CONTROLS TO MINIMIZE HAZARDOUS MATERIAL EXPOSURE

ENGINEERING CONTROLS

The laboratory facility must have an appropriate general ventilation system with air intakes and exhausts located so as to avoid intake of contaminated air. Stockrooms and storerooms, in particular, must be well-ventilated. The general laboratory ventilation system must provide a source of air for breathing and for input to local ventilation devices. However, the general ventilation system, or building ventilation, should not be relied upon for protection from toxic substances released into the laboratory. The ventilations system should be balanced so that the laboratory air is continually replaced, preventing increase of air concentrations of toxic substances during the working day. The laboratories should be under negative pressure with respect to hallways and other non-laboratory areas; that is, there must be direct air flow into the laboratory from non-laboratory areas and out to the exterior of the building.

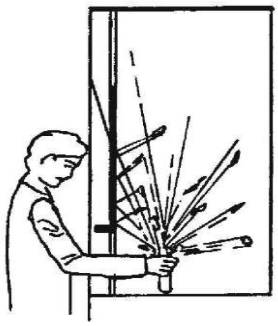
The laboratory must be equipped with appropriate laboratory hoods and sinks, and with safety equipment that includes plumbed in eyewash fountains and drench showers. A laboratory hood with 2.5 linear feet of hood space per person should be provided for every 2 workers if they spend most of their time working with chemicals. Each hood should have a continuous monitoring device for confirmation of adequate hood performance before use. If this is not possible, work with substances of unknown toxicity should be avoided or other types of local ventilation devices should be used, such ventilated storage cabinets, canopy hoods, snorkels, or glove boxes.

For maximum protection of the user and other laboratory occupants, fume hoods and other local ventilation devices must appropriate to the work being performed and must be used according to design specifications. Fume hoods should be operated with the sash in the lowest position possible. ***Do not remove sashes or make other modifications to the hood.***

Alterations to the ventilation system in a laboratory should be made only by trained personnel from Facilities Management. Alterations of the ventilation system should be made only if thorough testing indicates that worker protection from airborne toxic substances will continue to be adequate. Four to twelve room air changes/hour is normally adequate general ventilation if local exhaust systems such as hoods are used as the primary method of control. General air flow should not be turbulent and should be relatively uniform throughout the laboratory, with no high velocity or static areas. Ventilation should be evaluated, qualitatively and quantitatively, upon installation, regularly monitored and maintained, and reevaluated whenever a change in local ventilation devices is made.

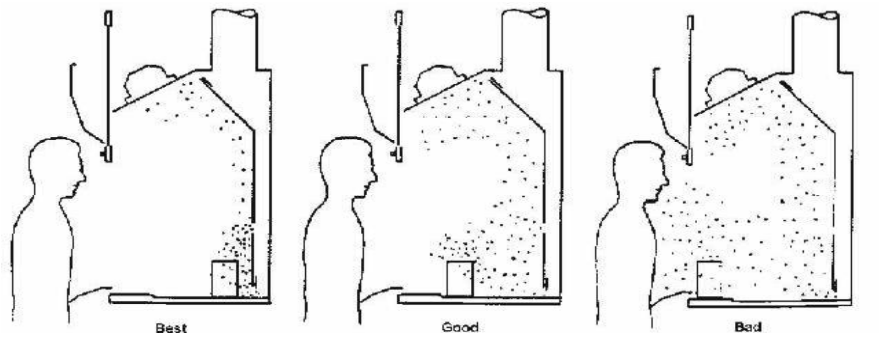
All new and modified fume hood(s) shall be ASHRAE Tested and/or other forms of recognized standardized evaluation test approved by EH&S office. Results of the test should be sent to EH&S office. A sticker containing the flow rate, date of test, and contact information of the person conducted and certified the fume hood should be place in right hand corner above the sash of the fume hood.

A chemical fume hood can provide adequate protection for most laboratory processes *if they are used correctly*. Here are some important points to remember:

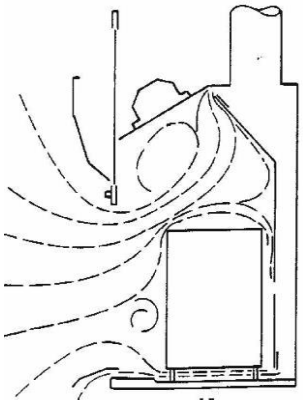


PROPER VIEWING SASH POSITION

Work with the hood sash partially or completely closed. If this is not possible, additional Personal Protective Equipment (PPE) should be used to ensure adequate protection.



Move work at least six inches inside the face of the fume hood. This minimizes the effect of cross-drafts and eddies created by the hood operator or by occupants walking by the hood. Also, keeping windows and doors closed will control cross-drafts.



Avoid overcrowding the fume hood work areas.

- Chemicals and equipment not in use should be removed from the hood to a proper storage cabinet.
- Large bulky equipment used in the hood will cause eddies that can be reduced by making sure there is a 1-2 inch air space on all sides including the bottom.
- Avoid using equipment that blocks the hood sash from closing. A safer ventilation method may exist and should be pursued.

Control reaction rates and observe process until completion.

- Controlling the rate of vapor and particle formation can minimize the risk of exposure.
- Never leave a reaction unobserved for an extended period of time, due to possible hood failure or unexpected accidents/spills.

Minimize fire hazard within the hood.

- Do not place electrical spark producing equipment in a hood containing flammable chemicals.
- Never leave a flame or heating apparatus unattended.
- No permanent electrical receptacles are permitted inside the hood.

Do not attach or insert exhaust ducts or snorkels to the hood without checking with EH&S.

- Drilling holes into the side of a hood increases the risk of fume exposure if not done properly.

Do not, under any circumstances, remove the sash from the hood!

- The sash was designed to be a safety barrier for the user. Call 575-5050 for maintenance related issues.

Lockout/Tagout

- It will occasionally be necessary for EH&S to take a fume hood or other piece of equipment out of service for maintenance or safety reasons. When this happens, a tag will be placed on the equipment advising users that the equipment is out of service.
    - DO NOT REMOVE THESE TAGS.
    - DO NOT USE EQUIPMENT THAT HAS BEEN TAGGED OUT.
- EH&S will remove the tags when the equipment is ready for use,

WORK PRACTICE CONTROLS

Substituting Less Hazardous Chemicals – Replace or reduce hazardous substances in products and processes by less hazardous or non-hazardous substances that will achieve an equivalent functionality. Below is list of considerations OSHA has recommended when determining the suitability of potential substitutes.

1. **Effectiveness**. Will the material meet the technical requirements (e.g., solubility, drying time) for the job or process?
2. **Compatibility**. The substitute must not interfere or react with the process, the other materials or the equipment.
3. **Existing Control Measures**. Existing control methods may not adequately control the substitute (e.g., a less toxic substitute may evaporate more rapidly and the existing ventilation system may not adequately capture the vapors).
4. **Waste Disposal**. Will the current waste disposal system meet technical and regulatory requirements when dealing with any new waste created by using the substitute?
5. **Hazard Assessment**. A hazard assessment should be done to decide whether to substitute a different chemical or material.

See below suggested examples of substitution by University of Minnesota.

Product Substitution: Examples of substitution of nonhazardous or less toxic materials in chemical processes and experiments.

Currently Use:	**Substitute:**
Xylene, benzene and toluene containing reagents in histology laboratories	Citric acid based reagents (e.g. AmeriClear)
Standard xylene or toluene based cocktails in radioactive tracer studies	Nonhazardous proprietary liquid scintillation cocktails; call the Radiation Protection Division at (612) 626-6764 for information.
Solvent based inks in printing operations	Soy based inks
Formaldehyde in cleaning hospital kidney dialysis machines	Peracetic acid
Mercury thermometers	Non-mercury thermometers
Solvent extraction	Solid phase or supercritical fluid extraction
Sulfuric acid/ potassium dichromate (chromerge) cleaning solutions	Detergents and enzymatic cleaners
Ethidium bromide	New filtration product to concentrate solvent waste 10 times
Phosphate chloride detergents for lab glass washing	Non-phosphate, non-chloride detergents

Design Changes

Isolate or enclose an experiment with in a closed system to reduce exposure to hazardous chemicals. Another procedure change is when possible to micro scaling the size of the experiment to reduce the amount of chemical used.

Hazard Posting

Each laboratory should have the standardized yellow CAUTION placard (available from EH&S) permanently displayed on the door. Information displayed on this placard is essential for emergency responders. The placard should display decals appropriate to the hazard(s) in the laboratory. Emergency contact information should be on the placard, as well.

Access Control

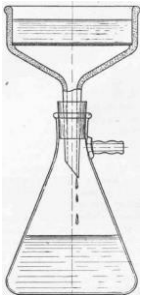
The PI or laboratory supervisor is responsible for controlling access to the laboratory. Access should be limited to only those persons working or having business in the laboratory. Laboratories containing hazardous materials of any sort should be secured when unattended.

Equipment

Chemical-hygiene-related equipment, such as hoods, eyewashes, safety showers, should be continually appraised and should be serviced or modified if inadequate. These items of equipment undergo scheduled maintenance by Facilities Management personnel, but there may be routine maintenance tasks that must be performed by the laboratory staff. For example, for sanitation reasons, the eyewashes must be flushed weekly by laboratory personnel. Work spaces must be kept clean and uncluttered. For any equipment failure please contact Facilities Management at 575-5050 or EH&S at 575-5448.

Laboratory operations

Laboratory operations that have the potential to create fires or explosions require special procedures and safety equipment. Such operations must have prior approval of the laboratory supervisor. Safety equipment such as fire extinguishers, shields and safety showers must be checked prior to such operations.



Pressurized or vacuum operations

Such operations require prior approval of PI or laboratory supervisor, and may require special protective equipment or shielding. Glass vessels under vacuum or pressure can implode or explode, and without the proper protection there is always the risk of being cut from projectiles or splashed by the contents of the flask on the skin or eyes.

- Inspect glassware for flaws such as cracks, scratches, deep scoring and etching marks before using vacuum apparatus
- Make sure the vessels are specifically designed for vacuum work.
- Tape the glass vacuum apparatus to minimize projectiles due to implosion.
- Use adequate shielding when conducting pressure and vacuum operations
- Anchor the vacuum flask in place with a ring stand and clamp.
- Before taking any actions with the flask (removing funnel/stopper, adjusting hoses), release the vacuum by disconnecting the hose from the vacuum pump.
- Always wear eye and face protection when handling vacuum or pressure apparatus.

Low temperature Operations - such as procedures using dry ice or liquid gas require special care to avoid frostbite, container rupture, or condensation of liquid oxygen. Glass Dewar flasks should be taped to avoid flying glass resulting from failure. Such operations require prior approval of the PI or laboratory supervisor.

Chemicals with Limited Shelf life – may require special handling or storage procedures. Examples include solvents that form peroxides, such as diethyl ether; chemicals that decompose upon storage to form potentially dangerous pressures, such as formic acid; and chemicals that become unstable upon storage, such as picric acid.

PERSONAL PROTECTIVE EQUIPMENT (PPE)


"OSHA requires employers to ensure that employees have appropriate eye or face protection if they are exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, potentially infected material or potentially harmful light radiation."1

Appropriate eye protection should be worn when using:

- caustics, corrosives, or irritants
- glassware under vacuum or pressure (reduced or elevated)
- cryogenic materials
- flammable materials
- radioactive materials
- explosives
- lasers (special lens protection required)
- UV light (special lens protection required)
- Biohazards

Eye protection should also be worn when performing these machine shop operations:

- welding
- sanding
- grinding
- drilling
- sawing

Contact lenses should not be routinely worn in the laboratory. Laboratory personnel who must wear contact lenses while performing laboratory work should be aware of the following potential hazards:

- It may be impossible to remove contacts from the eyes following entry of some chemicals into the eye area.
- Contact lenses will interfere with emergency flushing procedures.
- Contacts may trap solid materials in the eyes.

"Employers must ensure that their employees wear **head protection** if any of the following apply:

- Objects might fall from above and strike them on the head;
- They might bump their heads against fixed objects, such as exposed pipes or beams; or
- There is a possibility of accidental head contact with electrical hazards." [1]

Unrestrained long hair can be hazardous. The use of caps, elastic bands or hair nets will prevent the hair from coming in contact with instrument/machinery parts, chemicals or flame-producing sources.

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[1] OSHA 3151-12R

"When employees are subjected to **sound** exceeding those listed in Table G-16, feasible administrative or engineering controls shall be utilized. If such controls fail to reduce sound levels within the levels of Table G-16, personal protective equipment shall be provided and used to reduce sound levels within the levels of the table.

If the variations in noise level involve maxima at intervals of 1 second or less, it is to be considered continuous.

TABLE G-16 - PERMISSIBLE NOISE EXPOSURES (1)

Duration per day, hours	Sound level dBA slow response
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4 or less	115

Footnote(1) When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions: C(1)/T(1) + C(2)/T(2) C(n)/T(n) exceeds unity, then, the mixed exposure should be considered to exceed the limit value. Cn indicates the total time of exposure at a specified noise level, and Tn indicates the total time of exposure permitted at that level. Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level."[2]

The **lab coat or apron** is designed to protect the clothing and skin from chemicals that may be spilled or splashed. It should always be properly fitted to the wearer and is best if it is knee length. There are several different types of lab coats for different types of protection.

"Employees who face possible bodily injury of any kind that cannot be eliminated through engineering, work practice or administrative controls, must wear appropriate body protection while performing their jobs. In addition to cuts and radiation, the following are examples of workplace hazards that could cause bodily injury:

- Temperature extremes;
- Hot splashes from molten metals and other hot liquids;
- Potential impacts from tools, machinery and materials;
- Hazardous chemicals."[3]

[2] OSHA **1910.95**

[3] OSHA 3151-12R

- Appropriate **gloves** should be worn as needed.

"If a workplace hazard assessment reveals that employees face potential injury to hands and arms that cannot be eliminated through engineering and work practice controls, employers must ensure that employees wear appropriate protection. Potential hazards include skin absorption of harmful substances, chemical or thermal burns, electrical dangers, bruises, abrasions, cuts, punctures, fractures and amputations. Protective equipment includes gloves, finger guards and arm coverings or elbow-length gloves." [3]

Remove gloves before exiting the laboratory, recording data in a notebook, or working with a computer.

Care should be taken when removing gloves. Peel the glove off the hand, starting at the wrist and working toward the fingers. Keep the working surface of the glove from contacting skin during removal. Contaminated disposable gloves should be discarded in designated containers (e.g., radioactive or biohazardous waste containers).

Wash hands as soon as possible after removing protective gloves.

Foot protection is designed to prevent injury from corrosive chemicals, heavy objects, electrical shock, as well as giving traction on wet floors. Appropriate closed-toed shoes should be worn in the laboratory.

"Examples of situations in which an employee should wear foot and/or leg protection include:

- When heavy objects such as barrels or tools might roll onto or fall on the employee's feet;
- Working with sharp objects such as nails or spikes that could pierce the soles or uppers of ordinary shoes;
- Exposure to molten metal that might splash on feet or legs;
- Working on or around hot, wet or slippery surfaces; and
- Working when electrical hazards are present." [3]

RESPIRATORY PROTECTION

Introduction

One of the principal routes by which chemicals can enter the body is through inhalation. If an individual is exposed to an excessive airborne concentration of a chemical over a long period of time, undesirable health effects can result.

The **Occupational Safety and Health Administration** (OSHA) has set maximum exposure standards for many airborne toxic materials. The Office of Environmental Health and Safety (EHS) can assist in determining whether a worker's exposure to chemicals and/or particulates with which he or she works exceeds these standards. If the **permissible exposure limit** is exceeded, the exposure must be reduced to acceptable levels through the use of engineering and/or administrative controls.

Engineering controls include the following:

- substitution with a less toxic material
- change in process to minimize contact with hazardous chemicals
- isolation or enclosure of a process or work operation
- wet methods to reduce the generation of dust, when applicable
- general dilution ventilation
- local exhaust, including the use of chemical fume hoods or other types of specialized ventilation systems

Administrative controls include employee-training, use of standard operating procedures, and work scheduling to minimize the length of exposure.
Respirators and other personal protective equipment may be used where engineering controls are not feasible or cannot reduce exposure to acceptable levels, or while engineering controls are being installed. The need for a respirator is dependent upon the type of operations and the nature and quantity of the materials in use and must be assessed on a case by case basis.

Scope and Application

The use of respirators at the University of Arkansas is subject to prior review and approval by EH&S. The **OSHA Respiratory Protection Standard** regulates any use of respiratory protection.

Any individual who has received approval by EH&S to use a respirator, including self-contained breathing apparatus (SCBA), must be enrolled in the Respiratory Protection Program. A physical examination and health history review will be conducted by the University Health Center for medical approval and surveillance.
Respiratory protection, through the use of supplied air or self-contained breathing apparatus, is required for work in oxygen deficient atmospheres. It also may be necessary during non-routine

operations in which the individual is exposed briefly to high concentration of a hazardous substance (e.g., maintenance or repair activities or during spill clean-up).

Program Description

The use of respirators is regulated by OSHA through the ***Respiratory Protection Standard*** (29 CFR 1910.134). The standard requires the development of a Respiratory Protection Program, including all of the elements described below.

Initial Hazard Assessment

Anyone who believes that respiratory protection is needed during the course of his or her work must notify EH&S. EH&S will evaluate the potential hazards of the work and determine whether respiratory protection is needed. This may involve personal and area air sampling to measure exposure levels.

Respirator Selection

EH&S determines the type of respirator needed (e.g., half-face or full-face air purifying respirator, powered air purifying respirator, supplied air respirator or self-contained breathing apparatus) based on the results of the initial hazard assessment. When air-purifying respirators are recommended, the appropriate type of filter or chemical cartridge is selected. Only respirators and supplies approved by the **National Institute of Occupational Safety and Health** (NIOSH) may be used.

Medical Surveillance

Prior to the assignment of respiratory protection, the individual must be evaluated by the University Health Center to determine whether he or she is able to wear a respirator. This involves the completion of a medical history questionnaire, a limited physical examination and baseline laboratory testing. This may include a pulmonary function test, a chest x-ray, an echocardiogram, a urinalysis and a complete blood count.

The medical history questionnaire (which is part of the annual Respirator Fitting Form) must be completed annually by each individual enrolled in the Respiratory Protection Program and is reviewed by a licensed healthcare professional. The frequency of physical examinations and laboratory testing is at the discretion of the physician, based, in part, on age and general health.

Training and Fit-Testing

Individuals who require respiratory protection must receive **training** before using a respirator. The training is provided by EH&S and includes discussion of the

need for respiratory protection, the elements of the Respiratory Protection Program and the individual's responsibility under it, the medical surveillance program, proper use of respiratory protection, respirator maintenance, and handling emergency situations.

Individuals required to wear negative pressure respirators must be fitted properly and tested for an adequate seal prior to use in a contaminated atmosphere. Qualitative fit-testing using banana oil is performed by EH&S. Instructions on performing positive and negative pressure checks are provided to respirator users so that they may check their respirator's fit in the field.

SCBA users must show proficiency donning and doffing the respirator. It is imperative that they know how the SCBA functions and how to use it under varying conditions.

All respirator users must attend training and be fit-tested annually.

Inspection and Maintenance

Respirator users are responsible for regular cleaning and inspection of their respirators, including looking for defects and missing parts. Respirators must be stored properly in order to protect them from dust, sunlight, excessive heat or cold, moisture and chemicals. Inspection forms are available through EHS and are distributed during annual training.

SCBA must be inspected at least monthly and a record of the inspection must be maintained. The department appoints an individual or group to be responsible for the monthly inspections. Inspection forms are available through EHS and are distributed during annual training.

Recordkeeping

For each individual assigned a respirator, the department maintains records of training, fit-testing, and respirator inspections. Medical records, including copies of the Respirator Fitting Form and results of physical examinations, are kept by the University Health Center.

Roles and Responsibilities

Department

- Recognize potential hazards and contact EH&S for evaluation.
- Purchase respirators and associated equipment.
- Notify EH&S of new individuals requiring respiratory protection.
- Spot check respirators periodically.
- Maintain inspection records of SCBA units.

- Notify EHS of changes in procedures.

Supervisors

- Recognize potential hazards and notify the department or EHS.
- Enforce the use of respiratory protection, where necessary.

EHS

- Identify and evaluate hazards.
- Select suitable respiratory protection options.
- Conduct initial and annual training and fit-testing.
- Conduct initial and periodic practice sessions for SCBA users.
- Perform periodic reevaluations of exposures.
- Maintain records of fit-testing and training.
- Audit departmental program periodically.

Individual

- Recognize and report potential hazards to Supervisor.
- Use respiratory protection as instructed.
- Attend training and fit-testing annually
- Inspect respirator for defects or missing parts.
- Clean and store respirator as instructed.
- Notify EH&S in the event of physical changes, such as scars or extreme weight gain or loss.

For More Information
Contact EH&S at 575-5448

GENERAL STANDARD OPERATING PROCEDURES

GENERAL STANDARD OPERATING PROCEDURES

The PI or Laboratory Manager is responsible for providing written SOPs relevant to health and safety for laboratory activities. Copy of SOP should be provided to EH&S office involving restricted chemicals, extremely hazardous chemicals (pyrophoric, highly reactive, etc), and high risk research procedures. Enforcement of these procedures is the responsibility of the PI or his or her designated laboratory supervisor. The PI is also responsible for ensuring that the work conducted and its scale must be appropriate to the physical facilities available, particularly with respect to the quality of ventilation.

EMERGENCY PROCEDURES

EMERGENCY PROCEDURES

Reporting Accidents

Accidents with personal injury must be reported to the laboratory supervisor on the day in which the injury occurred.

Response to Chemical Spills

All labs shall contain a chemical spill kit. See below for suggested list. Spill kits should be modified for specific needs of the lab. All personal shall be familiar with the lab chemical spill response procedures. Safely handling chemical spills in the lab requires first having a plan in place, second evaluating the severity of the spill, and finally cleaning of the spill by trained personal.

Be prepared, accidents happen:

1. Post emergency numbers by phone and lab door.
2. Establish standard operating procedures for special conditions in your lab.
3. Everyone working in the lab should read and understand the procedures.
4. Assemble a spill kit, tailored to clean up small spills of chemicals commonly used in your lab. See Appendix B for recommended spill kit.
5. Keep spill kit fully stocked and easily accessible at all time.
6. Train personnel how to use the contents of the spill kit and when it is safe to clean up a spill.
7. All personnel in lab should know :

    - Locations of fire extinguishers and manual pull stations, eye washes, emergency showers, and telephones
    - How to operate the fire extinguisher and when it's safe to do so. Training is available through the EH&S Office. For more information call EH&S Office at 575-5448.
    - How to use the eye wash and emergency shower.

Evaluate, can the spill be handled in house:

1. Small, incidental spills include spills that can be cleaned up by lab personnel without putting themselves or others in danger. If the spill presents no fire hazard and the material is not particularly volatile or toxic, cleanup is directed by the volume and state of material.
2. Large, incidental spills include:

    - Spills that present an immediate hazard (fire, explosion, chemical exposure, etc.)
    - Any spill of highly dangerous chemicals
    - Moderate or large-scale chemical spill
    - There is a fire, or the threat of fire, outside of a controlled space (fume hood).
    - There is a personnel injury or exposure likely to require medical assistance.

- The spill involves unknown or highly reactive material.
- There is a release of a toxic or flammable gas outside of a controlled space.

3. In both cases the MSDS for the chemical should be provided to the personal who will handle the cleanup of the spill.
4. U of A Police Department should be contacted (575-2222) to report all small spills. The Fayetteville Police Department should be contacted (911) for large spills.

Small Spill, cleanup procedure:

1. Alert people in the area. Avoid breathing vapors and try to determine what spilled.
2. If someone has been splashed with chemicals, immediately flush the affected area with water for at least 15 minutes. Call U of A Police, 575-2222, for advice and seek medical attention as recommended.
3. Wear personal protective equipment including safety goggles, gloves, and a long-sleeved lab coat during cleanup.
4. Confine the spill to a small area. Use a commercial kit or absorbent material from your spill kit to absorb spilled materials.

    - Using a plastic dustpan to scoop the saturated absorbent in a plastic bag or plastic bucket.
    - Re-cover the affected area with more absorbent to ensure all of spilt chemical has been absorbed, and scoop the material in the same bag or bucket with saturated absorbent.
    - Label the bag with a hazardous waste tag and include it in the next hazardous waste collection.

5. Clean the spill area with water. Detergent may be used if appropriate.
6. Clean up and leave area dry.
7. Report to supervisor and EH&S Office.
8. Replenish your spill kit supplies, so the kit is ready when you need it.

Large Spill, cleanup procedure:

1. Call EH&S Hazardous Materials Response:

    - Call 911. Police and Fire Department as well as EH&S officers will be dispatched as needed.
    - Provide as much of the following as possible to dispatch.

        - What chemical(s) are involved.
        - How much was spilled.
        - Where the spill is located.
        - Nature of any injuries.
        - What control measures have been taken.

- Your name and phone number.
- How officers can identify you. Include what you are wearing and where you will be located.

2. Emergency Guide's instructions for major chemical spills:

    - Avoid breathing vapors.
    - Alert people in the area and evacuate, closing all doors.
    - If someone has been splashed with chemicals, flush the affected area with water for at least 15 minutes.
    - Quickly identify the spilled material if you can do so safely.
    - If the spill involves a flammable liquid, turn off all ignition sources if you can do so safely.
    - Keep people away from the spill area until responders arrive. Lock doors and post warning signs.
    - Stay in safe and accessible location and identify yourself when officer come on scene.

QUICK REFERENCE FOR SPILL CLEANUPS

Type of Material/Clean-Up Procedure: The table below provides a synopsis of type chemicals that may be spilled and recommended clean-up materials. This list should be amended to add any chemicals requiring special procedures. As always, the MSDS on the particular chemical is a preferable reference.

Chemical Spilled	**Clean-Up Procedures**
Acids, organic	Apply sodium bicarbonate. Adsorb with spill pillow or vermiculite.
Acids, inorganic	Apply sodium bicarbonate/Calcium Oxide or sodium carbonate/calcium oxide. Adsorb with spill pillow or vermiculite. NOTE: Hydrofluoric acid is an exception to the general practice, see below.
Acid Chlorides	Do not use water. Absorb with sand or sodium bicarbonate.
Aldehydes	Absorb with spill pillow or vermiculite.
Aliphatic Amines	Apply sodium bisulfite. Adsorb with spill pillow or vermiculite.
Aromatic Amines	Absorb with spill pillow or vermiculite. Avoid skin contact or inhalation.
Aromatic Halogenated Amines	Absorb with spill pillow or vermiculite. Avoid skin contact or inhalation.
Azides	Absorb with spill pillow or vermiculite. Neutralize with 10% ceric ammonium nitrate solution.
Bases (caustic alkalis)	Neutralize with acid, citric acid, or commercial chemical neutralizers. Absorb with spill pillow or vermiculite.
Carbon Disulfide	Adsorb with spill pillow or vermiculite.
Chlorohydrins	Absorb with spill pillow or vermiculite. Avoid skin contact or inhalation.
Cyanides	Cover solids with damp paper towel and push onto dust pan or use a HEPA filter vacuum to collect the solids. Absorb liquids with spill pillow or vermiculite.
Halides, organic or inorganic	Apply sodium bicarbonate.
Halogenated Hydrocarbons	Absorb with spill pillows or vermiculite.
Hydrazine	Avoid organic matter. Apply "slaked lime". Adsorb with spill pillow or vermiculite.
Hydrofluoric Acid	Adsorb with calcium carbonate (limestone) or lime (calcium oxide) rather than sodium bicarbonate. The use of sodium bicarbonate will lead to the formation of sodium fluoride, which is considerably more toxic than calcium fluoride. Be careful in the use of spill pillows used to adsorb the acid. Some pillows contain silicates which are incompatible with hydrofluoric acid.
Inorganic Salt Solutions	Apply soda ash
Mercaptans/Organic Sulfides	Neutralize with calcium hypochlorite solution. Absorb with spill pillow or vermiculite.

Chemical Spilled	Clean-Up Procedures
Nitriles	Sweep up solids. Absorb liquids with spill pillows or vermiculite.
Nanoparticles	Pick up particles with a HEPA or ULPA filtered vacuum.
Nitro compounds/Organic Nitriles	Absorb with spill pillow or vermiculite. Avoid skin contact or inhalation.
Oxidizing Agents	Apply sodium bisulfite.
Peroxides	Absorb with spill pillow or vermiculite.
Phosphates, organic and related	Absorb with spill pillow or vermiculite.
Reducing Substances	Apply soda ash or sodium bicarbonate.

Emergency Response

A written, laboratory-specific emergency plan must be established and communicated to all personnel. The plan should include procedures for ventilation failure, evacuation of the laboratory, first aid and securing medical care, and reporting. Regular laboratory safety meetings and drills are recommended. There must be a written procedure for alerting all personnel in the laboratory, including areas such as growth chambers and cold rooms. Contact EH&S professionals at 575-5448 for assistance in developing such a plan.

CHEMICAL EXPOSURE ASSESSMENT

CHEMICAL EXPOSURE ASSESSMENT

In 1983, the National Academy of Sciences (NAS) published consensus-based terminology and concepts for risk assessments.

Hazard	capability of a substance to cause an adverse effect
Risk	probability that the hazard will occur under specific exposure conditions
Risk assessment	the process by which hazard, exposure, and risk are determined
Risk management	the process of weighing policy alternatives and selecting the most appropriate regulatory action based on the results of risk assessment and social, economic, and political concerns

Four fundamental steps in the risk assessment process as defined by the NAS are:

Hazard identification	characterization of innate adverse toxic effects of agents
Dose-response assessment	characterization of the relation between doses and incidences of adverse effects in exposed populations
Exposure assessment	measurement or estimation of the intensity, frequency, and duration of human exposures to agents
Risk characterization	estimation of the incidence of health effects under the various conditions of human exposure

All PIs and lab supervisors are responsible for identifying hazards, critical exposure points, how to measure for exposure and risk associated with the exposure, and how to respond to the critical points. Standard operating procedures for each response must be created and all lab personal trained to assess the risk and response to exposure. Each PI should create methods (SOPs) not only to handle when critical exposure levels are reached, but how to minimize exposure.

Minimize Exposure

Minimize exposure by careful use of chemicals and by good housekeeping. Key provisions should include a prompt cleanup of equipment and work area, as well as the washing of hands prior to leaving the laboratory. Almost all laboratory chemicals involve some degree of hazard. Do not underestimate risk. Exposure should be minimized, even for substances not known to be hazardous. Some chemicals involve particular hazards, and for these, special precautions may be necessary. *Always assume that any mixture of chemicals is more toxic than its most toxic component.* The Permissible Exposure Limits (PEL) of OSHA and the Threshold Limit Values (TLV) of the American Conference of Governmental Industrial Hygienists should not be exceeded.

Avoid acute and chronic exposure by developing and encouraging safe habits; avoid unnecessary exposure to chemicals by any route. Do not smell or taste chemicals. Vent any apparatus that may discharge toxic chemicals (vacuum pumps, distillation columns, etc.) into local exhaust devices. Inspect gloves and test glove boxes or other containment equipment before use. Be especially careful of releasing toxic substances in cold rooms and warm rooms, since these have contained, recirculated atmospheres.

Knowledge of the Chemicals Used

Before a substance is received, information on proper handling, storage, and disposal should be made known to those who will be involved. No container should be accepted without an adequate identifying label. Chemical names and labels on each container should be carefully checked and double-checked prior to use. All chemical use should be preceded by knowledge of the chemical characteristics and its potential hazards.

Containment

When chemicals are hand carried from one location to another, the container should be placed in a secondary container or bucket. Freight-only elevators should be used if possible. Provisions also must be made for secondary containment in the event of spills or container breakage.