SUNY
DOWNSTATE
Medical Center

Chemical Hygiene Plan

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PURPOSE OF THIS MANUAL

The purpose of this manual is to meet the basic regulatory requirements of the OSHA Laboratory Standard for the development of a Chemical Hygiene Plan and to provide laboratories with useful recommendations that can help achieve compliance with the intent of the OSHA Lab Standard for Occupational Exposures to Hazardous Chemicals in Laboratories (29 CFR 1910.1450). Throughout this document, areas where regulatory or University requirements exist will be clearly identified using words such as “must”, “required”, “shall”, and “it is the responsibility”, etc. All other information provided within this document are recommendations that Environmental Health and Safety encourages laboratories to follow the best management practices.

Colleges, departments, other units, and individual laboratories are free to establish the guidelines found within this document as required policies for their units or laboratories.

CHEMICAL HYGIENE PLAN

I. CHEMICAL HYGIENE RESPONSIBILITIES

A. EHS Director has the ultimate responsibility for chemical hygiene within the institution and provides, along with other officers and administrators, continuing support for efforts to improve chemical laboratory safety and health.

B. Chemical Hygiene Officer (CHO)
The Associate Facilities Program Coordinator is the current Chemical Hygiene Officer. The Industrial Hygienist can be reached at 718-221-5212 and is located in BSB 3-136. The CHO coordinates all laboratory health and safety activities.

The Chemical Hygiene Officer reports to EHS Director and is given the authority to shutdown or suspend operations that do not conform to health and safety practices required by this Chemical Hygiene Plan. The CHO will exercise their authority in order to minimize the short and long-term dangers to laboratory employees, other workers, the community, and to the environment.

The major duties of the Chemical Hygiene Officer are to:

- Provide technical expertise and administrative support to the laboratory community in the area of laboratory safety and health, and direct inquiries to appropriate resources
- Ensure that extremely hazardous substances are appropriately labeled, handled, and stored and that specific standard operating procedures that instruct all personnel in the safe use of these substances
- Review specific operating procedures developed by Principal Investigators and departmental personnel for the use, disposal, spill cleanup, and decontamination of extremely hazardous chemicals and substances are developed and followed
- Review new research protocols prior to their initiation to determine if hazardous chemicals are used and, if so, to ensure proper measures are taken to protect laboratory personnel
- Conduct bi-annual inspections of laboratories and storage areas and provide inspection forms to departmental personnel and Principal Investigators to conduct their own routine inspections
- Write inspection reports and recommendation follow-up activities (with input from other members of the inspection team)
- Remain aware of campus-wide safety and health-related activities
- Liaison with the laboratory safety officer the principal investigators, laboratory supervisors or laboratory safety officer.

C. Department Chairpersons
The Department Chairperson is ultimately responsible for chemical hygiene in their department and must know and understand the goals of the Chemical Hygiene Program. The duties of the Chairpersons are to ensure that the Principal Investigators, Laboratory Supervisors, or the Laboratory Safety Officers are upholding their responsibilities.

D. Principal Investigators, Laboratory Supervisors and Laboratory Safety Officers

Principal Investigators, Laboratory Supervisors and Laboratory Safety Officers have ultimate responsibility for chemical hygiene in the clinical, research or teaching laboratories in which they work.

It is their duties to:

- Know and implement the guidelines and procedures of the Chemical Hygiene Plan
- Write specific operating procedures for handling and disposing of extremely hazardous substance used in their laboratories and submit these procedures to the CHO for review. (These policies do not have to be written for minimal-risk chemicals and derivatives).
- Conduct departmental and laboratory specific training for all laboratory personnel in these operating procedures and ensure the use of proper control measures
- Maintain these training records and sign-in sheets with the training outline
- Ensure all monthly departmental laboratory inspections forms be kept on file
- Ensure that all appropriate controls including fume hoods, biological cabinets, and safety equipment, such as eyewash stations are available and in good working order
- Development of checklists for needed safety equipment in the department laboratories, and to ensure prompt acquisition of the equipment
- Ensure that all incidents occurring in their laboratories are reported to the CHO and that a written incident report is also filed
- Supervise the maintenance of SDSs and ensure laboratory employee access to SDSs
- To act as a Liaison whenever a new chemical is used, a copy of the SDS should be submitted to the CHO
- Maintain and update each laboratory chemical inventory
- Routine identification of expired and unusable chemicals stored for disposal
- Include provisions for Chemical Hygiene Plan compliance in grant proposals

E. Laboratory Employees, Users, and Volunteers

Laboratory employees are those who, in the course of their work, are present in the laboratory or are at risk of possible exposure on a regular or periodic basis. These include laboratory technicians, instructors, researchers, secretaries, graduate assistants, and student aides, part-time and temporary employees.

All employees, users, and volunteers must:

- Follow procedures and guidelines outlined in the Chemical Hygiene Plan
- Report any unsafe working conditions, faulty fume hoods, biological cabinets or emergency safety equipment to the Laboratory Supervisor and CHO
- File incident reports with the administration
- Conduct hazard evaluations for procedures conducted in the laboratory and maintain a file of those hazards
- Wear or use required personal protective equipment
- Request information and training when unsure about how to handle an unfamiliar or hazardous chemical or procedure

F. Chemical Inventory Management

The management and control of chemicals are the responsibility of everyone involved in the acquisition, use, and disposition of a chemical. SUNY Downstate has a responsibility to comply with a myriad of federal, state, and local regulations covering chemical purchase, use, transportation, storage, emergency planning, and disposal.

G. Objectives

The goals of our system are to:

- Ensure that chemicals are properly identified in the records of SUNY Downstate and that pertinent health, safety and other information regarding each item in the inventory is readily available and accessible
- Facilitate the physical inventory of chemicals through maintenance of a standard system
- Minimize the number and amount of chemicals stored throughout the university
- Maintain information on usage, age, shelf-life and proper disposal of chemicals throughout the facility

H. Information and Training

Employee information and training will occur initially during a new employee orientation period. Information and training will be refreshed by department as needed with a formal training session at least annually. Training and information distribution is a continuous process. Principal Investigators, Laboratory Supervisors and Laboratory Safety Officers must ensure that everyone working or studying under them has been adequately trained on the chemicals, equipment and procedures that they are using. Training records must be kept on file.

I. Training

Training will consists of methods and observations that may be used to detect the presence or release of a hazardous chemical, the physical and health hazardous of chemicals in the work area, the measures employees can take to protect themselves from exposure, including engineering controls, personal protective equipment, work practices, and emergency procedures.

CHEMICAL INVENTORY

Every lab must have an updated inventory list of all chemicals in their labs. The Principal Investigator and Lab Supervisor are responsible for sending an updated list to the Office of Environmental Health & Safety quarterly.

PERSONNEL PROTECTIVE EQUIPMENT

Protective Clothing

Protective clothing includes lab coats or other protective garments such as aprons, boots, shoe covers, Tyvek coveralls, and other items, that can be used to protect street clothing from biological or chemical contamination and splashes as well as providing additional body protection from some physical hazards.

EH&S strongly recommends that Principal Investigators and laboratory supervisors discourage the wearing of shorts and skirts in laboratories using hazardous materials (chemical, biological, and radiological) by laboratory personnel, including visitors, working in or entering laboratories under their supervision. To minimize the possibility of spreading chemicals to members of the public and office areas, lab coats used in the laboratory shall not be worn outside the laboratory. Lab coats shall be cleaned regularly.

The following characteristics should be taken into account when choosing protective clothing:

- The specific hazard(s) and the degree of protection required, including the potential exposure to chemicals, radiation, biological materials, and physical hazards such as heat.
- The type of material the clothing is made of and its resistance to the specific hazard(s) that will be encountered.
- The comfort of the protective clothing, which impacts the acceptance and ease of use by laboratory personnel.
- Whether the clothing is disposable or reusable - which impacts cost, maintenance, and cleaning requirements.
- How quickly the clothing can be removed during an emergency. It is recommended that lab coats use snaps or other easy to remove fasteners instead of buttons.

Laboratory personnel who are planning experiments that may require special protective clothing or have questions regarding the best protective clothing to choose for their experiment(s) should contact Environmental Health & Safety at 718-221-5212 for recommendations.

Double Gloving

A common practice to use with disposable gloves is “double-gloving”. This is accomplished when two pairs of gloves are worn over each other to provide a double layer of protection. If the outer glove becomes contaminated, starts to degrade, or tears open, the inner glove continues to offer protection until the gloves are removed and replaced. The best practice is to check outer gloves frequently, watching for signs of degradation (change of color, change of texture, tears, etc.). At the first sign of degradation or contamination, always remove and dispose of the contaminated disposable gloves immediately and double-glove with a new set of gloves. If the inner glove appears to have any contamination or degradation, remove both pairs of gloves, and double glove with a new pair.

Another approach to double gloving is to wear a thin disposable glove (4 mil Nitrile) under a heavier glove (8 mil Nitrile). The outer glove is the primary protective barrier while the under glove retains dexterity and acts as a secondary barrier in the event of degradation or permeation of the chemical through the outer glove. Alternately, you could wear a heavier (and usually more expensive and durable) 8 mil Nitrile glove as an under glove and wear thinner, disposable 4 mil Nitrile glove as the outer glove (which can help improve dexterity). However, remember to change the thinner outer gloves frequently.

When working with mixtures of chemicals, it may be advisable to double glove with two sets of gloves made from different materials. This method can offer protection in case the outer glove material becomes permeated by one chemical in the mixture, while allowing for enough protection until both gloves can be removed. The type of glove materials selected for this type of application will be based on the specific chemicals used as part of the mixture. Check chemical manufacturers glove selection charts first before choosing which type of glove to use.

To properly remove disposable gloves, grab the cuff of the left glove with the gloved right hand and remove the left glove. While holding the removed left glove in the palm of the gloved right hand, insert a finger under the cuff of the right glove and gently invert the right glove over the removed left glove and dispose of them properly. Be sure to wash your hands thoroughly with soap and water after the gloves have been removed.

Types of Gloves

As with protective eyewear, there are a number of different types of gloves that are available for laboratory personnel that serve different functions: (See Appendix B)

Fabric Gloves

Fabric gloves are made of cotton or fabric blends and are generally used to improve grip when handling slippery objects. They also help insulate hands from mild heat or cold. These gloves are not appropriate for use with chemicals because the fabric can absorb and hold the chemical against a user's hands, resulting in a chemical exposure.

Leather Gloves

Leather gloves are used to guard against injuries from sparks, scraping against rough surfaces, or cuts from sharp objects like broken glass. They are also used in combination with an insulated liner when working with electricity. These gloves are not appropriate for use with chemicals because the leather can absorb and hold the chemical against a user's hands, resulting in a chemical exposure.

Metal Mesh Gloves

Metal mesh gloves are used to protect hands from accidental cuts and scratches. They are most commonly used when working with cutting tools, knives, and other sharp instruments.

Cryogenic Gloves

Cryogenic gloves are used to protect hands from extremely cold temperatures. These gloves should be used when handling dry ice and when dispensing or working with liquid nitrogen and other cryogenic liquids.

Chemically Resistant Gloves

Chemically resistant gloves come in a wide variety of materials. The recommendations given below for the specific glove materials are based on incidental contact. Once the chemical makes contact with the gloved hand, the gloves should be removed and replaced as soon as practical. Often a glove specified for incidental contact is not suitable for extended contact, such as when the gloved hand can become covered or immersed in the chemical in use. Before selecting chemical resistant gloves, consult the glove manufacturers' recommendations or their glove selection charts, or contact EH&S at 718-221-5212 for more assistance.

Some general guidelines for different glove materials include:

- Natural Rubber Latex***- Resistant to ketones, alcohols, caustics, and organic acids. See note below.
- Neoprene - Resistant to mineral acids, organic acids, caustics, alcohols, and petroleum solvents.
- Nitrile - Resistant to ketones, alcohols, caustics, and organic acids.
- Norfoil - Rated for chemicals considered highly toxic and chemicals that are easily absorbed through the skin. These gloves are chemically resistant to a wide range of materials that readily attack other glove materials. These gloves are not recommended for use with Chloroform. Common brand names include: Silver Shield by North Hand Protection, 4H by Safety4, or New Barrier by Ansell Edmont.
- Polyvinyl chloride (PVC) - Resistant to mineral acids, caustics, organic acids, and alcohols.
- Polyvinyl alcohol (PVA) - Resistant to chlorinated solvents, petroleum solvents, and aromatics.

*** A note about latex gloves

The use of latex gloves, especially thin, disposable exam gloves, for chemical handling is discouraged because latex offers little protection from commonly used chemicals. Latex gloves can degrade severely in minutes or seconds, when used with common lab and shop chemicals. Latex gloves also can cause an allergic reaction in a percentage of the population due to several proteins found in latex. Symptoms can include nasal, eye, or sinus irritation, hives, shortness of breath, coughing, wheezing, or unexplained shock. If any of these symptoms become apparent in personnel wearing latex gloves, discontinue using the gloves and seek medical attention immediately.

The use of latex gloves is only appropriate for:

- Most biological materials
- Non-hazardous chemicals
- Clean room requirements
- Medical or veterinary applications
- Very dilute, aqueous solutions containing <1% for most hazardous chemicals or less than 0.1% of a known or suspected human carcinogen

Staff required to wear latex gloves should receive training on the potential health effects related to latex. Hypoallergenic, non-powdered gloves should be used whenever possible. If a good substitute glove material is available, then use non-latex gloves. A general-purpose substitute for disposable latex gloves are disposable Nitrile gloves.

See the appendix for a list of recommended gloves for specific chemicals, definitions for terms used in glove selection charts, glove materials and characteristics, and a list of useful references.

Flammable and Combustible Liquids

The OSHA Laboratory Standard defines a flammable liquid as any liquid having a flashpoint below 100 degrees F (37.8 degrees C), except any mixture having components with flashpoints of 100 degrees F (37.8 degrees C) or higher, the total of which make up 99% or more of the total volume of the mixture. Flashpoint is defined as the minimum temperature at which a liquid gives off enough vapor to ignite in the presence of an ignition source. An important point to keep in mind is the risk of a fire requires that the temperature be above the flashpoint and the airborne concentration be in the flammable range above the Lower Explosive Limit (LEL) and below the Upper Explosive Limit (UEL).

The OSHA Laboratory Standard defines a combustible liquid as any liquid having a flashpoint at or above 100 degrees F (37.8 degrees C), but below 200 degrees F (93.3 degrees C), except any mixture having components with flashpoints of 200 degrees F (93.3 degrees C), or higher, the total volume of which make up 99% or more of the total volume of the mixture. OSHA further breaks down flammables into Class I liquids, and combustibles into Class II and Class III liquids. Please note this classification is different than the criteria used for DOT classification. This distinction is important because allowable container sizes and storage amounts are based on the particular OSHA Class of the flammable liquid.

Classification	Flash Point	Boiling Point
Flammable Liquid		
Class IA	<73 degrees F	<100 degrees F
Class IB	<73 degrees F	>=100 degrees F
Class IC	>=73 degrees F, <100 degrees F	>100 degrees F
Combustible Liquid		
Class II	>=100 degrees F, <140 degrees F	--
Class IIIA	>=140 degrees F, < 200 degrees F	--
Class IIIB	>=200 degrees F	--

Under the Department of Transportation (DOT) hazard class system, flammable liquids are listed as hazard class 3.

When using flammable liquids, keep containers away from open flames; it is best to use heating sources such as steam baths, water baths, oil baths, and heating mantels. Never use a heat gun to heat a flammable liquid. Any areas using flammables should have a fire extinguisher present. If a fire extinguisher is not present, then contact Environmental Health & Safety at 718-270-1216 for more assistance.

Always keep flammable liquids stored away from oxidizers and away from heat or ignition sources such as radiators, electric power panels, etc.
When pouring flammable liquids, it is possible to generate enough static electricity to cause the flammable liquid to ignite. If possible, make sure both containers are electrically interconnected to each other by bonding the containers, and connecting to a ground.

Always clean up any spills of flammable liquids promptly. Be aware that flammable vapors are usually heavier than air (vapor density > 1). For those chemicals with vapor densities heavier than air (applies to most chemicals), it is possible for the vapors to travel along floors and, if an ignition source is present, result in a flashback fire. Also contact Environmental Health & Safety at 718-270-1216 or Public Safety at 718-270-2626.

Flammable Storage in Refrigerators/Freezers

It is important to store flammable liquids only in specially designed flammable storage refrigerators/freezers or explosion-proof refrigerators/freezers. Do not store flammable liquids in standard (non-flammable rated) refrigerators/freezers. Standard refrigerators are not electrically designed to store flammable liquids. If flammable liquids are stored in a standard refrigerator, the build up of flammable vapors can be in sufficient quantities to ignite when the refrigerator's compressor or light turns on, resulting in a fire or an explosion.
Properly rated flammable liquid storage refrigerators/freezers have protected internal electrical components and are designed for the storage of flammable liquids. Explosion-proof refrigerators/freezers have both the internal and external electrical components properly protected and are designed for the storage of flammable liquids. Refrigerators and freezers rated for the storage of flammable materials will be clearly identified as such by the manufacturer.

For most laboratory applications, a flammable storage refrigerator/freezer is acceptable. However, some operations may require an explosion-proof refrigerator/freezer. In the case of limited funding where a laboratory cannot purchase a flammable storage refrigerator for the laboratory's own use, EH&S strongly encourages departments and laboratory groups on each floor to consider purchasing a communal flammable storage refrigerator for the proper and safe storage of flammable liquids.

Flammable Storage Cabinets

The requirements for use of flammable storage cabinets are determined by the classification of the flammable liquids, the quantities kept on hand, the building construction (fire wall ratings), and the floor of the building the flammables are being stored on. As a general rule of thumb, **if you have more than 10 gallons of flammable liquids, including materials in use, then you should store the flammable liquids in a properly rated flammable liquid storage cabinet.** All flammable liquids not in use should be kept in the flammable liquid storage cabinet. For stand-alone flammable cabinets (as opposed to cabinets underneath fume hoods), there are vent holes on each side of the cabinet (called bung holes) that must have the metal bungs screwed into place for the cabinet to maintain its fire rating. Venting of flammable cabinets is NOT required, however, if a flammable cabinet is vented, it must be vented properly according to the manufacturer's specifications and NFPA 30. Typically, proper flammable cabinet ventilation requires that air be supplied to the cabinet and the air be taken away via non-combustible pipes.

Flammable Solids

The OSHA Laboratory Standard defines a flammable solid as a "solid, other than a blasting agent or explosive, that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited, burn so vigorously and persistently to create a serious hazard." An example of a flammable solid is gunpowder.

Under the DOT hazard class system, flammable solids are listed as hazard class 4. Flammable solids are further broken down into three subcategories:

- Flammable Solids – Class 4.1
- Spontaneously Combustible – Class 4.2
- Dangerous When Wet – Class 4.3

Many of the same principles for handling and storage of flammable liquids apply to flammable solids. Always keep flammable solids stored away from oxidizers, and away from heat or ignition sources such as radiators, electric power panels, etc.

Labeling Requirements

In all cases, regardless of the labeling system used, the following labeling requirements must be followed:

- All chemical containers (both hazardous and non-hazardous) MUST be labeled. Chemical names must be written out in English. If a label is starting to fall off a chemical container or is becoming degraded, then the container needs to be relabeled (using tape, permanent marker, EH&S Right-To-Know labels, etc.) or the chemical needs to be transferred to another properly labeled container.
- If abbreviations such as formulas, structures, or acronyms are used, then a "key" to the abbreviations must be hung up in a conspicuous location.
- All personnel working in the laboratory must be fully trained on how to label chemicals using the system and how to understand the labeling system. Training must occur when a new person begins working in the laboratory, when new chemicals are introduced, and should occur on a regular basis – annually at a minimum.
- Chemical waste containers must be labeled with the list of following:
  - Name of chemical(s)
  - Initial date chemical was added
  - Room number

Chemical Storage

Chemical storage areas in the academic laboratory setting include central stockrooms, storerooms, laboratory work areas, storage cabinets, refrigerators, and freezers. There are established legal requirements as well as recommended practices for proper storage of chemicals. Proper storage of chemicals promotes safer and healthier working conditions, extends the usefulness of chemicals, and can help prevent contamination. Chemicals that are stored improperly can result in:

- Degraded containers that can release hazardous vapors that are detrimental to the health of laboratory personnel.
- Degraded containers that allow chemicals to become contaminated, which can have an adverse effect on experiments.
- Degraded containers that can release vapors, which in turn can affect the integrity of nearby containers.
- Degraded labels that can result in the generation of unknowns.
- Chemicals becoming unstable and/or potentially explosive.
- Citation and/or fines from state and federal regulatory agencies.

General Storage Guidelines

Laboratories should adhere to the following storage guidelines for the proper and safe storage of chemicals. By implementing these guidelines, laboratories can ensure safer storage of chemicals and enhance the general housekeeping and organization of the lab. Proper storage of chemicals also helps utilize limited laboratory space in a more efficient manner.

- All chemical containers MUST be labeled. Labels should include the name of the chemical constituent(s) and any hazards present. Be sure to check chemical containers regularly and replace any labels that are deteriorating or falling off and/or relabel with another label before the chemical becomes an unknown.
- Every chemical should have an identifiable storage place and should be returned to that location after use.
- The storage of chemicals on bench tops should be kept to a minimum to help prevent clutter and spills, and to allow for adequate working space.
- Chemical storage in fume hoods should be kept to a minimum - limited to the experiment being conducted. Excess storage of chemical containers in hoods can interfere with airflow, reduce working space, and increase the risk of a spill, fire, or explosion.

- For chemical storage cabinets, larger chemical bottles should be stored towards the back and smaller bottles should be stored up front where they are visible. Chemical bottles should be turned with the labels facing out so they can be easily read.
- Chemicals should not be stored on the floor due to the potential for a bottle to be knocked over and result in a spill. If it is necessary to store bottles on the floor, then the bottles should be placed in secondary containment, such as trays, and the bottles should be placed away from aisle spaces.
- For multiples of the same chemical, older containers should be stored in front of newer chemicals and containers with the least amount of chemical should be stored in front of full containers. This allows for older chemicals to get used up first and helps to minimize the number of chemical containers in the storage area.
- Do not store chemicals in direct sunlight or next to heat sources.
- Laboratories should strive to keep only the minimum quantity of chemicals necessary. When ordering new chemicals, laboratories should only order enough stock needed for the experiment or the quantity that will get used up within 1 or 2 years at most.
- Liquid chemical containers should be stored in secondary containment, such as trays, to minimize the potential for bottle breakage and minimize the potential for spills.
- Always segregate and store chemicals according to compatibility and hazard classes.
- Chemical containers should be dated when they arrive and should be checked regularly and disposed of when they get past their expiration date. **Please Note**: Due to the potential explosion hazard, peroxide forming chemicals are required to be tested and dated.
- Flammable liquids in excess of quantities for specific flammability classes must be stored in approved flammable liquid storage cabinets.
- Do not store acids in flammable liquid storage cabinets. This can result in serious degradation of the storage cabinet and the containers inside. Corrosive chemicals should be stored in corrosion resistant cabinets. The exceptions to this rule are organic acids, such as Acetic acid, Lactic acid, and Formic acid, which are considered flammable/combustible and corrosive and can be stored in flammable or corrosive storage cabinets.
- Do not store corrosive or other chemicals that can be injurious to the eyes above eye level. In general and where practical, no chemicals should be stored above eye level.
- Do not store flammable liquids in standard (non-explosion proof) refrigerators or freezers. Due to the potential explosion hazard, only store flammables in refrigerators or freezers approved by the manufacturer for storage of flammables.
- Highly toxic chemicals such as inorganic cyanides should be stored in locked storage cabinets. Always keep the quantities of highly toxic chemicals to an absolute minimum. See Particularly Hazardous Substances section.
- Be aware of any special antidotes or medical treatment that may be required for some chemicals (such as cyanides and Hydrofluoric acid).
- Always keep spill kits and other spill control equipment on hand in areas where chemicals are used. Ensure all personnel working in the lab have been properly trained on the location and use of the spill kit.
- For reagent shelves, it is recommended to use shelves with anti-roll lips, to prevent bottles from falling off. This can also be accomplished using heavy gauge twine or wire to create a lip on the shelf.

Transporting Chemicals

When transporting chemicals between laboratories or other buildings on campus, the following guidelines should be implemented for protection of people and the environment, and to minimize the potential for spills to occur.

- Whenever transporting chemicals by hand, always use a secondary container such as a rubber acid carrying bucket, plastic bucket, or a 5-gallon pail). If necessary, a small amount of packing material (shipping peanuts, vermiculite, or cardboard inserts), that is compatible with the chemical(s), should be used to prevent bottles from tipping over or breaking during transport. You should also have proper PPE accessible in the event of a spill.
- Wheeled carts with lipped surfaces (such as Rubbermaid carts) should be used whenever feasible.
- Whenever possible, do not use passenger elevators when transporting chemicals, only freight elevators should be used. If it is necessary to use a passenger elevator, use should be restricted to low-use times such as early in the morning or late in the afternoon. If this is not possible, be sure to warn passengers, or prohibit passengers from riding with you.
- When transporting compressed gas cylinders, always use a proper gas cylinder hand truck with the cylinder strapped to the cart and keep the cap in place. NEVER roll or drag a compressed gas cylinder.
- Avoid riding in elevators with cryogenic liquids or compressed gas cylinders. If this is necessary, consider using a buddy system to have one person send the properly secured dewars or cylinders on the elevator, while the other person waits at the floor by the elevator doors where the dewars or cylinders will arrive.

Chemical Segregation

Chemicals should be stored according to compatibility and hazard classes. Rather than store chemicals alphabetically, or by carbon number, or by physical state, etc., EH&S recommends that you segregate them by DOT hazard class first.

The potential hazards of storing incompatible chemicals together, and when an emergency occurs, include:

- Generation of heat
- Possible fires and explosion
- Generation of toxic and/or flammable gases and vapors
- Formation of toxic compounds
- Formation of shock and/or friction sensitive compounds
- Violent polymerization

The benefits of chemical segregation by hazard class include:

- Safer chemical storage
- Understanding the hazards a chemical exhibits will increase your knowledge about the chemical
- Identifying potentially explosive chemical
- Identifying multiple containers of the same chemical

When you are making decisions on how to segregate, keep in mind the following:

- Physical hazards of the chemical
- Health hazards of the chemical
- The chemical form (solid, liquid or gas)
- Concentration of the chemical

Segregation of different chemical hazard classes (such as acids and bases) can occur in the same cabinet as long as there is some form of physical separation, such as using trays with high sides or deep trays. However never store oxidizers and flammables in the same cabinet. Also, do not store compounds such as inorganic cyanides and acids in the same cabinet.

Once chemicals have been separated, ensure everyone in the lab knows the process and what system is being used. It is best to clearly identify where chemicals in each hazard class will be stored by labeling cabinets with signs, or hazard class labels. These can be purchased from a safety supply company, you can create your own, or contact Environmental Health & Safety at 718-221-5212.

If you need assistance with cleaning out your lab of old and excess chemicals, or would like assistance with segregating your chemicals, contact Environmental Health & Safety at 718-270-2395.

Biological Safety Cabinet Certifications

All biological safety cabinets must be certified to ensure proper operation. Certification is recommended:

- Before a cabinet is put into service
- After a cabinet has been repaired or relocated
- After a filter has been replaced
- At least annually

This certification must be performed by a certified contractor.

  - ENV Services - 800-292-5255 (Service Testing & Certification, Inc.)

Please note: Environmental Health & Safety does not certify biological safety cabinets.

It is the responsibility of the Principal Investigator or Laboratory Supervisor to ensure biological safety cabinets within laboratories under their supervision are certified annually.

Fume Hood Information

Fume hoods are an important engineering control designed to protect laboratory workers from potential chemical exposures. However, to gain the most protection, fume hoods must be used and maintained properly. As a user of fume hoods, there are a few simple things you can do to get the most out of this important safety device:

- Always work with hazardous chemicals in a fume hood; do not use hazardous chemicals on the bench top.
- Follow the guidelines outlined in the safe fume hood use guide below.
- Always work 6 inches back from the sash of the fume hood to achieve the best capture of chemical vapors and fumes.
- Always work with the fume hood sash as low as possible and always keep your fume hood sash closed when you are not working in it (this offers better protection against splashes and explosions and saves a significant amount of energy and electricity.
- Always report any malfunctioning fume hoods to the Control Room at x2810 immediately to have the hood repaired. If the hood is not working properly, let other people in the lab know this by hanging up a sign on the fume hood.

Biological Safety Cabinets Work Practices and Procedures

The proper use of biological safety cabinets (BSC) can complement good microbiological practices, and result in effective containment and control of biohazardous and infectious agents. These general guidelines should be followed:

- Locate the BSC “deep” in the laboratory away from air currents produced by ventilation inlets, opening/closing of the laboratory door(s), and away from areas of heavy traffic. If possible, close laboratory doors, limiting entry and egress, and walking traffic during operation. Air currents and movements create turbulence that disrupts the protective envelope of the cabinet. Additionally, other nearby laboratory equipment such as centrifuges, vacuum pumps, etc. can affect the performance of the BSC. Cabinets should not be located directly opposite of each other or opposite a chemical fume hood, as laminar airflow will be hindered.

- Plan and prepare for your work in the cabinet by having a checklist of materials needed, and place those materials in the BSC before commencing work. This reduces the number of disruptions and arm movements across the air barrier of the cabinet, thereby preserving the protective envelope and containment properties. Slow movement of arms in and out of the cabinet will reduce the risk of potential contamination.

Biological Safety Cabinets Operational Procedures

- Operate the cabinet blowers for at least five minutes before beginning work to allow the cabinet to purge or remove particulates from the cabinet.
- Disinfect and ready the work area. Wipe the work surface, interior walls, and interior surface of the window with a suitable disinfectant such as 70% ethanol, or quaternary ammonium compound, and keep wet for at least 5 -10 minutes.
- Assemble material. Introduce only those items that are required to perform the procedures and arrange the items such that work "flows" from the least to the most contaminated item. Avoid having to reach for supplies or discard items outside of the cabinet. Consequently, place pipette discard trays (containing disinfectant), biohazard bags, sharps containers, etc. inside the BSC to the most contaminated side. Limited motion in and out of the cabinet preserves the protective envelope, and prevents the release of infectious materials outside of the BSC.
- Don protective clothing. Wear laboratory coats or solid front gowns over street clothing, and long-cuffed latex or other appropriate gloves (e.g., Nitrile, vinyl). The cuffs of the gloves should be pulled up and over the cuffs of the coat sleeves.
- Avoid rapid movements inside the cabinet, and perform procedures slowly to avoid disrupting the containment properties of the cabinet.
- Do not block the front grille with papers, equipment, etc. as this may cause air to enter the workspace instead of flowing through the front grille and to the HEPA filter. Raise arms slightly, and perform operations in the middle third area of the work surface. Likewise, do not block the rear exhaust grille with any operations or equipment.
- Avoid using open flames inside the cabinet as this can create turbulence and disrupt the pattern of air, and compromise the safety of the operator and affect product protection (i.e., cause contamination). Flames can also damage the interior of the cabinet and the HEPA filters, and in certain circumstances, cause explosions (especially when flammable materials such as ethanol are present). Reevaluate your procedures to determine if sterilization is required (e.g., it is not necessary to flame the necks of flasks). Use devices such as electric furnaces to sterilize any tools, or use disposable, sterile instruments. Lastly, if a burner is necessary, use a touch plate device that provides a flame on demand, and place it to the rear of the cabinet.
- Connect suction or aspirator flasks to an overflow collection flask that contains a disinfectant (the aspirated materials can then be discarded down the sanitary sewer). Couple the flasks to an inline hydrophobic or HEPA filter designed to protect the vacuum system.
- When the work is completed, remove all items within the cabinet. Do not use the interior of the BSC as a storage area since stray organisms may become "trapped" and contaminate the cabinet. Clean all the interior surfaces of the cabinet with a suitable disinfectant. Let the blowers operate for at least five minutes with no activity inside the cabinet, to purge the BSC of contaminants.
- Investigators should remove their gowns and gloves and thoroughly wash their hands with soap and water before exiting the laboratory.

Use of Ultraviolet Lights in the Biological Safety Cabinets

Ultraviolet lights are a common accessory of many BSCs. These lamps are regarded as biocidal devices "protecting" the operator from exposure to infectious agents, and experimental materials from contamination. However, the actual effectiveness of UV light in providing this "sterile" environment is unclear. Additionally, there are potential occupational hazards that carry significant risks (e.g., serious eye and skin injury) associated with the use and misuse of these lamps. Ultraviolet lamps must be periodically tested to ensure that the energy output is adequate to kill microorganisms. The radiation output should be at least 40 microwatts/cm^2 at 254 nm when measured with a UV flux meter placed in the center of the work surface. Dust that accumulates on the surface of the lamps (UV light is unable to penetrate through dust or other materials), can affect the output performance of the lamps. Microorganisms adhering to floating dust particles or other fixed objects are also “protected” and unaffected by UV illumination.

Effective strategy to reduce or eliminate contamination utilizes well-practiced microbiological procedures, good aseptic techniques, operational procedures as outlined in this manual, and thorough decontamination procedures before and after BSC use.

Types of Biological Safety Cabinets

Biological safety cabinets are divided into 3 classifications. Class I and Class II cabinets, and the total containment Class III cabinets. Class II cabinets are the most common type of cabinet used on campus.

- Class I: The Class I biological safety cabinet is designed to provide personnel and environmental protection only. Unfiltered air is directed through the front opening, across the work area and out through the HEPA filter on top. This cabinet is conventionally used with a full width open front, or can be used with an attached armhole front panel with or without attached rubber gloves. Although Class I cabinets are simple and economical, and radioisotopes and some toxic chemicals can be used (if the exhaust is ducted to the outside), filtered air is not provided over the work area. These cabinets do not protect your materials from contaminants introduced from the environment or the operator.
- Class II: A Class II cabinet meets the requirements for the protection of product, personnel, and the environment. The capacity to protect materials within the cabinet is provided by the flow of HEPA-filtered air over the work surface. There are four subtypes of Class II cabinets based on the construction, inflow air velocities, and exhaust systems. These cabinets can be used to manipulate low to moderate risk agents.
  - Class IIA1: Air, at a face velocity of 75 lfpm, is drawn into the front grille of the cabinet away from the work surface. HEPA-filtered air is directed downward over the work area. As the air approaches the work surface, the blower part of the air is directed through the front grille and the remainder through the rear grille. From a common plenum, approximately 70% of the air is re-circulated to the work zone through a HEPA filter and about 30% is exhausted to the room through another HEPA filter. This cabinet is unsuitable for work that involves radioactive materials and toxic chemicals because of the buildup of vapors in the air re-circulated within the cabinet and exhausted out into the laboratory.
  - Class IIA2: This cabinet has a face velocity of 100 lfpm. About 70% of the air directed over the work surface is re-circulated through a HEPA supply filter, and about 30% is exhausted through a HEPA exhaust filter. Exhaust air can be directed to the room or to a facility exhaust system. Minute amounts of toxic chemicals and trace amounts of radioisotopes can be used within the hood (if used with facility exhaust), although activities should be conducted toward the rear of the cabinet.
  - Class IIB1: This cabinet has a face velocity of 100 lfpm. In contrast to the A2 cabinet, approximately 70% of the circulated air passes through a HEPA exhaust filter, whereas the remaining 30% of the air is re-circulated to the work area through a HEPA supply filter.
  - Class IIB2: These are total exhaust cabinets (no re-circulation of air within the work area), and are widely used in toxicology laboratories and similar applications where chemical effluent is present and clean air is essential. Room air enters through a blower/motor in the top of the

cabinet and passes through a HEPA supply filter into the work area as laminar unidirectional airflow. Descending air is pulled through the base of the cabinet through the perforated front and rear grilles. All of the air is pulled into a dedicated, hard-ducted exhaust system. Small quantities of toxic chemicals and radioisotopes can be used within the hood. The exhaust of a large volume of conditioned room air makes this cabinet very expensive to operate. Additionally, the cabinet must be running continuously so as not to interfere with room exhaust.

Biohazardous Waste (Regulated Medical Waste)

In New York State, the Department of Health (DOH) defines biohazardous or regulated medical waste (RMW) as "waste, which is generated in the diagnosis, treatment or immunization of human beings or animals, in research pertaining thereto, or in production and testing of biologicals". This includes:

- Cultures and stocks of agents infectious to humans (including human, primate, and mammalian cell lines), associated biologicals (e.g., serums, vaccines), and culture dishes and devices used to transfer, inoculate or mix cultures (e.g., Petri dishes, vials, flasks, inoculation loops, disposable gloves).
- Human pathological wastes including tissue, organs, and body parts, and specimens of body fluids and their containers.
- Human blood and blood products.
- Sharps such as syringes and needles, razor blades, scalpels, blood vials, etc.
- Animal wastes including carcasses, body parts, body fluids, blood, or bedding originating from animals known to be contaminated with (zoonotic organisms) or intentionally inoculated with infectious agents.

Hypodermic Syringes and Needles

All users of hypodermic syringes and needles must comply with New York State Department of Health regulations, and are responsible for appropriate procurement, storage, and distribution.

- All non-medical and non-veterinary use of syringes and needles (e.g., teaching, research) require a Department of Health Certificate of Need. Generally, individual academic departments at Cornell possess Certificates that cover all members within the respective department (please consult with your administrative manager or department chair).
- The Principal Investigator or supervisor of the laboratory or work area should assign an individual (i.e., custodian) who is responsible for the storage, security, and maintaining records of purchases and distribution.
- Individual users are responsible for securing hypodermic syringes and needles not in use in a locked drawer or cabinet, and maintaining a written log of use and distribution.
- Follow the guidelines for disposal in one of the waste segregation and disposal tables.

Compressed Gases

Compressed gases are commonly used in laboratories for a number of different operations. While compressed gases are very useful, they present a number of hazards for the laboratory worker:

- Gas cylinders may contain gases that are flammable, toxic, corrosive, asphyxiants, or oxidizers.
- Unsecured cylinders can be easily knocked over, causing serious injury and damage. Impact can shear the valve from an uncapped cylinder, causing a catastrophic release of pressure leading to personal injury and extensive damage.
- Mechanical failure of the cylinder, cylinder valve, or regulator can result in rapid diffusion of the pressurized contents of the cylinder into the atmosphere; leading to explosion, fire, runaway reactions, or burst reaction vessels.

Handling Compressed Gas Cylinders

There are a number of ways that compressed gases can be handled safely. Always practice the following when handling compressed gases:

- The contents of any compressed gas cylinder must be clearly identified. Such identification should be stenciled or stamped on the cylinder, or a label or tag should be attached. Do not rely on the color of the cylinder for identification because color-coding is not standardized and may vary with the manufacturer or supplier.
- When transporting cylinders:
  - Always use a hand truck equipped with a chain or belt for securing the cylinder.
  - Make sure the protective cap covers the cylinder valve.
  - Never transport a cylinder while a regulator is attached.
  - Always use caution when transporting cylinders – cylinders are heavy.
- Avoid riding in elevators with compressed gas cylinders. If this is necessary, consider using a buddy system to have one person send the properly secured cylinders on the elevator, while the other person waits at the floor by the elevator doors where the cylinders will arrive.
- Do not move compressed gas cylinders by carrying, rolling, sliding, or dragging them across the floor.
- Do not transport oxygen and combustible gases at the same time.
- Do not drop cylinders or permit them to strike anything violently.

Safe Storage of Compressed Gas Cylinders

Procedures to follow for safe storage of compressed gas cylinders include:

- Gas cylinders must be secured to prevent them from falling over. Chains are recommended over clamp-plus-strap assemblies due to the hazards involved in a fire and straps melting or burning. Be sure the chain is high enough on the cylinder to keep it from tipping over.
- Do not store incompatible gases right next to each other. Cylinders of oxygen must be stored at least 20 feet away from cylinders of hydrogen or other flammable gas, or the storage areas must be separated by a firewall five feet high with a fire rating of 1/2 hour.
- All cylinders should be stored away from heat and away from areas where they might be subjected to mechanical damage.
- Keep cylinders away from locations where they might form part of an electrical circuit, such as next to electric power panels or electric wiring.
- The protective cap that comes with a cylinder of gas should always be left on the cylinder when it is not in use. The cap keeps the main cylinder valve from being damaged or broken.

Operation of Compressed Gas Cylinders

The cylinder valve hand wheel opens and closes the cylinder valve. The pressure relief valve is designed to keep a cylinder from exploding in case of fire or extreme temperature. Cylinders of very toxic gases do not have a pressure relief valve, but they are constructed with special safety features. The valve outlet connection is the joint used to attach the regulator. The pressure regulator is attached to the valve outlet connector in order to reduce the gas flow to a working level. The Compressed Gas Association has intentionally made certain types of regulators incompatible with certain valve outlet connections to avoid accidental mixing of gases that react with each other. Gases should always be used with the appropriate regulator. Do not use adaptors with regulators. The cylinder connection is a metal-to-metal pressure seal. Make sure the curved mating surfaces are clean before attaching a regulator to a cylinder. Do not use Teflon tape on the threaded parts, because this may actually cause the metal seal not to form properly. Always leak test the connection.

Basic operating guidelines include:

- Make sure that the cylinder is secured.

- Attach the proper regulator to the cylinder. If the regulator does not fit, it may not be suitable for the gas you are using.
- Attach the appropriate hose connections to the flow control valve. Secure any tubing with clamps so that it will not whip around when pressure is turned on. Use suitable materials for connections; toxic and corrosive gases require connections made of special materials.
- Install a trap between the regulator and the reaction mixture to avoid backflow into the cylinder.
- To prevent a surge of pressure, turn the delivery pressure adjusting screw counterclockwise until it turns freely and then close the flow control valve.
- Slowly open the cylinder valve hand wheel until the cylinder pressure gauge reads the cylinder pressure.
- With the flow control valve closed, turn the delivery pressure screw clockwise until the delivery pressure gauge reads the desired pressure.
- Adjust the gas flow to the system by using the flow control valve or another flow control device between the regulator and the experiment.
- After an experiment is completed, turn the cylinder valve off first, and then allow gas to bleed from the regulator. When both gauges read "zero", remove the regulator and replace the protective cap on the cylinder head.
- When the cylinder is empty, mark it as "Empty", and store empty cylinders separate from full cylinders.
- Attach a "Full/In Use/Empty" tag to all of your cylinders, these tags are perforated and can be obtained from the gas cylinder vendor.

Precautions to follow:

- Use a regulator only with gas for which it is intended. The use of adaptors or homemade connectors has caused serious and even fatal accidents.
- Toxic gases should be purchased with a flow-limiting orifice.
- When using more than one gas, be sure to install one-way flow valves from each cylinder to prevent mixing. Otherwise accidental mixing can cause contamination of a cylinder.
- Do not attempt to put any gas into a commercial gas cylinder.
- Do not allow a cylinder to become completely empty. Leave at least 25 psi of residual gas to avoid contamination of the cylinder by reverse flow.
- Do not tamper with or use force on a cylinder valve.

Return of Cylinders

- Disposal of cylinders and lecture bottles is expensive, especially if the contents are unknown.
- Make sure that all cylinders and lecture bottles are labeled and included in your chemical inventory. Before you place an order for a cylinder or lecture bottle, determine if the manufacturer will take back the cylinder or lecture bottle when it becomes empty. If at all possible, only order from manufacturers who will accept cylinders or lecture bottles for return.

Hazards of Specific Gases

- Inert Gases
  - Examples: Helium, Argon, Nitrogen
  - Can cause asphyxiation by displacing the air necessary for the support of life.
  - Cryogens are capable of causing freezing burns, frostbite, and destruction of tissue.
- Cryogenic Liquids
  - Cryogenic liquids are extremely cold and their vapors can rapidly freeze human tissue.
  - Boiling and splashing will occur when the cryogen contacts warm objects.

    - Can cause common materials such as plastic and rubber to become brittle and fracture under stress.
    - Liquid to gas expansion ratio: one volume of liquid will vaporize and expand to about 700 times that volume, as a gas, and thus can build up tremendous pressures in a closed system. Therefore dispensing areas need to be well ventilated. Avoid storing cryogenics in cold rooms, environmental chambers, and other areas with poor ventilation. If necessary, install an oxygen monitor/oxygen deficiency alarm and/or toxic gas monitor before working these materials in confined areas.
- Oxidizers
    - Examples: Oxygen, Chlorine
    - Oxidizers vigorously accelerate combustion; therefore keep away from all flammable and organic materials. Greasy and oily materials should never be stored around oxygen. Oil or grease should never be applied to fittings or connectors.
- Flammable Gases
    - Examples: Methane, Propane, Hydrogen, Acetylene
    - Flammable gases present serious fire and explosion hazards.
    - Do not store near open flames or other sources of ignition.
    - Cylinders containing Acetylene should never be stored on their side.
    - Flammable gases are easily ignited by heat, sparks, or flames, and may form explosive mixtures with air. Vapors from liquefied gas often are heavier than air, and may spread along ground and travel to a source of ignition and result in a flashback fire.
- Corrosive Gases
    - Examples: Chlorine, Hydrogen Chloride, Ammonia
    - There can be an accelerated corrosion of materials in the presence of moisture.
    - Corrosive gases readily attack the skin, mucous membranes, and eyes. Some corrosive gases are also toxic.
    - Due to the corrosive nature of the gases, corrosive cylinders should only be kept on hand for 6 months (up to one year maximum). Only order the smallest size needed for your experiments.
- Poison Gases
    - Examples: Arsine, Phosphine, Phosgene
    - Poison gases are extremely toxic and present a serious hazard to laboratory staff.
    - Poisonous gases require special ventilation systems and equipment and must only be used by properly trained experts. There are also special building code regulations that must be followed with regard to quantities kept on hand and storage.

Chemical Spill Procedures

When a chemical spill occurs, it is necessary to take prompt and appropriate action. The type of response to a spill will depend on the quantity of the chemical spilled and the severity of the hazards associated with the chemical. The first action to take is to alert others in your lab or work area that a spill has occurred. Then you must determine if you can safely clean up the spill yourself.

Many chemical spills can be safely cleaned up by laboratory staff without the help of EH&S. Only attempt to clean up incidental spills if you are trained and have the proper spill cleanup materials available. Note: The following advice is intended for spills that occur within a University building. A release to the outside environment may require the University file a report with the EPA. Calling University Police will initiate this determination by the Environmental Compliance Office.

Incidental Spills

A spill is considered incidental if the criteria below are met:

Physical:

- The spill is a small quantity of a known chemical
- No gases or vapors are present that require respiratory protection

Equipment:

- You have the materials and equipment needed to clean up the spill
- You have the necessary proper personal protective (PPE) equipment available

Personal:

- You understand the hazards posed by the spilled chemical
- You know how to clean up the spill
- You feel comfortable cleaning up the spill

Incidental Spill Cleanup Procedures

- Notify other people in the area that a spill has occurred. Prevent others from coming in contact with the spill (i.e. walking through the spilled chemical). The first priority is to always protect yourself and others.
- Put on the proper Personal Protective Equipment (PPE) such as goggles, gloves, etc. before beginning cleanup. Do not unnecessarily expose yourself to the chemical.
- Stop the source of the spill if possible, and if safe to do so.
- Try to prevent spilled chemicals from entering waterways by building a dike around access points (sink, cup sinks, and floor drains inside and storm drains outside) with absorbent material if you can safely do so.
- Use the appropriate absorbent material for liquid spills (detailed in the following section).
- Slowly add absorbent material on and around the spill and allow the chemical to absorb. Apply enough absorbent to completely cover the spilled liquid.
- Sweep up the absorbed spill from the outside towards the middle.
- Scoop up and deposit in a leak-proof container.
- For acid and base spills, transfer the absorbed materials to a sink, and complete the neutralization prior to drain disposal.
- For absorbed hazardous chemicals, label the container and dispose of through the hazardous waste management program.
- If possible, mark the area of the spill on the floor with chalk.
- Wash the contaminated surface with soapy water. If the spilled chemical is highly toxic, collect the rinse water for proper disposal.
- Report the spill to your supervisor.
- Restock any spill clean up supplies that you may have used from any spill kits.

Spill Absorbent Materials

Note: *The following materials are EH&S approved/recommended spill absorbent materials, however, they are not appropriate for every possible chemical spill – when in doubt, contact EH&S at 718-270-2395 for advice.*

For acid spills (except Hydrofluoric Acid):

- Sodium carbonate
- Sodium bicarbonate (baking soda)

- Calcium carbonate
- Calcium bicarbonate
- Do not use absorbent clay for acid spills

For hydrofluoric acid (HF) spills:

- Use Calcium carbonate or Calcium bicarbonate to tightly bind the fluoride ion.

For liquid base spills:

- Use Sodium bicarbonate to lower the pH sufficiently for drain disposal.

For oil spills:

- Use ground corncobs (SlikQwik), vermiculite, or absorbent clay (kitty litter).

For most aqueous solutions:

- Use ground corn cobs (SlikQwik)

For most organic liquid spills:

- Use ground corn cobs (SlikQwik). If the liquid is flammable, be sure to use an excess of SlikQwik.

For oxidizing liquids:

- Use absorbent clay, vermiculite, or some other non-reactive absorbent material. Do not use SlikQwik or paper towels. Note: Most nitrate solutions are not sufficiently oxidizing for this requirement.

For mercury spills:

- Do not dispose of mercury or mercury contaminated spill debris in the regular trash or down the drain.
- There is no absorbent material available. Physical removal processes are best for removing and collecting mercury.
- If you need help collecting Mercury from a spill, contact EH&S spill responders by calling 911. Note: While powdered sulfur will help reduce mercury vapors, the sulfur greatly complicates the spill cleanup.

Spill Kits

While commercially available spill kits are available from a number of safety supply vendors, laboratory personnel can assemble their own spill kits to properly clean up chemicals specific to their laboratory. Whether commercially purchased or made in-house, Environmental Health & Safety strongly encourages all laboratories to obtain a spill kit for their use. Colleges and departments should give serious consideration to distributing basic spill kits to all laboratories within their units.

A useful spill kit can be assembled using a 2.5 or 5 gallon bucket containing the following absorbent materials. Stock only the absorbents appropriate for your space. Each container of absorbent must be labeled as to what it contains and what type of spills it can be used for.

Spill kit absorbent material:

- 1-5 lbs of ground corn cobs (SlikQwik) – for most aqueous and organic liquid spills.
- 1-5 lbs of absorbent clay (kitty litter) - for oils or oxidizing liquids
- 1-5 lbs of Sodium bicarbonate - for liquid acid and base spills
- 1-5 lbs of Calcium carbonate or Calcium bicarbonate - for HF spills

Equipment in the spill kit could include:

- Wisk broom and dust pan (available at home improvement stores)
- Sponge
- pH paper
- 1 gallon and 5 gallon bags - for collection of spill cleanup material
- Small and large Ziploc bags – for collection of spill cleanup material or to enclose leaking bottles/containers.

- Safety goggles
- Thick and thin Nitrile gloves
- Hazardous waste labels

The spill kit should be clearly labeled as “SPILL KIT”, with a list of the contents posted on or in the kit. This list should include information about restocking the kit after use and where to obtain restocking materials.

Laboratory personnel must also be properly trained on:

- How to determine if they can or should clean up the spill, or if they should call 911 or Environmental Health & Safety at 718-270-1216
- Where the spill kit will be kept within the laboratory
- What items are in the kit and where replacement items can be obtained
- How to use the items in the kit properly
- How to clean up the different types of chemical spills
- How to dispose of spill cleanup material

Environmental Health and Safety can provide assistance in assembling spill kits for laboratories and offer a training class on “Cleaning Up Small Spills”. More information can be obtained by contacting Environmental Health and Safety at 718-270-1216.

Major Spills

A major spill is any chemical spill for which the researcher determines they need outside assistance to safely clean up a spill. EH&S is activated to assist with spill cleanup whenever University Police are notified of a spill by calling x2626 from a campus phone 718-270-2626 from a cell phone or an off campus phone.

Major Spill Cleanup Procedures

When a spill occurs that you are not capable of handling:

- Alert people in the immediate area of the spill and evacuate the room.
- If an explosion hazard is present, do not unplug, or turn electrical equipment on or off – doing so can result in a spark and ignition source.
- Confine the hazard by closing doors as you leave the room.
- Use eyewash stations or safety showers as needed to rinse spilled chemicals off people or yourself.
- Evacuate any nearby rooms that may be affected. If the hazard will affect the entire building, then evacuate the entire building by pulling the fire alarm.
- Notify University Police by calling x2626. Always call from a safe location.

Be prepared to provide University Police with the following information:

- Where the spill occurred (building and room number)
- If there are any injuries and if medical attention is needed
- The identity of the spilled material(s) - be prepared to spell out the chemical’s name
- The approximate amount of material spilled
- How the spill occurred (if you know)
- Any immediate actions you took.
- Who first observed the spill and the approximate time it occurred
- Where you will meet emergency responders, or provide a call back number (if available)

Once outside, notify emergency responders of the location, nature and size of the spill. Isolate contaminated persons and protect yourself and others from chemical exposure.

Understanding Chemical Hazards

Chemicals pose both health and physical hazards. For the purposes of this document, health hazard will be used interchangeably with chemical hazard and health effects on the body will be used interchangeably with chemical effects on the body.

According to OSHA, health hazard means "a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term 'health hazard' includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system and agents which damage the lungs, skin, eyes, or mucous membranes."

According to OSHA, physical hazard means "a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive." Separate sections on physical hazards will be covered in later in this manual.

See Appendix C for an example of a label with the 6 GHS labeling requirements with pictograms.

Chemical Hazard Information

As part of the employers Chemical Hygiene Plan, the OSHA Laboratory Standard requires that "the employer shall provide employees with information and training to ensure that they are apprised of the hazards of chemicals present in their work area. Such information shall be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations".

It is the responsibility of the Principal Investigator and Laboratory Supervisor to ensure that staff and students under their supervision are provided with adequate training and information specific to the hazards found within their laboratories.

In addition to required health and safety training as per the OSHA Lab Standard and the University Health and Safety Policy, other sources of information on chemical and physical hazards include:

- This Laboratory Safety Manual
- Known reference materials
- Training videos
- Other department's safety manuals
- Safety Data Sheets (SDSs)
- Websites
- EH&S Training Programs
- Departmental Safety Committees
- Container labels
- Laboratory Standard Operating Procedures
- Laboratory signage and postings
- Publications such as the American Chemical Society – Chemical Health & Safety Magazine

Safety Data Sheets

Safety Data Sheets (SDSs) are an important part of any laboratory safety program in communicating information to chemical users. SDSs provide useful information such as:

- The identity of the chemical substance
- Physical and chemical characteristics
- Physical and health hazards
- Primary routes of entry
- OSHA Permissible Exposure Limits (PELs)
- Carcinogenic and reproductive health status
- Precautions for safe handling and use (including PPE)
- Spill response procedures
- Emergency and first aid questions
- Date the SDS was prepared

Any chemical shipment received should be accompanied by an SDS (unless one has been shipped with a previous order). If you do not receive an SDS with your shipment, check the chemical manufacturers website first (or call the manufacturer directly), or check the Downstate SDS website (http://www.dolphinrtk.com/frame.asp) for links to SDSs, or contact Environmental Health & Safety at 718-221-5212 to request assistance in obtaining the SDS (See Appendix A for access to Downstate SDS website).

It is the responsibility of Principal Investigators and Laboratory Supervisors to ensure that staff and students working in laboratories under their supervision have obtained required health and safety training and have access to SDSs (and other sources of information) for all hazardous chemicals used in laboratories under their supervision.

SDSs must be accessible at all times. Access to SDSs can mean access to paper copies or electronic access via the Internet. Downstate maintains links to a number of SDS websites.

EH&S strongly encourages paper copies of SDSs be kept in the laboratory, however, having SDS websites book-marked is acceptable as long as all employees in the workplace know where to find the SDS and are trained on the use of computers to access SDSs. If a laboratory chooses to use electronic access, then EH&S recommends the SDS website link be posted on the computer or in another conspicuous location.

Any accidents involving a chemical will require an SDS being provided to emergency response personnel and to the attending physician so proper treatment can be administered.

The EH&S "rule of thumb" is that a person working in a laboratory should be able to produce an SDS for any hazardous chemical found in the lab within five minutes.

Eyewash Information

Eyewash stations are important safety devices designed to protect laboratory workers from chemical exposures when an accident occurs. However, to gain the most protection, emergency showers and eyewashes must be used and maintained properly. As someone who may come to rely on the safety device someday, there are a few simple things you can do to get the most out of this important safety device:

- Always preplan your experiments and what you will do in case of an emergency. Always identify the locations of the nearest eyewash station before working with hazardous chemicals. .

- Environmental Health & Safety conducts annual inspections of eyewash stations; laboratory personnel are encouraged to test eyewash stations on a monthly basis. Laboratory personnel only need to activate the units to let the water flow for a few minutes to test the units and indicate the date and initials of person doing the testing on the tag. Testing these units on a regular basis ensures they operate properly, help to maintain the units and avoid costly repairs, and help to prevent the buildup of sediment and harmful bacteria.
- Always report any malfunctioning eyewash station to Environmental Health & Safety immediately for repairs. If the eyewash station is not working properly, let other people in the lab know this by hanging up a sign on the unit.

Housekeeping

Housekeeping refers to the general condition and appearance of a laboratory and includes:

- Keeping all areas of the lab free of clutter, trash, extraneous equipment, and unused chemical containers. Areas within the lab that should be addressed include benches, hoods, refrigerators, cabinets, chemical storage cabinets, sinks, trashcans, etc.
- Cleaning up all chemicals spills immediately, regardless if the chemical is hazardous or not. When cleaning up a chemical spill, look for any splashes that may have resulted on nearby equipment, cabinets, doors, and counter tops.
- Keeping areas around emergency equipment clean and free of clutter. This includes items such as eyewash/emergency showers, electric power panels, fire extinguishers, and spill cleanup supplies.
- Keeping a minimum of three feet of clearance (as required by fire codes) between benches and equipment. Exits must be clear of obstacles and tripping hazards such as bottles, boxes, equipment, electric cords, etc.
- When storing items overhead, keep heavier and bulkier items closer to the floor. New York State (NYS) Building Code prohibits the storage of combustible material (such as paper, boxes, plastics, etc.) within two feet of the ceiling in unsprinklered rooms and within 18" of the crown of a sprinkler head in sprinklered rooms.

In summary, good housekeeping has obvious health and safety benefits and can have a positive mental effect on laboratory personnel who work in a clean environment, which can lead to increased productivity. Also keep in mind that during an inspection by a state or federal regulatory agency, the general condition of the laboratory observed in the first few minutes of the inspection (the housekeeping of the lab) can have a significant impact (positive or negative) on the rest of the inspection process.

It is the responsibility of Principal Investigators and laboratory supervisors to ensure laboratories under their supervision are maintained in a clean and orderly manner and personnel working in the lab practice good housekeeping.

Personal Hygiene

Good chemical hygiene practices include the use of personal protective equipment (PPE) and good personal hygiene habits. Although PPE can offer a barrier of protection against chemicals and biological materials, good personal hygiene habits are essential to prevent chemical exposure, even when using PPE.

Some general guidelines that should always be followed include:

- Do not eat, drink, chew gum, or apply cosmetics in a lab.
- Do not store food or drink in refrigerators that are used to store chemicals.
- Do not ever try starting a siphon or pipette by mouth, doing so can result in ingestion of chemicals or inhalation of chemical vapors. Always use a pipette aid or suction bulb to start a siphon.

- Always confine long hair, loose clothing, and jewelry.
- Wear a lab coat when working with hazardous materials.
- Shorts and sandals should not be worn in a lab when anyone is using corrosives or other chemicals that present a skin contact hazard or where the potential for physical hazards such as dropping pieces of equipment or broken glass are present.
- Remove laboratory coats, gloves, and other PPE immediately when chemical contamination occurs. Failure to do so could result in chemical exposure.
- After removing contaminated PPE, be sure to wash any affected skin areas with soap and water for at least 15 minutes.
- Always remove lab coats, scrubs, gloves, and other PPE before leaving the lab. Do not wear lab coats, scrubs, or other PPE (especially gloves) in areas outside the lab, particularly not in areas where food and drink are served, or other public areas.

- Always wash hands with soap and water after removing gloves and before leaving the lab or using items such as the phone, turning doorknobs, or using an elevator.
- Always wash lab coats separately from personal clothing. Be sure to identify contaminated lab coats to commercial laundry facilities to help protect their workers by placing the contaminated lab coat in a separate plastic bag and clearly identifying the bag with a note or label indicating the lab coat is contaminated.
- Smoking is prohibited in all lab areas at SUNY Downstate.

Exposure Determination

The ability to recognize the signs and symptoms associated with chemical exposure is an important part of determining exposure. These may include smell, taste, skin or upper respiratory tract irritation, tearing of the eyes, cough, headache or dizziness. Specific acute and chronic health effects of exposure can be found under the *Health Hazard* section of a chemical's SDS, or the Toxicological Information section of the SDS.

If there is reason to believe that exposure levels for a substance regulated by an OSHA standard routeinely exceed the Action Level (or in the absence of an Action Level, the PEL), the air monitoring shall be conducted to determine exposure as follows:

- **Initial air monitoring:** EH&S shall measure employee exposure to the OSHA regulated substance
- **Periodic air monitoring:** If initial monitoring demonstrates employee exposure above the Action Level (or the PEL), EH&S shall implement exposure monitoring in accordance with the relevant OSHA standard
- **Termination of air monitoring:** Monitoring may be terminated in accordance with the relevant OSHA standard
- **Communication of air monitoring results:** Directors and administrators, or their designees, shall notify affected employees in writing within 15 days of receiving air monitoring results
- **Exposure control:** Based on monitoring results, directors, and administrators, or their designees, may be required to implement exposure controls. EH&S will assist with the selection of these controls

Chemical Exposure Control Methods

Hazardous chemicals can cause harm when used in a manner which provides a pathway for the chemical to enter or contact the body. The manner in which a chemical is used and the primary route of entry to or contact with the body, determine the types of controls needed to prevent exposure. The three exposure control methods are:

- Engineering controls (e.g. substituting a less hazardous chemical or using fume hoods, glove boxes, cold traps or air filtering devices).
- Administrative controls (e.g. general lab safety and health procedures, self-audits, safety policies, safety reviews of new labs and renovation projects, health and safety training programs, chemical use authorization programs, and medical consultation).
- Personal protective equipment (e.g. safety glasses, splash goggles, face shields, lab coats, aprons, gloves, arm covers and respirators).

Engineering Controls

- Laboratory employees shall use fume hoods or glove boxes when working with hazardous chemicals. The hood sash shall be placed as low as practical. Laboratory fume hoods shall have an average face velocity of 80 – 120 feet per minute with the sash open 12-18 inches. EH&S shall ensure that fume hoods are tested and certified annually. If a hood is not functioning properly, contact EH&S (718-221-5212).

Administrative Controls

- Standard Operating Procedures (SOPs)
    - The SUNY Downstate Lab Safety Handbook includes general SOPs for work with hazardous chemicals
    - PIs and laboratory managers and supervisors shall develop laboratory-specific SOPs as needed, and ensure that such procedures are followed in their laboratories
- Laboratory Safety Audits
    - EH&S shall coordinate an audit of each laboratory at least annually. Based on audit results, directors, and administrators, or their designees, may be required to ensure laboratories implement exposure controls, such as:
    - A designated area for use of extremely hazardous substance
    - Use of fume hood or glove box
    - Procedures for storage of incompatible chemicals
    - Specific waste disposal procedures
    - Specific decontamination procedures
- Information and training
    - Laboratory employees shall receive information and training at the time of initial assignment prior to any new exposure situations involving hazardous chemicals
    - EH&S shall provide and maintain documentation of general initial and refresher chemical hygiene training to include information on:
        - The requirements of the OSHA standard, Occupational Exposure to Hazardous Chemicals in Laboratories
        - The location, availability and use of SDSs and other known reference materials on the hazards, safe handling, and disposal of hazardous chemicals
        - The physical and health hazards of hazardous chemicals and signs and symptoms associated with exposure to them
        - Protective measures that can be used to protect employees from chemical hazards
        - Methods for detecting the presence or release of hazardous chemicals

Personal Protective Equipment (PPE)

- The PI/laboratory manager/supervisor shall provide employees with PPE which provides appropriate and necessary protection for substances being handled. Further information is available in the Lab Safety Handbook or by contacting EH&S

Eating, Drinking, and Applying Cosmetics in the Lab

Chemical exposure can occur through ingestion of food or drink contaminated with chemicals. This type of contamination can occur when food or drinks are brought into a lab or when food or drinks are stored in refrigerators, freezers, or cabinets with chemicals. When this occurs, it is possible for the food or drink to absorb chemical vapors and thus lead to a chemical exposure when the food or drink is consumed. Eating or drinking in areas exposed to toxic materials is prohibited by the OSHA Sanitation standard, 29 CFR 1910.141(g)(2).

A similar principle of potential chemical exposure holds true with regard to the application of cosmetics (make-up, hand lotion, etc.) in a laboratory setting when hazardous chemicals are being used. In this instance, the cosmetics have the ability of absorbing chemical vapors, dusts, and mists from the air and when applied to the skin and result in skin exposure to chemicals.

To prevent exposure to hazardous chemicals through ingestion, do not eat, drink, chew gum, or apply cosmetics in areas where hazardous chemicals are used.

Wash your hands thoroughly after using any chemicals or other laboratory materials, even if you were wearing gloves, and especially before eating or drinking.

APPENDIX A: HOW TO ACCESS ONLINE AND UNDERSTAND SDSs

Please follow all instructions carefully. If any difficulties are encountered while trying to gain access to this information, please call the Office of Environmental Health and Safety at x5212 or x1216

1. Go to www.downstate.edu
2. On the left side of the computer screen, there is a list of services offered by SUNY. Click on "Administration"
3. Click on "Material Safety Data Sheets" below the Intranet tab
4. A search page comes-up with the following information:

   Product Name: ______________________________
   Manufacturer: ______________________________

5. Type in name of chemical or the manufacturers' name, whichever is applicable/available. Then click on the 'Search option'

Chemical manufacturers are required by law to supply "Safety Data Sheets" (OSHA Form 174 or its equivalent) upon request by their customers. These sheets have nine sections giving a variety of information about the chemical. Following is a section-by-section reproduction and explanation of a Safety Data Sheet (SDS).

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration
SAFETY DATA SHEET
Required For compliance with OSHA Act of 1970
Public Law 91-596 (CFR 1910)

SECTION I	
Product Name	Size
Chemical Name	
Formula	
Manufacturer	
Address	
For Information on Health Hazards Call	
For Other Information Call	
Signature and date	

This section gives the name and address of the manufacturer and an emergency phone number where questions about toxicity and chemical hazards can be directed. Large chemical manufacturers have 24-hour hotlines manned by chemical safety professionals who can answer questions regarding spills, leaks, chemical exposure, fire hazard, etc. Other information that may be contained in Section I include:

- **Trade Name:** This is the manufacturer's name for the product.
- **Chemical Name and Synonyms:** This refers to the generic or standard names for the chemical.
- **Chemical Family:** This classification allows one to group the substance along with a class of similar substances, such as mineral dusts, acids, caustics, etc. The potential hazards of a substance can sometimes be gauged by experience with other chemicals of that hazard class.

SECTION II - HAZARDOUS INGREDIENTS OF MIXTURES		
Principal Hazardous component(s)	%	TVL (Units)

This section describes the percent composition of the substance, listing chemicals present in the mixture. It lists Threshold Limit Values for the different chemicals that are present.

Threshold Limit values (TLV's) are values for airborne toxic materials that are used as guides in the control of health hazards. They represent concentrations to which nearly all workers (workers without special sensitivities) can be exposed to for long periods of time without harmful effect. TLV's are usually expressed as parts per million (ppm), the parts of gas or vapor in each million parts of air. TLV's are also expressed as mg/m^3 the milligrams of dust or vapor per cubic meter of air.

SECTION III - PHYSICAL DATA	
Boiling Point (^oF)	Specific Gravity (H_2O=1)
Vapor Pressure (mm Hg)	Percent Volatile By Volume (%)
Vapor Density (Air=1)	Evaporation Rate (Butyl Acetate=1)
Solubility in Water	
Appearance and Odor	

This section gives information about the physical characteristics of the chemical. This information can be very useful in determining how a chemical will behave in a spill situation and what appropriate steps should be taken.

- **Vapor Pressure:** Vapor pressure (VP) can be used as a measure of how volatile a substance is…how quickly it evaporates. VP is measured in units of millimeters of mercury (mm Hg). For comparison, the VP of water (at 20^o Centigrade) is 17.5 mm Hg. The VP of Vaseline (a nonvolatile substance) would be close to zero mm Hg, while the VP of diethyl ether (a very volatile substance) is 440 mm Hg.
- **Vapor Density:** Vapor density describes whether the vapor is lighter or heavier than air. The density of air is 1.0. A density greater than 1.0 indicates a heavier vapor, a density less than 1.0 indicates a lighter vapor. Vapors heavier than air (gasoline vapor for instance) can flow along just above the ground and can collect in depressions where they may pose a fire and explosion hazard.
- **Specific Gravity:** Specific gravity describes whether the liquid is lighter or heavier than water. Water has a specific gravity of 1.0.
- **Percent Volatile by Volume:** Describes how much of the substance will evaporate

SECTION IV - FIRE AND EXPLOSION HAZARD DATA			
Flash Point (^{o}F)	Flammable Limits in Air (% by Vol.)	Lower	Upper
Extinguisher Media	Autoignition Temperature (^{o}F)		
Special Fire Fighting Procedures			
Explosion Hazards			

This section gives information, which is important for preventing and extinguishing fires and explosions. If a fire does occur, this information should be made available to fire fighters.

- **Flash Point:** Flash point is the lowest temperature at which a liquid gives off enough vapor to ignite when a source of ignition is present. A fire or explosion hazard may exist if the substance is at or above this temperature and used in the presence of spark or flame.
- **Flammable Limits:** In order to be flammable, a substance must be mixed with a certain amount of air (as in an automobile carburetor). A mixture that is too "lean" (not enough chemical) or too "rich" (not enough air) will not ignite. The Lower Explosive Limit (LEL) and the Upper Explosive Limit (UEL) define the range of concentration in which combustion can occur. The wider the range between the LEL and UEL, the more flammable the substance is.

SECTION V - HEALTH HAZARD DATA
Threshold Limit Value
Effects of Overexposure
Acute Overexposure
Chronic Overexposure
Emergency and First Aid Procedures
Inhalation
Eyes
Skin
Ingestion

This section describes the potential health effects resulting from overexposure to the chemical and gives emergency and first aid procedures. The symptoms and effects listed are the effects of exposure at hazardous levels. Most chemicals are safe in normal use and the vast majority of workers never suffer toxic effects. However, any chemical can be toxic in high concentrations, and the precautions outlined in the SDS should be followed.

The health hazards section often contains information on the toxicity of the substance. The data most often presented are the results of animal experiments. For example, "LD50 (mouse) = 250 mg/kg." The usual measure of toxicity is dose level expressed as weight of chemical per unit body weight of the animal-usually milligrams of chemical per kilogram of body weight (mg/kg). The LD50 describes the amount of chemical ingested or absorbed by the skin in test animals that causes death in 50% of test animals used during a toxicity test study. Another common term is LC50, which describes the amount of chemical inhaled by test animals that causes death in 50% of test animals used during a toxicity test study. The LD50 and LC50 values are then used to infer what dose is required to show a toxic effect on humans.

As a general rule of thumb, the lower the LD50 or LC50 number, the more toxic the chemical. Note there are other factors (concentration of the chemical, frequency of exposure, etc.) that contribute to the toxicity of a chemical, including other hazards the chemical may possess.

Health hazard information may also distinguish the effects of acute and chronic exposure. Acute toxicity is generally thought of as a single, short-term exposure where effects appear immediately and the effects are often reversible. Chronic toxicity is generally thought of as frequent exposures where effects may be delayed (even for years), and the effects are generally irreversible. Chronic toxicity can also result in acute exposures, with long-term chronic effects.

SECTION VI - REACTIVITY DATA		
Stability	Unstable	Conditions to Avoid
	Stable	
Incompatibility (Materials to Avoid)		
Hazardous Decomposition Products		
Hazardous Polymerization		Conditions to Avoid
May Occur	Will Not Occur	

This section gives information on the reactivity of the chemical – with other chemicals, air, or water, which is important when responding to a spill or fire. Chemical substances may be not only hazardous by themselves, but may also be hazardous when they decompose (break down into other substances) or when they react with other chemicals.

- **Stability: Unstable** indicates that a chemical can decompose spontaneously under normal temperatures, pressures, and mechanical shocks. Rapid decomposition may be hazardous because it produces heat and may cause a fire or explosion. **Stable** compounds do not decompose under normal conditions.
- **Incompatibility:** Certain chemicals should never be mixed because the mixture creates hazardous conditions. Incompatible chemicals should not be stored together where an accident could cause them to mix.
- **Hazardous Decomposition Products:** Other chemical substances may be created when a chemical burns or decomposes.
- **Hazardous Polymerization:** Some chemicals can undergo a type of chemical reaction (rapid polymerization), which may produce enough heat to cause containers to explode. Conditions to avoid are listed in this section.

SECTION VII - SPILL OR LEAK PROCEDURES
Steps to be Taken in Case Material is Released or Spilled

Waste Disposal Method

This section can provide specific information about how to clean up a spill of the chemical and how the chemical should be properly disposed.

<table>
<tr><th colspan="4">SECTION VIII - SPECIAL PROTECTION INFORMATION</th></tr>
<tr><td colspan="4">Respiratory Protection (Specify type)</td></tr>
<tr><td>Ventilation</td><td colspan="2">Local Exhaust</td><td>Special</td></tr>
<tr><td></td><td colspan="2">Mechanical (general)</td><td>Other</td></tr>
<tr><td colspan="2">Protective Gloves</td><td colspan="2">Eye protection</td></tr>
<tr><td colspan="4">Other Protective clothing or Equipment</td></tr>
</table>

This section gives information for any special protection that needs to be taken when handling this chemical including ventilation requirements and the type of personal protective equipment that should be worn.

SECTION IX - SPECIAL PRECAUTIONS
Precautions to be Taken in Handling and Storing
Other Precautions

This section describes other precautionary measures that may need to be taken. Some of the precautions presented are intended for large-scale users and may not be necessary for use with small quantities of the chemical. Any questions about precautions or health effects should be referred to Environmental Health & Safety at 718-221-5212.

APPENDIX B: GLOVE SELECTION FOR SPECIFIC CHEMICALS

Chemical	Incidental Contact	Extended Contact
Acetic acid	Nitrile	Neoprene, Butyl rubber
Acetic anhydride	Nitrile (8 mil), double glove	Butyl rubber, Neoprene
Acetone	[1]Natural rubber (Latex) (8 mil)	Butyl rubber
Acetonitrile	Nitrile	Butyl rubber, Polyvinyl acetate (PVA)
Acrylamide	Nitrile, or double Nitrile	Butyl rubber
bis-Acrylamide	Nitrile	
Alkali metals	Nitrile	
Ammonium hydroxide	Nitrile	Neoprene, Butyl rubber
Arsenic salts	Nitrile	
Benzotriazole, 1,2,3-	Nitrile	
Bismuth salts	Nitrile	
Butanol	Nitrile	Nitrile, Butyl rubber
Butyric acid	Nitrile	Butyl rubber, Neoprene
Cadmium salts	Nitrile	
Carbon disulfide	Nitrile (8 mil), double glove, or 15 mil or heavier	Viton, Polyvinyl acetate (PVA)
Carbon tetrachloride	Nitrile (8 mil), double glove, or 15 mil or heavier	Viton
Catechol	Nitrile	
Chloroform	Nitrile (8 mil), double glove, or 15 mil or heavier	Viton, Polyvinyl acetate (PVA)
Chlorosulfuron	Nitrile	
Chromium salts	Nitrile	
Cobalt chloride	Nitrile	
Cobalt salts	Nitrile	Nitrile
Copper (Cupric) sulfate	Nitrile	Nitrile
Cyrogenic liquids	Cryogloves	
3,3'-Diaminobenzidine (DAB)	Nitrile	Nitrile, double glove
Diazomethane in Ether	Nitrile (8 mil), double glove, or 15 mil or heavier	Norfoil
Dichloromethane	Nitrile (8 mil), double glove	Polyvinyl acetate (PVA) or Viton
2,4-Dichlorophenoxy acetic acid	Nitrile	
Diethyl pyrocarbonate	Nitrile	Nitrile, double glove
Dimethyl sulfoxide	[1]Natural rubber (15-18mil)	Butyl rubber
1,4-Dioxane	Nitrile (8 mil), double glove, or 15 mil or heavier	Butyl rubber

Dithiothreitol	Nitrile	
Ethanol	Nitrile	
Ethidium bromide (EtBr)	Nitrile	Nitrile, double glove
Ethyl acetate	Nitrile (8 mil), double glove	Butyl rubber, PVA
Ethyl ether	Nitrile (8 mil), double glove, or 15 mil or heavier	Polyvinyl acetate (PVA)
Formaldehyde	Nitrile	Nitrile
Formamide	Nitrile	Butyl rubber
Formic acid	Nitrile (8 mil), double glove	Butyl rubber, Neoprene (.28-.33mm)
Gallic acid	Nitrile	
Geneticin	Nitrile	
Glutaraldehyde	Nitrile	
Heavy metal salts	Nitrile	Nitrile, double glove
Heptane	Nitrile (8 mil), double glove, or 15 mil or heavier	Nitrile (35 mils or thicker), Viton, PVA
Hexamethylenediamine (1,6-Diaminohexane)	Nitrile (8 mil)	Neoprene
Hexane	Nitrile (8 mil), double glove, or 15 mil or heavier	Nitrile (35 mils or thicker), Viton, PVA
Hydrochloric acid	Nitrile	Neoprene, Butyl rubber
Hydrofluoric acid (HF)	Nitrile (8 mil), double glove, or 15 mil or heavier	Nitrile or Rubber sleeves
Hypophosphorous acid	Nitrile (4mil), double glove or 8 mil or heavier	
Isoamyl alcohol	Nitrile	
Isoctane	Nitrile	Heavy weight Nitrile
Isopropanol	Nitrile	
Kananmycin	Nitrile	
Lactic acid	Nitrile	Nitrile (double glove), or Neoprene or Butyl rubber
Laser dyes	Nitrile	
Lead acetate	Nitrile	Nitrile, double glove
Lead salts	Nitrile	
Mercuric chloride	Nitrile	Nitrile, double glove
Mercury	Nitrile	
Mercury salts	Nitrile	
Methanol (Methyl alcohol)	Nitrile	
Methylene chloride	Nitrile (8 mil), double glove	Polyvinyl acetate, Viton

Methylphosphonic acid	Nitrile (4 mil), double glove	8 mil or heavier Nitrile
Methyl sulfonic acid, Ethyl ester (EMS) (Ethyl methanesulfonate)	Nitrile	Nitrile, double glove
Monoethanolamine	Nitrile	
Nickel chloride	Nitrile	Nitrile, double glove
Nickel salts	Nitrile	Nitrile, double glove
Nitric acid	Nitrile (8 mil), double glove	Heavy weight (.28-.33mm) Butyl rubber or Neoprene
N-Methylethanolamine	Nitrile (8 mil), double glove	Viton, Neoprene, Butyl rubber
Octane	Nitrile	Heavy weight Nitrile or Viton
Organophosphorous compounds	Nitrile (8 mil), double glove, or 15 mil or heavier	
Osmium salts	Nitrile	
Osmium tetroxide	Nitrile	Nitrile, double glove
Paraformaldehyde	Nitrile	
Pentane	Nitrile (8mil), double glove	Heavy weight Neoprene, or Viton
Perchloroethylene (tetrachloroethylene)	Nitrile (8 mil), double glove	Nitrile (22mil or heavier)
Pesticides	Heavy weight, unlined Nitrile (8-20 mils), or glove specified by pesticide label.	
Petroleum ether	Nitrile	Heavy weight Nitrile or Viton
Phenol	Nitrile (8 mil), double glove	Neoprene, Butyl rubber
Phenol-Chloroform mixtures	Nitrile (8 mil), double glove, or 15 mil or heavier	Viton
Phenylmethylsulfonyl fluoride (PMSF)	Nitrile	Nitrile, double glove
Phosphonic acid	Nitrile (4 mil), double glove, or 8 mil or heavier single	
Phosphoric acid	Nitrile (4 mil), double glove, or 8 mil or heavier	
Picloram (4-amino-3,5,6-trichloropicolinic acid)	Nitrile	
Polychlorinated Biphenyls (PCB's)	Nitrile (8 mil) glove over a Neoprene glove	Neoprene (20 mil)
Polyoxyethylene-sorbital-n-monolaurate (Tween 20)	Nitrile	
Potassium ferricyanide	Nitrile	
Potassium ferrocyanide	Nitrile	
Potassium permanganate	Nitrile	

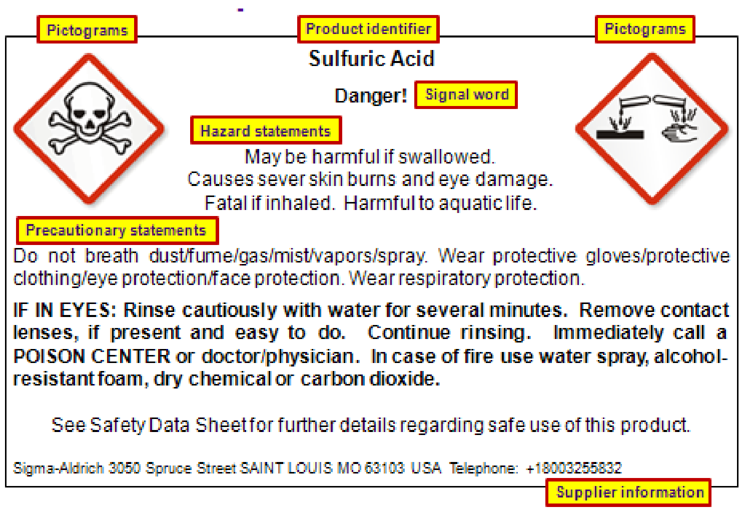
Propanol	Nitrile	
Propionic acid	Nitrile	Neoprene or Butyl rubber
Propylene oxide	Heavier weight (17 mil or greater) Butyl rubber or Neoprene	Norfoil
Psoralen	Nitrile	Nitrile, double glove
Pump oil	Butyl rubber	
Silane based silanization or derivatization compounds	Nitrile (8 mil), double glove, or 15 mil or heavier single	
Silver nitrate	Nitrile	Nitrile, double glove
Silver salts	Nitrile	
Sodium dodecyl sulfate (SDS)	Nitrile	
Sodium azide	Nitrile, or double glove	
Spermidine	Nitrile	
Sulfuric acid	Nitrile (8 mil)	Neoprene, Butyl rubber (20 mil or greater)
Tetrahydrofuran (THF)	Nitrile (8 mil), double glove, or 15 mil or heavier	Norfoil
3,3',5,5'-Tetramethyl-benzidine (TMB)	Nitrile	Nitrile, double glove
N,N,N',N'-Tetramethyl-ethylenediamine (TEMED)	Nitrile	Nitrile, double glove
Timetin	Nitrile	
Toluene	Nitrile (8 mil), double glove, or 15 mil or heavier	Viton, Polyvinyl acetate (PVA)
Trichloroethylene	Nitrile (8 mil), double glove	Viton, Polyvinyl acetate (PVA)
Trichloromethyl chloroformate (diphosgene)	Nitrile (8 mil) over Butyl rubber glove	This material must be used in a glove box.
Triton-X100	Nitrile	
Uranium salts	Nitrile	
Valeric acid	Nitrile	Nitrile, double gloves, or Neoprene or Butyl rubber
Xylene	Nitrile	Polyvinyl acetate (PVA), Viton

[1]If you are allergic to natural rubber products, you may double glove with 8 mil Nitrile gloves.

APPENDIX C: GHS LABELING REQUIREMENTS

SAMPLE LABEL

WITH 6 REQUIRED LABEL ELEMENTS



PICTOGRAMS

Health Hazard  ▪ Carcinogen ▪ Mutagenicity ▪ Reproductive Toxicity ▪ Respiratory Sensitizer ▪ Target Organ Toxicity ▪ Aspiration Toxicity	**Flame**  ▪ Flammables ▪ Pyrophorics ▪ Self-Heating ▪ Emits Flammable Gas ▪ Self-Reactives ▪ Organic Peroxides	**Exclamation Mark**  ▪ Irritant (skin and eye) ▪ Skin Sensitizer ▪ Acute Toxicity ▪ Narcotic Effects ▪ Respiratory Tract Irritant ▪ Hazardous to Ozone Layer (Non-Mandatory)
Gas Cylinder  ▪ Gases Under Pressure	**Corrosion**  ▪ Skin Corrosion/Burns ▪ Eye Damage ▪ Corrosive to Metals	**Exploding Bomb**  ▪ Explosives ▪ Self-Reactives ▪ Organic Peroxides
Flame Over Circle  ▪ Oxidizers	**Environment**  (Non-Mandatory) ▪ Aquatic Toxicity	**Skull and Crossbones**  ▪ Acute Toxicity (fatal or toxic)

APPENDIX D: GUIDELINES FOR THE ALLOCATION OF RESEARCH LABORATORY SPACE IN THE COLLEGE OF MEDICINE

<u>Principles</u>:

A) Though the ultimate authority for space allocation resides with the Dean of the College of Medicine, Departmental Chairs have been given the primary responsibility for assigning or reassigning space, in accordance with the principles outlined below.

B) Space assignments are not deeded for "life" but will be periodically reviewed and adjusted, when necessary, to reflect changes in (1) research direction, (2) the size, scope and nature of research that is ongoing, and (3) the magnitude of funding and the source of that funding (peer-reviewed full indirect cost-bearing grants being most valuable to the institution). The Department Chair is responsible, in the first instance, for this periodic review of the space allocation/usage within his/her department, using available qualitative and quantitative measures of productivity relating to research.

C) As a general rule, faculty members and staff personnel should be assigned space appropriate to their needs by their department chair. When those needs change, e.g., when an individual no longer applies for or is unable to secure peer-reviewed indirect cost-bearing extramural funds, the chair will re-assign space that is more appropriately sized to accommodate his/her needs. If a faculty member or staff member is unwilling to accept space offered to him/her by his/her chair, the issue should be referred to the Dean or appropriate administrative officer for adjudication.

D) In order to enjoy the continued use of laboratory space, faculty members must meet two threshold conditions:
   1) They must have published at least one paper reporting the results of their laboratory-based research in a peer-reviewed journal as first or senior author in the previous two years.
   2) They must be fully compliant (or become compliant within 30 days of notification of non-compliance) with all applicable EPA, OSHA, PESH, Fire Marshal, and other regulatory authorities.

E) Once these threshold conditions have been met, laboratory research space should be allocated according to the following criteria (in descending priority):
   1) Investigators who have secured peer-reviewed grants that bear full indirect costs. Expenditure of these monies should be directly related to the use of the space provided.
   2) Investigators who have secured peer-reviewed grants that bear indirect costs at less than the current federal rate. Expenditure of these monies should be directly related to the use of the space provided.
   3) Currently unfunded investigators who have persistently pursued indirect cost bearing extramural funding (at least one application per year) after expiration of their grants and who continue to publish research findings as first or senior author in peer-reviewed journals.

F) New faculty should be allowed a minimum of three years to obtain extramural funding. Biotech research per se that does not attract indirect cost-bearing extramural funding is not sufficient justification for allocation of research space within the medical center.

G) When possible, small amounts of lab space may be made available to unfunded faculty with major teaching responsibilities who are pursuing small research projects.

H) There should be a relationship between the proven ability to acquire peer-reviewed indirect cost-bearing extramural research support (or the pursuit of that support) and space needs described therein and the quality and size of research space that is allocated. In particular, we affirm the principle that research lab space allocation should be commensurate with and proportional to research productivity and demonstrated research need.

I) Faculty with reduced 'wet laboratory' research activity will be expected to relinquish underutilized research lab space and make it available for other uses. Inadequate utilization of research space could be identified by one or both of the following criteria: (1) a lack of papers published as first or senior author over a period of three or more consecutive years, or (2) a lack of extramural research funding, in particular a lack of attempts to obtain such funding, over a period of two or more consecutive years.

J) Scholarly and academic pursuits that do not require wet laboratories for their execution are not a sufficient basis for the retention of previously allocated research laboratory space. Longevity of space retention is not a justifiable basis for retaining that space. No individual has an inviolate claim to space solely because he/she has occupied that space in the past.

K) Re-consideration of space that is assigned to faculty should be triggered by the failure to apply for peer-reviewed extramural support within a one-year period (unless of course such monies are on hand for that period of time). In such cases, the Chair is expected, within 60 days, to review the faculty member's plan for securing peer-reviewed, indirect cost-bearing support and report to the Dean on their assessment of:
   1) the merit of the plan itself;
   2) the aggressiveness of the timeframe and the level of effort that the faculty member is prepared to commit, in light of their other responsibilities; their assessment of the likelihood of success; and
   3) the milestones by which progress toward the eventual goal could be measured.

   The Dean will then approve or modify the Chair's recommendation.

L) In any case, a faculty member who loses research support should be given at least one year from the time that funding was lost to obtain extramural funding before the space is re-allocated.

<u>General Recommendations</u>:

It is recognized that sharing of space in basic science departments with clinical departments is necessary if Downstate is to grow its research enterprise. However, every effort should be made to ensure that there are meaningful collaborations among co-located investigators. It is important that allocation of research space to clinician scientists be accompanied by an explicitly stated commitment by their department, e.g., protected time, which will maximize the likelihood that the research for which space is being provided will be successfully completed. The willingness of pre-clinical departments to join forces with their clinical counterparts should be matched by an equivalent commitment from the relevant clinical chair and space occupied by clinical departments should be subjected to the guidelines outlined above and evaluated accordingly.