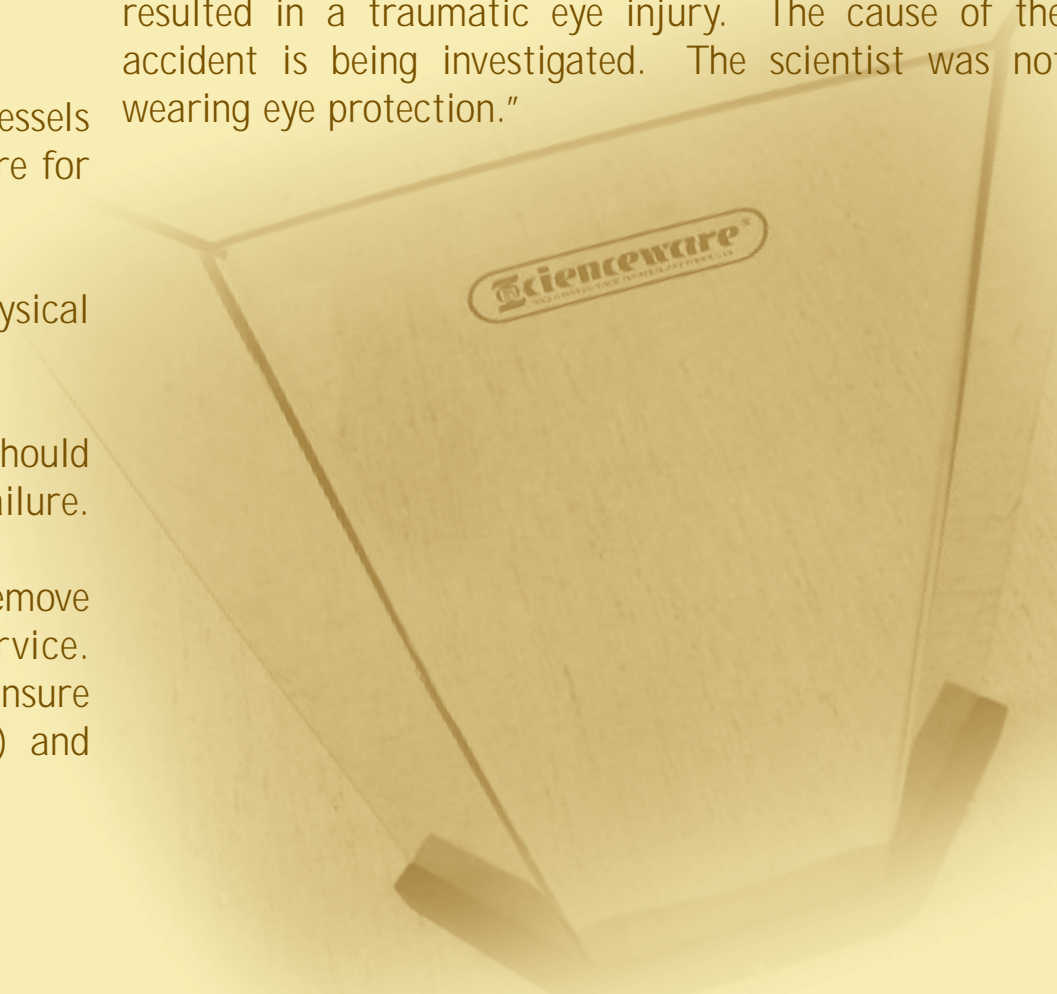
Always inspect pressure vessels before use and remove damaged or questionable equipment from service. Periodically inspect and test reaction vessels to ensure integrity. Consider thermal properties (brittleness) and chemical compatibility when choosing containers.

Cryogen Safety

- Some cryogenics can condense oxygen causing a violent reaction or fire.
- Discuss the use of reactive or liquefied flammable gasses (i.e. O₂, H₂, propane, CH₄, etc.) with EHS before ordering.
- Contact EHS before using liquid oxygen and any liquefied flammable gasses (H₂, Propane, etc.).

It Happened at Dartmouth...

“An accident resulting in a serious injury occurred to a biomedical research scientist on campus. While “flash” freezing yeast samples in 50 ml conical polypropylene tubes, liquid nitrogen caused the tube to explode and resulted in a traumatic eye injury. The cause of the accident is being investigated. The scientist was not wearing eye protection.”



THREE EMERGENCY STEPS TO TAKE IN THE EVENT OF AN EXPOSURE TO HUMAN BLOOD OR BODY FLUID: BLOODBORNE PATHOGENS

1. Begin first aid immediately.

- Wash contaminated skin thoroughly for 10 minutes with Povidone iodine solution (generic Betadine®). If not available, use antibacterial soap and copious amounts of water.
- Irrigate contaminated eyes and mucous membranes with warm water for 15 minutes.

2. Notify your supervisor, if available. Otherwise, do not delay and go to step three.

3. During the week, report to Occupational Medicine at DHMC. Telephone 653-3850. After hours, report to the DHMC Emergency Room.



BIOLOGICAL SAFETY LEVEL 2: Essential Practices and Procedures

- Wash your hands thoroughly for 15-30 seconds with plenty of soap and water after removing your gloves. Turn off the faucet using paper towels.
- Wear a clean lab coat and high quality disposable gloves.
- Dress to protect your feet and exposed skin. Do not wear open toed shoes, sandals, shorts or any other garment that leaves skin unprotected.
- Decontaminate work surfaces daily and after any spill involving viable/potentially-infectious material.
- Do not consume (or store) food or drink in the lab--or allied locations such as cold rooms. Apply cosmetics and handle contact lenses in restrooms.
- Autoclave your waste promptly (add 250-500 ml of water to the bag just before processing). Please do not allow autoclave bags to accumulate in the lab or autoclave room.
- Chemically decontaminate liquids such as bacterial cultures, spent media, etc. (no autoclaving required).



Chemical Waste

Hazardous Chemical Waste

Definition:

The EPA and State of New Hampshire regulate the collection and disposal of hazardous waste. Most chemicals used in our laboratories cannot be drain disposed, thrown in the trash, evaporated or treated. Broadly defined, hazardous wastes include any material that is:

- Flammable, Ignitable or Combustible - Flash Point < 140 Deg F (60 Deg C)
- Corrosive, Acidic, Basic/Caustic - pH <2 or > 12.5 or materials damaging to skin/eyes/mucous membranes
- Reactive - oxidizers, air/water reactives or any material unstable under normal handling conditions
- Toxic - materials damaging to the structure or function of cells

Note: any number of factors can make a chemical "toxic". The Hazardous Waste Disposal Guide (Green Guide), provides a comprehensive (but not exhaustive) list of toxic chemicals. Look for statements on the container label such as Warning, Caution, Poison or Danger. When in doubt collect the material and contact EHS.



Collection Supplies



A Complete Label is a Correct Label

HAZARDOUS WASTE LABEL	
Dartmouth College Environmental Health & Safety (EHS)	
Information on Hazardous Waste Disposal is Available in the "Green Guide" or through EHS.	
Principal Investigator:	N. Label
Contact Person:	John Smith
Account #:	245000
Does this waste contain REACTIVE MATERIALS? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Does this waste contain REFRIGERABLE LIQUIDS? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
CHEMICAL WASTE IDENTIFICATION (List 100% of constituents) recipients: 100% of contents	
1	Nitric Acid 50
2	Water 50
3	
4	
5	
pH of contents:	4
Date Filled:	3-23-05
WASTE REDUCTION MAKES SENSE FOR DARTMOUTH	
For EHS Use Only	
Date Received:	
Waste Code:	

- Where it came from
- Other hazards?
- List contents--list everything by name
- List % to 100%
- pH and date filled
- This is a simple yet important step

You can find physical properties for each chemical (i.e. flash point, pH) on the MSDS. Also take the mandatory hazardous waste web training for detailed instructions on waste identification, collection and disposal. Remember to collect contaminated solids and debris as hazardous waste including protective equipment, disposable lab ware or spill cleanup debris.

Handle Hazardous Waste Safely - protect your eyes, wear appropriate chemically resistant gloves and a lab coat.

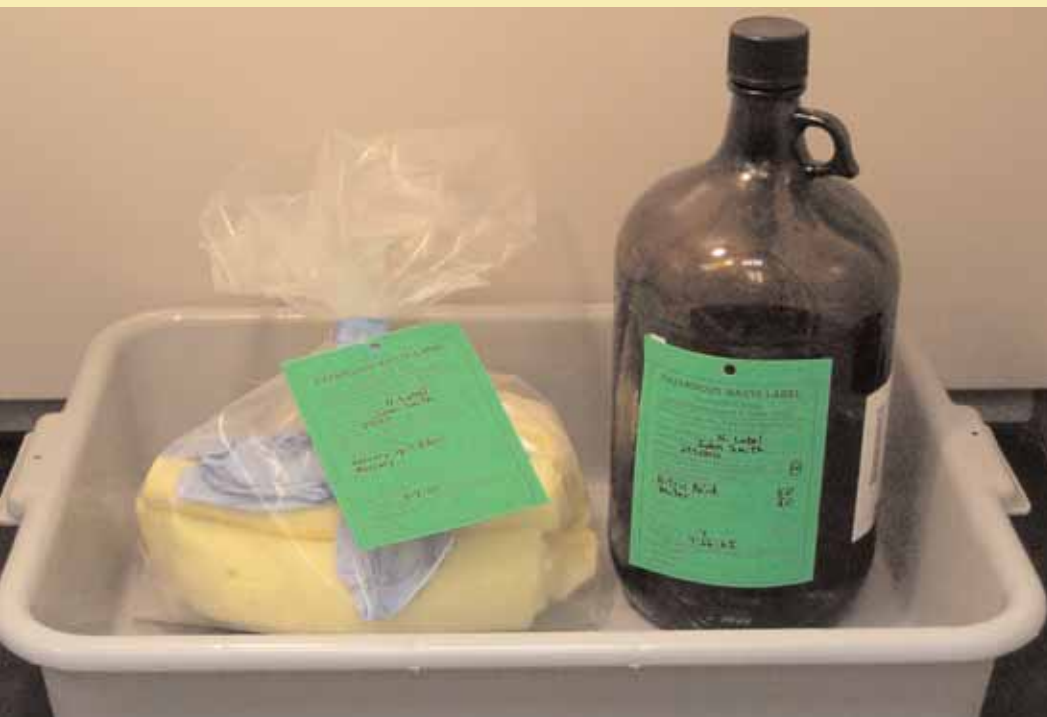
Four simple steps in hazardous waste management

1. ID and Collect
2. Label
3. Storage/Containment/Segregation
4. Dispose when full

1. Identify and collect chemical waste– never drain, dispose, evaporate or discard in trash!

- Select sturdy and chemically compatible containers with tight fitting caps/lids.
- Original containers work best for waste collection.
- Never mix incompatible wastes in collection containers.
- Keep solvents free from metals and water when possible.
- Never mix radioactive or biological wastes with chemical waste.
- Do not overfill—fill 3/4 full.

Proper Liquid & Dry Waste Collection



2. Label – always use the labels provided by EHS

- Print legibly – use complete chemical names (no formulas or abbreviations).
- Identify all constituents – its ok to estimate percentages or concentrations – but do not leave things out!
- List the pH (ok to estimate). pH paper protects probes!
- Fill in the date when the container is 3/4 full and ready for pick-up.

3. Storage/Containment/Segregation

- Keep containers sealed except when adding or removing waste, no funnels or loose caps.
- Liquid wastes must be stored in containment bins – flammable wastes should be stored flammable cabinets.
- Segregate incompatible wastes (never store acids with caustics or oxidizers with solvent).

4. Contact EHS for disposal when full

Biological Waste

Including Biohazardous and Anatomical Waste

Definition:

Waste associated with biological or biomedical sciences including bacteriology, cell culture, recombinant DNA, pathology, anatomy or animal sciences where potentially infectious agents MAY or MAY NOT be present. Additionally, this includes materials that may present an actual or perceived biological risk to others on sight.

Using appropriate collection (autoclave bags in plastic pails) and decontamination methods (chemical disinfection, autoclaving) labs can render most biological waste (biohazardous waste) non-hazardous before collection and removal.

COLLECT ALL ANIMAL CARCASSES, ANATOMICAL PARTS OF ANY SORT (HUMAN OR ANIMAL) FOR DISPOSAL BY THE ANIMAL RESOURCE CENTER OR EHS. THESE MATERIALS REQUIRE SPECIAL HANDLING AND DISPOSAL-NO EXCEPTIONS!

Never place items such as soda cans, paper, cardboard, bottles, etc. in autoclave bags-- once combined they cannot be separated.

- Hazardous or radioactive waste must never go into an autoclave bag. This includes labware associated with microfuge amounts of hazardous chemicals. When in doubt, please call EHS first.
- Do not leave autoclave bags in hallways, equipment rooms or other areas with public access.

- Clean spills from leaking autoclave bags immediately with a suitable disinfectant (a fresh 1:10 dilution of bleach and water works well for most spills).
- Chemically decontaminate all bacterial cultures, spent media, etc. with bleach (10% final concentration) or Wescodyne[®] (1% final concentration) for 30 minutes before pouring the solution down the drain. Chemical decontamination saves time.
- Do not autoclave blood or other bodily fluids since they tend to congeal and make a mess-chemically decontaminate instead.
- All aspiration traps must have an in-line filter to protect the building vacuum system.

Aspiration Trap



BIOHAZARD

HAZARD IDENTITY:



Biologically Contaminated Needles

Autoclave Use - Decontaminating Biological Waste

- Autoclave bags must always be orange emblazoned with the word "biohazard" and the international biohazard symbol. NEVER USE RED AUTOCLAVE BAGS!
- Add ~250-500 ml of water to the autoclave bag just before closing (do not seal tight) and processing. Note: the water generates steam to ensure proper decontamination.
- Use the metal trays provided by EHS to support the bag in the autoclave. Avoid the use of Nalgene® trays since plastic is a poor conductor of heat.
- Do not rely on autoclave tape as an adequate indicator of decontamination. Autoclave tape does not indicate decontamination.
- Autoclave effectiveness testing materials and procedures are available through EHS.

**Autoclave All Waste
Prior to Disposal!**



Biological Waste

Radioactive Waste

Definition:

Any unusable material(s) containing or contaminated with a radioactive material.

- Reduce the volume of radioactive waste by pre-planning.
- Segregate waste by isotope and activity.
- Distinguish between contaminated and non-contaminated items.
- Collect and dispose of all radioactive waste using the supplies provided by EHS. Specifically, the clear plastic bags and "deli containers"-no exceptions!
- Radioactive waste bags must be dry--only slight associated moisture is acceptable.
- Clearly label all radioactive waste containers with an EHS radioactive waste label.
- Segregate aqueous solutions from organic solvents.
- pH of aqueous solution must be 7-9. Protect pH probes by using pH paper.



Proper Shielding and Collection for Cr51 & I125

- Never leave radioactive waste unattended or unsecured in an unlocked lab.
- Avoid mixing radioactivity with biohazardous agents or hazardous chemicals - contact EHS before generating mixed waste.
- Non-contaminated/non-hazardous wastes are general (unregulated) lab trash.

H3 Collection Materials



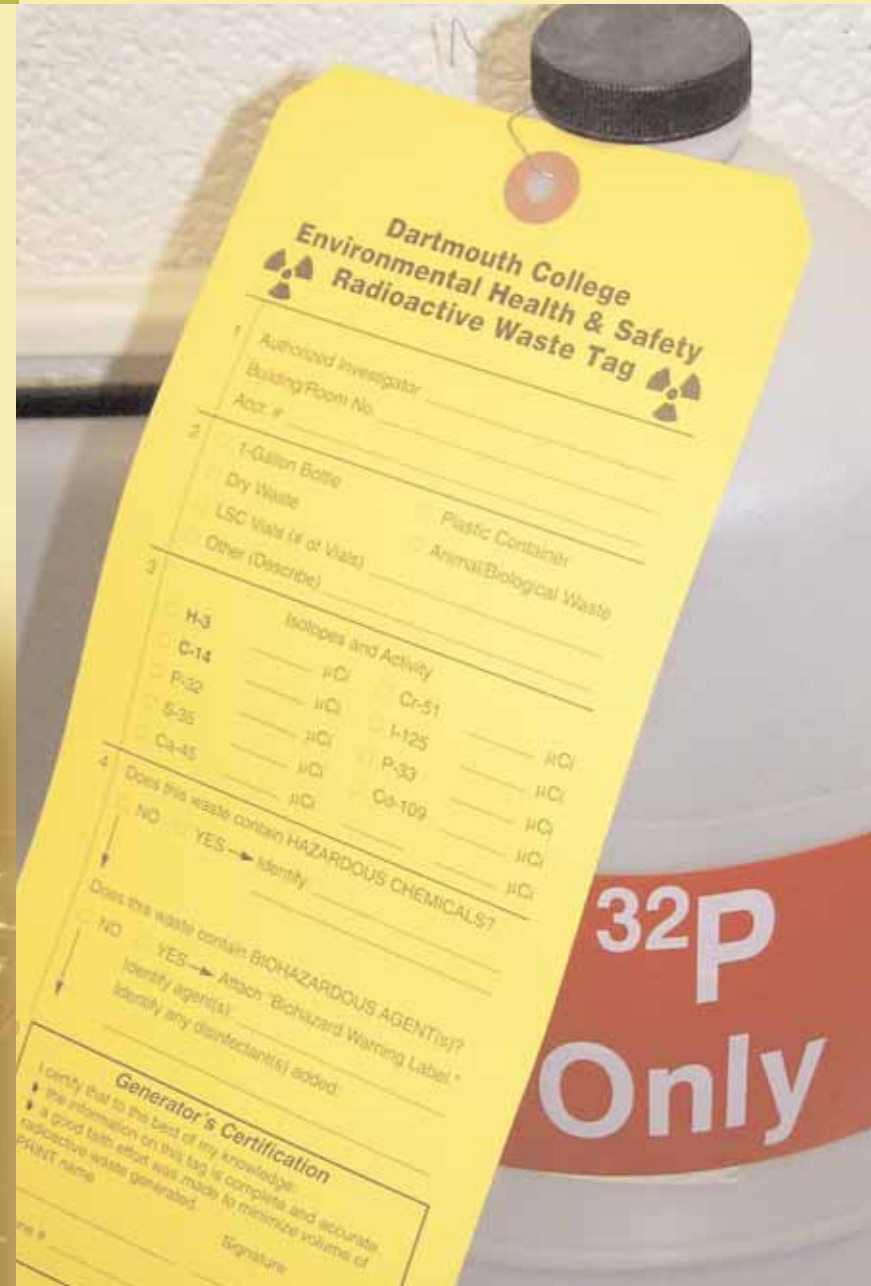


P32 Shielding and Collection Materials



All Radioactive Waste Must Be Tagged

- Assume that disposable gloves worn when using tritium (^3H), carbon (^{14}C) or sulfur (^{35}S) are always contaminated. Bag these as radioactive waste for collection.
- Remove or thoroughly deface all radioactive warning stickers on non-contaminated wastes or shipping boxes before their disposal into a lab trash can.
- Request regular waste pick ups. For labs using isotopes on a daily basis, scheduling a weekly waste pick up is best - once a month at least. For other labs, please ensure you waste is removed at least every three months.



Radioactive Waste

Laser Safety

Each laser system (IIIb and IV) must have a Laser Safety Procedure (LSP).

The LSP must contain the following information--

- The name of the PI.
- An adequate description of safety features for each device.
- A description of required protective equipment for each device.
- Specific operating procedures including safe start-up and shutdown in the form of a checklist.
- Specific alignment procedures.
- An emergency contact list.

Laser Protective Eyewear

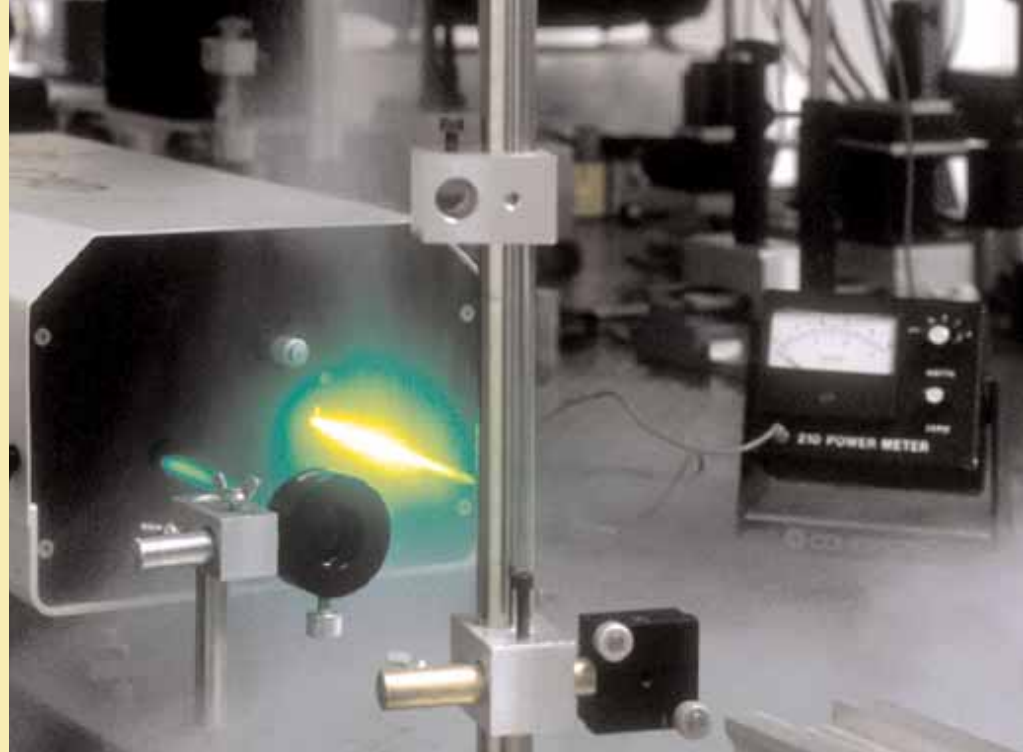
Laser protective eyewear must be appropriate for the equipment in use. Laser eyewear must indicate the optical density values and wavelengths. Periodically inspect laser eyewear for pitting, cracking and proper seal around the eyes. All laser eyewear must be ANSI compliant.

Medical Surveillance

Following a known or suspected laser injury, immediately seek emergency medical care and report the incident to Environmental Health & Safety.

Associated Hazards

- Associated laser hazards may include electrical hazards, fire, cryogenic materials and compressed gasses, toxic and carcinogenic chemicals.
- Electrocution and severe shock have occurred when trouble-shooting or servicing energized laser equipment.
- The servicing, adjustment or repair of laser equipment or power supplies is restricted to qualified personnel.



- Specific steps to eliminate or reduce the chance of electrical shock include grounding and insulation.
- Equipment must be in "zero-energy" state (power removed, stored energy released) before servicing.
- In some cases, it may be necessary to take special precautions to prevent fire/explosion hazards.
- The case or housing surrounding laser equipment must be capable of withstanding the explosive energy when high-pressure arc lamps/filament lamps disintegrate.

Laser Safety: Hazard Control

- Do not align or view a laser beam with unprotected eyes.
- Register all new equipment with EHS prior to first use.
- Anticipate and protect against reflected beams.
- Isolate the laser operator(s) from beam exposure.
- Use an adequate beam stop.
- Do not operate malfunctioning or suspect equipment.
- Utilize all safety features provided by the manufacturer.
- Use laser eyewear matched to the wavelength-must be ANSI approved.
- Do not allow untrained persons to operate laser equipment.
- Conduct your initial set-up in a well-lit room.
- Conduct a second safety check before energizing the device(s).



Radiation Safety

Postings by the Radioactive Use Area

- *Notice to Employees* contains information on the responsibilities of the supervisor and the radiation worker; on the policies of radioactive use; on dosimetry reports; and on New Hampshire State rules for facility inspections.
- *Radiation Safety Notice and Emergency Response Procedures* contains information on New Hampshire State regulations on the control of radiation. This posting includes the radiological emergency response and the EHS telephone number.

Pregnancy Policy

- A pregnant radiation worker may choose to declare (or not declare) her pregnancy to the Radiation Safety Office. Declared pregnant workers have lower permissible exposure limits.
- A formally declared pregnancy requires a "Declaration of Pregnancy" letter to the RSO. Declared pregnant workers are entitled to a fetal dose monitor.

Radiation Survey

- Portable survey instruments-all portable radiation instruments at Dartmouth must be Ludlum® units. Check the battery status before each use. Set the instrument at 0.1x scale and adjust the scale accordingly. Monitor the radiation level by using either the pancake probe (beta radiation) or the scintillation probe (gamma or x-ray) close to the source of emission. Note instrument reading(s) in your rad notebook.
- Liquid scintillation counting-Use 1" filter papers and wipe the suspected surface(s) for removable contamination. Sketch a simple map to track the locations sampled. Count the filter papers in the presence of scintillation fluid for at least one minute per sample. Keep the print out(s) stapled to your records in your rad notebook.

Radioactive Contamination

- Skin contamination-Apply liquid hand soap with a gloved hand (reducing re-contamination). Gently wash contaminated skin area with plenty of soap and running water for at least 15 minutes. Do not abrade or damage the skin. Note: the objective is to isolate and remove contamination from the skin. Contact EHS for assistance and follow-up.
- Surface contamination-Place paper towels over the radioactive spill to absorb the excess liquid. Use fresh paper towels and a commercial decontamination solution to lift removable contamination. Wipe the contaminated surface from the outer edge(s) toward the center to minimize further contamination. Survey by the appropriate method and continue decontamination efforts until the results are less than 3x background. Bag and label all spill debris. For larger unconfined spills, call EHS immediately and avoid tracking potential contamination from one location to another.

Recordkeeping

- Log the receipt of radioactive source vials in the radioisotope receiving log found in the Radioactive Materials Logbook provided by EHS.
- Reconcile any discrepancy between your quarterly Inventory Report and current inventory.
- Maintain accurate information on the Radioactive Material Tracking Sheet provided by EHS.
- Submit a copy of the Radioactive Material Tracking Sheet with the disposal of each used source vial at the time of disposal through EHS.
- Maintain records of radiation survey and liquid scintillation counter results in your rad notebook for three years.

Security of Radioactive Sources

- All radioactive sources must be stored in a locked refrigerator/freezer/container to prevent unauthorized access.
- Report unaccounted for source vial(s) to EHS immediately.
- Lock your laboratory when not occupied.

High Hazard Chemicals

Peroxides

- Ethyl ether can form unstable peroxides when exposed to air.
- Ether containers have an expiration date on the label indicating how long it can be safely stored.
- Note the following on each container: (1) date purchased, (2) date opened and (3) peroxide test dates. EHS can provide labels.
- Never open, or move an expired container--contact EHS immediately!
- Refer to the Hazardous Waste Disposal Guide for a more complete list of chemicals that can form peroxides.

- Purchase HF in the smallest possible volume and store in a chemical fume hood.
- Segregate HF from bases, reducing agents, cyanides, sulfides, glass, ceramic and metal surfaces.
- Do not store HF in glass containers. HF etches glass.
- Wash your hands thoroughly with soap and water after removing your gloves.
- EHS provides Calcium Gluconate gel - but it is not a substitute for prompt medical evaluation and treatment. Provide the Gluconate gel & MSDS to the EMT and/or ER physicians.

Toxic Chemicals

All chemicals fall into one of four broad toxicity groupings: extremely toxic, highly toxic, moderately toxic and slightly toxic. Toxicity is expressed as LD₅₀ (Lethal Dose) values. Be sure to review the Material Safety Data Sheet (MSDS).

Extremely toxic - LD₅₀ of <5mg/kg

Highly toxic - LD₅₀ between 5 and 50 mg/kg

Moderately toxic - LD₅₀ between 50 and 500 mg/kg

Slightly toxic - LD₅₀ 500 mg/kg or greater

- Any chemical with an LD₅₀ ≤50 mg/kg (by any route) requires special precautions defined by the Dartmouth Chemical Hygiene Plan
- Chemicals that have a "skin" notation also require precautions to avoid all potential dermal contact.

Unstable/Reactive

- This includes chemicals which are oxidizers, water reactive, pyrophoric, air sensitive (requiring an inert atmosphere) or temperature sensitive. This also includes chemicals that become unstable due to shock, static discharge or contamination with other chemicals such as heavy metals.

Peroxide Forming Chemicals

A few examples...

- Ethers
- Alkali Metals
- Olefins
- Dienes
- Vinyl Halides
- Tetrahydrofuran



Perchloric Acid

- Perchloric acid can react violently with organic material. Never heat or evaporate Perchloric acid solutions. Review the use of Perchloric acid with EHS before purchase or use.

Hydrofluoric (HF) Acid Safety

HF is an acutely toxic and corrosive chemical. At low concentrations (<15%) exposure can cause skin burns that may go undetected for hours. At high concentrations, deep burns are immediate and painful. **DISCUSS THE USE OF HF WITH EHS PRIOR TO PURCHASE!**

- ALL EXPOSURES MUST BE TREATED AS MEDICAL EMERGENCIES - Immediately flush exposure with water - Call 911(DMS@DHMC/Hospital Complex dial 5555)- and continue flushing until help arrives.



Corrosives: Acids, Basics/Caustics

- Use chemically resistant gloves, aprons/lab coats and splash goggles when handling corrosives. Splash goggles are mandatory when transferring more than one liter of any corrosive liquid.

Nitric Acid

Nitric acid is highly corrosive to the eyes, skin and mucous membranes. A powerful oxidizing agent, nitric acid can ignite or react explosively with many organic and inorganic substances. Physically segregate nitric acid from other chemicals.

Toxic Gasses

- Review the intended purchase and use of all toxic gases with EHS.
- All toxic gasses must be stored and used in a certified chemical fume hood or gas cabinet.

Mercury

- It is essential to minimize the use of mercury at Dartmouth. Mercury vapor poses a chronic inhalation hazard. If you spill mercury, do your best to contain the beads and contact EHS.
- Enclose mercury-containing devices in secondary containment to capture spills.
- Non-mercury thermometers have the same degree of accuracy as a mercury equivalent for virtually all applications.
- EHS accepts all mercury containing devices for recycling.

Formaldehyde Safety

- Formaldehyde is a low molecular weight gas. What we typically think of as formaldehyde is actually a saturated solution with methanol (to inhibit polymerization). As a saturated solution including methanol, the liquid is a carcinogen and poses a moderate fire and explosion hazard.
- Formaldehyde poses an inhalation, skin/eye or accidental ingestion hazard. Your sense of smell becomes less sensitive with prolonged exposure.
- Formaldehyde is highly irritating to the upper respiratory tract, eyes and skin. Symptoms are dose dependent with as little as 0.5 to 2.0 ppm irritating the eyes, nose or throat. Higher concentrations of 25 to 30 ppm can cause severe injury to the respiratory tract.
- Formaldehyde is a potential human carcinogen. Repeated and prolonged exposure increases the potential risk. In humans, formaldehyde exposure has been associated with cancers of the lung, nasopharynx, oropharynx and nasal passages. Prolonged or repeated exposure to formaldehyde may result in respiratory impairment. Some people have developed asthma or bronchitis following exposure to formaldehyde, usually after a single exposure to a high concentration.
- Work with formaldehyde in a chemical fume hood. Other local exhaust ventilation systems (for example, down draft or perfusion tables) are effective in controlling formaldehyde exposures during surgical procedures.
- Wear heavy-duty nitrile or neoprene gloves when handling formaldehyde. When there is a limited splash or contact hazard, disposable nitrile gloves are also acceptable.
- Wear eye protection. For amounts less than 100 ml, ANSI approved safety glasses are usually adequate. Wear ANSI approved splash goggles when handling larger volumes.
- When using formaldehyde on routine basis contact EHS for exposure monitoring. Exposure monitoring provides a useful assessment of chemical handling and practice.
- Label all solutions containing more than 1% formaldehyde with the following information:

CAUTION

**Contains Formaldehyde
Potential Cancer Hazard
Toxic by inhalation and if swallowed.**

- EHS can help with the disposal of specimens preserved in formaldehyde.

Mercury Minimization



- Dartmouth has made a major effort to find and remove elemental mercury from our labs
- Other forms of mercury have been included
- We take—at no cost—mercury for recycling or disposal

**Non Hg replacement
thermometers are
available from EHS**

Important Information

Chemical Fume Hoods

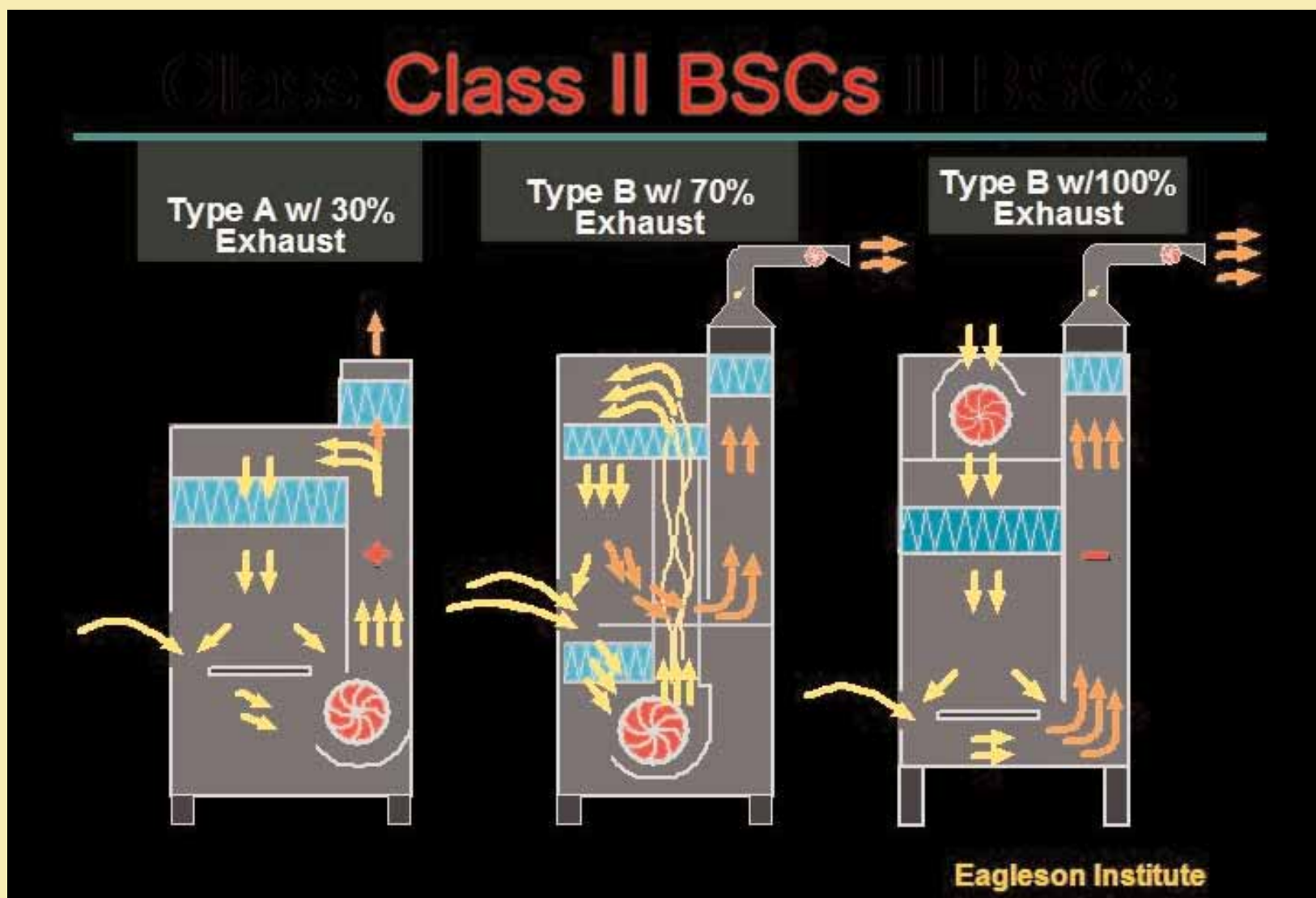
- Minimize clutter and do not obstruct the air vent at the rear of the hood.
- Keep the sash as low as practical but never above the inspection sticker.
- Some hoods have an alarm to warn you when it is not working properly.
- If the building ventilation fails, immediately stop your work and close the sash.
- Contact facilities staff for maintenance issues.

Equipment Clearance Procedures

- Clean and prepare surplus equipment to remove known or potential hazards.
- Complete and affix a clearance tag to assure others it is clean and ready to go.
- EHS must clear all equipment containing or potentially contaminated with radioactive materials.

Biological Safety Cabinets (BSCs)

- A BSC is not a chemical fume hood! Never use toxic or volatile chemicals in a BSC.
- When moving a cabinet, contact EHS for decontamination and recertification.
- Protect all vacuum systems with in-line filters.



Chemical Storage and Compatibility

General Chemical Storage Compatibility						
+ means these groups may be stored together in most cases			* means store these groups AWAY from water and water sources			
Group 1 +	Group 2+	Group 3 +*	Group 4 *	Group 5 *	Group 6 *	Group 7 *
Halogenated compounds	Ketones	Organic Acids	Aminies & Alkanolamines	Caustics	Oxidizers	Inorganic acids
Olefins	Saturated hydrocarbons	Acid Anhydrides	Ammonia	Hydroxides	Nitrates	Hydrochloric
Alcohols, glycols & glycol ethers	Aromatic hydrocarbons	Acetic Acid		Carbonates	Persulfates	Sulfuric
Phenol	Oils					Phosphoric
Chloroform	Aldehydes					Halogens
Dyes & Stains	Olefins					
Ethidium bromide	Esters					
	Formaldehyde					

Medical Consultation

Medical consultation and evaluation are available to Dartmouth College employees through the Exposure Consultation Program. Contact EHS to discuss potential occupational exposures or to request a consultation with a health care worker through the Occupational/Employee Health Program located at Dartmouth-Hitchcock Medical Center.

A consultation is advisable when medical evaluation is considered prudent for a particular hazardous (biological, chemical or radiological) material or there has been an acute exposure to a hazardous material. It is also important when signs or symptoms develop that may be associated with potential exposure(s) to hazardous materials in the laboratory. Finally, medical consultation is required when monitoring finds exposure(s) at or above the action level for a substance with an occupational exposure level.

Material Safety Data Sheets and Information Resources

MSDS

The Occupational Safety and Health Administration (OSHA) requires that information on the physical and health effects of hazardous chemicals be readily available to employees who must work with or are potentially exposed to such substances (CFR 1910.1200 and 29 CFR 1910.1450). The required form of this information is fact sheets - known commonly as Material Safety Data Sheets - or simply MSDSs. According to OSHA, these sheets must be readily available to employees during working hours in an easily accessible location.

At Dartmouth, an on-line MSDS system is available 24 hours a day through the EHS web site. In addition to the online system, laboratories must keep current copies of MSDS sheets for any commercial products used in the lab (mixtures, experimental compounds, proprietary compounds, etc.) and any MSDS sheets not available through our online resources.



You Have a Right to a Safe and Healthful Workplace.

IT IS THE LAW!

- You have the right to notify your employer or OSHA about workplace hazards. You may ask OSHA to keep your name confidential.
- You have the right to request an OSHA inspection if you believe that there are unsafe and unhealthful conditions in your workplace. You or your representative may participate in the inspection.
- You can file a complaint with OSHA within 30 days of discrimination by your employer for making safety and health complaints or for exercising your rights under the OSH Act.
- You have a right to see OSHA citations issued to your employer. Your employer must post the citations at or near the place of the alleged violation.
- Your employer must correct workplace hazards by the date indicated on the citation and must certify that these hazards have been reduced or eliminated.
- You have the right to copies of your medical records or records of your exposure to toxic and harmful substances or conditions.
- Your employer must post this notice in your workplace.



The Occupational Safety and Health Act of 1970 (OSH Act), P.L. 91-596, assures safe and healthful working conditions for working men and women throughout the Nation. The Occupational Safety and Health Administration, in the U.S. Department of Labor, has the primary responsibility for administering the OSH Act. The rights listed here may vary depending on the particular circumstances. To file a complaint, report an emergency, or seek OSHA advice, assistance, or products, call 1-800-321-OSHA or your nearest OSHA office: • Atlanta (404) 562-2300 • Boston (617) 565-9860 • Chicago (312) 353-2220 • Dallas (214) 767-4731 • Denver (303) 844-1600 • Kansas City (816) 426-5861 • New York (212) 337-2378 • Philadelphia (215) 861-4900 • San Francisco (415) 975-4310 • Seattle (206) 553-5930. Teletypewriter (TTY) number is 1-877-889-5627. To file a complaint online or obtain more information on OSHA federal and state programs, visit OSHA's website at www.osha.gov. If your workplace is in a state operating under an OSHA-approved plan, your employer must post the required state equivalent of this poster.

1-800-321-OSHA
www.osha.gov

U.S. Department of Labor



Occupational Safety and Health Administration • OSHA 3165

OSHA Safe Workplace

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