UMBC Laboratory Safety Guide

UMBC Office of Environmental Safety & Health (410)455-2918

Revised 01/2023

EMERGENCY TELEPHONE NUMBERS

Emergency (Fire, Police, Rescue, Emergency Medical Service)	**extension 5-5555**

ASSISTANCE TELEPHONE NUMBERS

Environmental Safety & Health	extension 5-2918
Hazardous Waste Pick-up(Safety Officer, Environmental Safety & Health)	extension 5-2918
Maryland Poison Center (for information only - dial extension 5-5555 for emergencies)	1-800-222-1222
Facilities Management Work Control	extension 5-2550
UMB Environmental Health & Safety	(410) 706-7055
Radiation Safety/Waste Disposal	(410) 706-7055
Retriever integrated Health (RIH)	(410) 455-2542

Note: To call any UMBC extension from off-campus, use the prefix (410) 455-

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Special appreciation to the faculty and staff of the Departments of Biological Sciences, Chemistry & Biochemistry, Physics, Chemical & Biochemical Engineering, Computer Science & Electrical Engineering, Mechanical Engineering, and the Dean's Office of the College of Engineering who helped in the production of this Safety Guide.

Special thanks to the Deans of Arts & Sciences, the College of Engineering and the Graduate School for their encouragement and support.

Funding for this publication was provided by the UMBC Graduate School.

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FOREWORD

Overall safety in the lab is EVERY LAB USER'S responsibility. Each individual has an obligation to maintain, to the best of their ability, a safe work environment. It is suggested that one method of maintaining a safe workplace is to actively incorporate these safety practices into your laboratory activities. As a guide, these practices will help identify potential hazards in the lab, and will provide a reminder of routine safety requirements.

The Laboratory Safety Guide incorporates both general guidelines as well as more in-depth information about specific laboratory safety practices. Please refer to the Table of Contents for topics of interest to you or which pertain to your laboratory.

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ACKNOWLEDGMENTS

This guide represents a true group effort. It is the combined effort of the University faculty and staff members, and it contains a wealth of safety information available from our peers in the field.

We would especially like to acknowledge the University of Virginia Office of Environmental Health and Safety for generously providing the framework for this document. We also thank the University of Maryland, College Park Department of Environmental Safety and the University of Maryland, Baltimore Radiation Safety Office for their assistance.

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SAFETY CHECKLIST FOR LABORATORY USERS

Please read the following questions and think carefully about your answers.

		YES	NO
1.	Do you wash your hands before leaving the laboratory?		
2.	Do you wear appropriate attire in the laboratory (lab coat, safety goggles, gloves, shoes)?		
3.	Are the appropriate hazard signs and emergency numbers posted on the outside of the laboratory door?		
4.	Are all containers in your lab properly labeled? Do you know how to interpret these labels?		
5.	Do you know where to find Material or access Safety Data Sheets (SDSs) for all chemicals used in your laboratory?		
6.	Are the chemicals in your lab properly stored?		
7.	Have you been instructed in the proper use and handling of the chemicals in your laboratory?		
8.	Have you been instructed in the location and use of safety devices (safety showers, eye washes, laboratory hoods, etc.) in your laboratory?		
9.	Are you aware of emergency procedures in the event of a chemical exposure, spill, fire or explosion?		
10.	Do you know how to properly segregate and dispose of chemicals you will use?		
11.	Are all mechanical engineering controls (e.g., fume hoods) operating properly?		
12.	It is not advisable to work alone in a laboratory after hours. If unavoidable, have you notified your supervisor or a coworker, or the police? Are you aware that in designated laboratories working alone is not permitted?		
13.	Have you read the Chemical Hygiene Plan provided by ESH?		
14.	Have you attended laboratory specific training provided by your Laboratory Supervisor?		
15.	Do you know where your laboratory Standard Operating Procedures (SOP) are stored and how to use them?		
16.	Are you familiar with the protocol you are following? Do you feel comfortable performing the procedure without additional information or demonstration?		

If you answered NO to any of these questions, read this laboratory safety guide and if you still have questions, see your laboratory supervisor or contact Environmental Safety & Health at extension 5-2918 for assistance.

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GENERAL LABORATORY SAFETY PRACTICES

The purpose of this guide is to promote safety awareness and encourage safe work practices in the laboratory. These are guidelines; they should serve as a reminder of things you can do to work more safely. Although these guidelines are applicable to all research, teaching and academic laboratories, your lab may require more specialized rules that apply to specific materials and equipment. Please see your Laboratory Supervisor (LS) or Principal Investigator (PI) for more information before beginning work in the lab.

AWARENESS

√ Be alert to unsafe conditions and actions, and call attention to them so that corrections can be made as soon as possible.

√ Label all storage areas, refrigerators, etc., appropriately, and keep all chemicals in properly labeled containers.

- → Date all bottles when received and when opened.
- → Note expiration dates on chemicals.
- → Note special storage conditions.

√ Be familiar with the appropriate protective measures to take when exposed to the following classes of hazardous materials. Information is available from your lab supervisor or ESH at 5-2918.

- → Flammables
- → Corrosives
- → Toxics
- → Reactives
- → Radioactive Compounds
- → Biohazards
- → Carcinogens
- → Compressed gasses

√ Segregate chemicals by compatibility groups for storage. (See Appendix V)

√ Be aware of the potential interactions of lab furniture and equipment with chemicals used or stored in the lab. (e.g., are oxidizers stored directly on wooden shelving?)

√ Post warning signs for unusual hazards such as flammable materials, biohazards or other special problems.

√ Pour more concentrated solutions into less concentrated solutions to avoid violent reactions (i.e., Always add acid to water; not water to acid).

√ Avoid distracting other workers. Practical jokes or horseplay have no place in the laboratory.

√ Use equipment only for its designated purpose.

√ Position and secure apparatus used for hazardous reactions in order to permit manipulation without moving the apparatus until the entire reaction is complete.

PERSONAL SAFETY

Respiratory and Body Protection

√ Use fume hoods whenever possible.

√ Splash proof safety goggles should be worn at all times in the laboratory.

√ Laboratory coat/apron should be worn in the laboratory.

√ Appropriate gloves should be worn as needed.

√ Appropriate closed-toed shoes should be worn in the laboratory.

√ Respirators may only be worn by individuals that have completed respirator training and fit testing and obtained a respirator medical clearance.

Personal Hygiene

√ Wash hands before leaving the laboratory.

√ Launder clothing worn in the laboratory separately from other clothing.

√ Never mouth pipette anything in the lab.

√ Never eat, drink or apply cosmetics in a laboratory or areas where chemicals/hazardous agents are stored. (Smoking is prohibited in all areas of University buildings, including laboratories.)

√ Never store food in a refrigerator where hazardous materials are stored.

√ Never eat or drink from laboratory glassware.

√ Avoid wearing contact lenses in the laboratory.

√ Avoid situating long hair, loose sleeves/cuffs, rings, bracelets, etc. in close proximity to open flames or operating machinery.

√ Keep exposed skin covered. Shorts, mini-skirts, sleeveless or tank-top shirts, and sandals or open-toed shoes should not be worn in the laboratory.

FIRE PREVENTION

√ Be aware of ignition sources in the lab area (open flames, heat, electrical equipment).

√ Whenever possible, purchase and store flammable reagents in the smallest quantities available.

√ Store flammable liquids that require refrigeration in explosion-proof refrigerators.

√ Store flammable liquids in appropriate safety cabinets and/or safety cans.

√ Do not store incompatible reagents together (e.g., acids with flammables). Lists of incompatible reagents can be found in several source books (for example, Handbook of Reactive Chemical Hazards). See Appendix V for a table of some commonly-used laboratory chemicals and incompatibilities.

√ Do not store ethers or conjugated dienes for extended periods of time as explosive peroxides could form. Date ethers when received and opened.

√ Make sure that all electrical cords and wires are in good condition. All electrical outlets should be grounded and should accommodate a 3-pronged plug. Never remove the grounding prong or use an adapter to bypass the grounding on an electrical plug.

√ Remain out of the area of a fire or personal injury unless it is your responsibility to meet the emergency responders. Meet responders from a safe location.

√ Be aware of the condition of fire extinguishers. Report any broken seals, damage, low gauge pressure or improper mounting toESH (x5-2918), If the seal has been broken, assume that the fire extinguisher has been used and must be recharged. (NOTE: Do not use fire extinguishers unless you are trained and feel confident to do so.) **Report ALL fires by phoning extension 5-5555**.

√ Automatic fire sprinklers must remain clear and unblocked to function properly. Do not store materials within 18" below the sprinkler head.

HOUSEKEEPING

√ Eliminate safety hazards by maintaining laboratory work areas in a good state of order.

√ Maintain at least two clear passages to laboratory exits.

√ Always keep tables, fume hoods, floors, aisles and desks clear of unnecessary material.

√ Wipe down bench tops and other laboratory surfaces after each use with an appropriate cleaning or disinfecting agent.

√ All equipment should be inspected before use.

√ Use borosilicate glassware for laboratory work. If dichromate/sulfuric acid glass cleaner is used in your laboratory, make sure that cleaning is confined to the fume hood because toxic chromyl chlorides are released from the dichromate/sulfuric acid solution.

Better yet, use a non-chromate cleaning solution. (i.e., No Chromix®) which will also minimize hazardous waste generation.

√ If experiments must be left unattended, place a note next to the experimental apparatus indicating the chemicals involved, your name and a number where you can be reached in case of an emergency.

√ Keep the laboratory floor dry at all times. Immediately attend to spills of chemicals or water, and notify other lab workers of potential slipping hazards.

√ All machinery under repair or adjustment should be properly tagged prior to servicing. All service work should be done by authorized personnel.

√ Sink traps and floor drains should be flushed and filled with water on a regular basis to prevent the escape of sewer gasses or the release of chemical odors in the event of an emergency. Drains which will not be routinely used may be "topped" with 20 - 30 ml of mineral oil to prevent evaporation of water in the trap.

√ All compressed gas cylinders should be securely chained or clamped to a rack or fixed stationary piece of lab furniture. Mark empty cylinders, but use all safety precautions as if the cylinder were full.

EMERGENCY PROCEDURES

√ In the event of an emergency, remember one number: extension 5-5555. By calling this number, all necessary emergency response departments can then be alerted to your needs.

√ Be familiar with the emergency evacuation plan.

√ Be sure the names and phone numbers of lab personnel to be contacted in an emergency are posted in the lab or outside of the door.

√ Be familiar with the location, use and limitations of the following safety devices:

- → safety shower
- → eye wash station
- → protective respiratory gear
- → fume hood
- → fire extinguisher
- → fire alarm
- → spill cleanup materials
- → first aid kit

√ Clean up all small spills immediately. If a large chemical spill occurs, call the campus emergency phone number, extension 5-5555. If the spill poses a hazard to individuals outside of the laboratory, follow the laboratory's emergency standard operating procedure. Stop current reactions or equipment if possible, activate the building fire alarm, exit the building, call extension 5-5555 to report the emergency and stand by at a safe distance to provide information to emergency response personnel.

√ If volatile, flammable, or toxic materials spill, shut off flames and spark-producing equipment at once and evacuate.

√ In the event of fire or explosion, activate the building fire alarm, exit the building, call extension 5-5555 to report the emergency and standby in a safe location to meet emergency responders.

√ Do not cover windows of laboratory doors, except for special experimental requirements. This allows passers-by to notice if anyone is in need of emergency assistance.

√ Maintain a clear path to all safety equipment at all times. Keep lab doors open when working.

WASTE DISPOSAL

√ MINIMIZE WASTE at the source by limiting the quantities of materials purchased and used.

√ Segregate and prepare chemical waste for disposal in accordance with UMBC Waste Disposal Guidelines.

√ Dispose of all waste in designated containers. There are many different types of containers used at UMBC for the collection of waste. Know which ones are appropriate for the waste you generate. Questions may be directed to Environmental Safety & Health (x5-2918).

MISCELLANEOUS

√ Children and pets should not be brought into the laboratory.

√ If work is being conducted after hours, let other laboratory personnel know of your presence. If possible, avoid carrying out experimental laboratory work in an unoccupied building.

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SAFETY EQUIPMENT

An expanding array of federal, state, and local laws and regulations make the protection of worker health and safety a legal requirement as well as an economic necessity. In the final analysis, personal and laboratory safety can be achieved only by informed, responsible individuals. This section summarizes various forms of personal and laboratory safety equipment. Based on this information, knowledgeable choices for appropriate personal protection in the laboratory can be made.

PERSONAL PROTECTIVE EQUIPMENT

Eye Protection

It is easy to take your senses for granted since they function without conscious thought. It's easy to relax your guard in the laboratory environment. After all, for those people not used to wearing glasses, it can be regarded as a burdensome task to wear unattractive, often restrictive eyewear. However, the laboratory is likely to be the most health-threatening place that you can encounter.

Splashing chemicals and flying objects are possible at any time in the lab environment. For this reason, eye protection is an important consideration. Protective eyewear for personnel and visitors should be splash proof. They must meet the ANSI (American National Standards Institute) Z87.1-1968 specifications. Approved eyewear bears an ANSI approval on the lens or eyepiece of the eyewear.

If you don't have safety glasses, tell your supervisor. They can be purchased from any safety supply company and at the campus bookstore

**** Chemical splash goggles or safety glasses are required in all chemistry laboratories. Requirements are noted in class syllabi and are posted on laboratory doors. Refusal to wear required eye protection will result in expulsion from the laboratory.**

Use and Maintenance

√ Eyewear should be as comfortable as possible, fit snugly over the eyes and around the face, and not interfere with the movement of the wearer.

√ When it is appropriate, signs should be posted outside the door stating that eye protection is required before entering the room.

√ Appropriate eye protection should be worn when using:

→ caustics, corrosives, or irritants

→ glassware under vacuum or pressure (reduced or elevated)

→ cryogenic materials

→ flammable materials

→ radioactive materials

→ explosives

→ lasers (special lens protection required)

→ UV light (special lens protection required)

→ biohazards

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

→ welding → sanding

→ grinding → drilling

→ sawing → glass blowing

√ Eye safety equipment should be capable of being cleaned and disinfected.

√ Eye protection should always be kept in good condition.

Corrective Lenses

√ Laboratory workers whose vision requires the use of corrective lenses should wear safety eye protection of one of the following types:

→ Prescription lens safety splash goggles.

→ Splash-proof safety eye wear that can be worn over prescription glasses without disturbing the adjustment of the glasses.

Contact Lenses

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

→ It may be impossible to remove contacts from the eyes following entry of some chemicals into the eye area.

→ Contact lenses will interfere with emergency flushing procedures.

→ Contacts may trap solid materials in the eyes.

√ Use of contact lenses should be considered carefully, with extra consideration given to choosing eye protection that fits snugly over the eyes and around the face (Chemical Splash Goggles).

Protective Clothing

Lab Coat

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

→ Cotton protects against flying objects, sharp or rough edges and is usually treated with a fire retardant.

→ Wool protects against splashes of molten materials, small quantities of acid, and small flames.

→ Synthetic fibers protect against sparks and infrared or ultraviolet radiation. However, synthetic fiber lab coats can increase the severity of some laboratory hazards. For instance, some solvents may dissolve particular classes of synthetic fibers, thereby diminishing the protective ability of the coat. In addition, on contact with flames, some synthetic fibers will melt. This molten material can cause painful skin burns and release irritating fumes.

→ Aluminized and reflective clothing protect against radiant heat.

√ The construction of the material must also be considered (twill, felt, plain, etc.), as the materials are rated differently by various manufacturers. Lab coats should be made with snaps/fasteners which afford the wearer quick removal in the event of an emergency.

Aprons

√ An apron provides an alternative to the lab coat. It is usually made of plastic or rubber to protect the wearer against corrosive or irritating chemicals. An apron should be worn over garments that cover the arms and body, such as a lab coat.

Hand It is a good idea to always get into the habit of wearing protective gloves in

Protection the laboratory. Aside from acting as a shield between hands and hazardous materials, some gloves can also absorb perspiration or protect the hands from heat. Because certain glove types can dissolve in contact with solvents, it is important to take extra care in matching the protective glove with the nature of the job. Before use, check to make sure the gloves (especially latex gloves) are in good condition and free from holes, punctures, and tears.

Glove Types and Removal

√ Gloves should be selected on the basis of the material being handled and the particular hazard involved. Glove manufacturers and the Material Safety Data Sheets (SDSs) accompanying products in use are good sources of specific glove selection information, or contactESH (x5-2918) for assistance in selection. The Fisher catalog also contains an excellent resistance chart.

→ PVC protects against mild corrosives and irritants.

→ Latex provides light protection against irritants and limited protection against infectious agents.

→ Natural Rubber protects against mild corrosive material and electric shock.

→ Neoprene for working with solvents, oils, or mild corrosive material.

→ Cotton absorbs perspiration, keeps objects clean, provides some limited fire retardant properties.

→ Zetex® when handling small burning objects. These are a good replacement for asbestos gloves. (Asbestos containing gloves may not be purchased or used in UMBC labs since asbestos is a known carcinogen. Asbestos gloves must be disposed of through the University's asbestos waste disposal system. If your laboratory currently has asbestos gloves (or products) for disposal, seal them in a plastic bag, label the contents of the bag and contactESH (x5-2918) for an asbestos waste pick-up.)

√ When working with extremely corrosive material, wear thick gloves. Take extra precaution in checking for holes, punctures, and tears.

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

√ Wash hands as soon as possible after removing protective gloves.

Foot Protection

Foot protection is designed to prevent injury from corrosive chemicals, heavy objects, electrical shock, as well as giving traction on wet floors. If a corrosive chemical or heavy object were to fall on the floor, the most vulnerable portion of the body would be the feet. For this reason, shoes that COMPLETELY COVER AND PROTECT the foot are recommended.

√ Fabric shoes, such as tennis shoes, absorb liquids readily. If chemicals happen to spill on fabric shoes, remove footwear immediately.

√ When selecting footwear for the lab, choose sturdy shoes that cover the foot. These will provide the best protection.

√ The following shoe types should not be worn in the laboratory:

- → sandals
- → clogs
- → high heels
- → shoes that expose the foot IN ANY WAY

√ The following are recommended types of footwear:

- → Safety Shoes (steel-toed) protect against crushing injuries caused by impact from any object during work activities (e.g., lifting heavy objects, using power tools, etc.).
- → Treated Shoes, Rubber Boots or Plastic Shoe Covers protect against corrosive chemicals.
- → Insulated Shoes protect against electric shock.

→ Rubber Boots with slip resistant outer soles provide traction in wet conditions where the possibility of slipping exists.

√ Safety Shoes, Rubber Boots or Plastic Shoe Covers protect against specific types of chemical contamination and like gloves must be selected to match the current hazard.

Hearing Protection

ESH will respond to inquiries regarding noise exposure in the work place. Upon request, ESH will arrange for environmental noise and/or personal exposure dosimetry. Hearing protection should be worn where the noise level is above 85 decibels (dBA). Areas where excessive noise is present should be posted with signs indicating hearing protection is required. Hearing protectors should be readily available and rated for sufficient noise reduction. Contact ESH for assistance in selecting appropriate hearing protection for your situation.

√ Noise reduction ratings (NRR) for hearing protection products must be listed on hearing packaging. The NRR number is used in context of the following formula:

8-hour TWA (dbA) - (NRR-7)

dbA = decibels on an A weighted scale
8-hour TWA = eight hour time weighted average
NRR = noise reduction rating.

√ Types of hearing protection include:

→ Ear plugs provide basic protection to seal the ear against noise.

→ Ear muffs provide extra protection against noise, and are more comfortable than ear plugs.

→ Cotton inserts are poor suppressors of noise and should be avoided.

Head Protection

Some environments within UMBC have the potential for falling or flying objects. Appropriate head protection can protect laboratory workers from impacts, penetration by falling or flying objects, electric shock and burns.

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

Respiratory Protection

Because certain laboratory procedures can produce noxious fumes and contaminants, respiratory protection may be required in your work environment. In fact, lab personnel noting changes in air quality should contact the lab supervisor and ESH (x5-2918) to express their concerns. When engineering controls cannot successfully minimize or eliminate the airborne contaminants, a respiratory protection program should be established.

Departments must refer individuals who need respiratory protection to ESH for assistance in respirator selection, fit testing and training. A medical examination is also required to assure the potential respirator wearer is physically capable of respirator use.

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LABORATORY SAFETY EQUIPMENT

Laboratory Chemical Fume Hood

Chemical fume hoods capture, contain, and expel emissions generated by hazardous chemicals. In general, it is a good idea to conduct all laboratory chemical experiments in a fume hood. While you may be able to predict the release of undesirable or hazardous effluents in some laboratory operations, "surprises" can always happen. Therefore, the fume hood offers an extra measure of protection.

Before use, check to see that your hood has an inspection tag. This will tell you the date of the most recent hood evaluation. If the fume hood in your lab does not appear to be in good working order (a tissue, held inside the fume hood, can indicate if airflow is present), or if you have any questions, call ESH (x5-2918). (NOTE: Do not allow tissues/towels or other material to be pulled into the hood exhaust system as this may damage the unit or affect the air flow.)

Certain laboratory procedures may require the use of perchloric acid. The use of this material may cause the formation of explosive perchlorate crystals. Special fume hoods, commonly known as Perchloric Acid Fume Hoods, MUST be used for this purpose. These hoods have self-contained wash-down units to inhibit crystal formation.

Operation

√ All laboratory workers with access to a laboratory chemical fume hood should be familiar with its use.

√ Maintain the sash at or below the optimum operating height as designated by the label with an arrow.

√ The optimum condition for general laboratory work in a chemical fume hood is between 80 and 125 fpm face velocity in a well installed unit. Radioactive material use requires a face velocity of 100 fpm to 125fpm at a minimum sash height of 12 inches. Higher face velocities often produce turbulence inside of the hood sufficient to eject contaminants into the laboratory.

√ Raise large objects that must be in the hood (i.e., a water bath) to allow airflow beneath and on all sides of the object.

√ **ALWAYS** work back into the hood, six inches beyond the sash line, keeping the sash line between your body and your work.

Maintenance

√ Keep the inside of the hood clean and uncluttered.

√ The hood should always be in good condition and capable of routine use. Any hood or component of ventilation not properly functioning must be taken out of service and clearly tagged.

√ The lab worker should not be able to detect strong odors released from materials in the hood. If odors are detected, check to make sure that the ventilation fan is turned on. If the fume hood is malfunctioning, discontinue work and notify the laboratory supervisor *and* Work Control (x5-2550).

√ An emergency plan should exist in case of hood ventilation malfunction.

√ All protective clothing should be worn when working with chemicals in the hood. In addition to gloves, safety glasses, and lab coats, a face shield or explosion shield will provide an extra measure of safety from reactive chemicals.

√ Solid objects or materials should not be allowed to enter the exhaust ducts at the rear of the hood, as they can become lodged in the duct or fan.

√ **Fume hoods should not be used for long-term chemical storage**.

√ All electrical outlets should be located outside of the hood.

Chemical Storage Cabinets

Storage of flammables and corrosives in the lab should be limited to as small a quantity as possible. Flammable materials should be stored in flammable material storage cabinets which meet NFPA 30 specifications. These specifications are available from Environmental Safety & Health.

Use and Maintenance

√ Chemicals should **NEVER** be stored in alphabetical order without consideration for chemical compatibility. This system may contribute to the probability of incompatible materials being stored next to one another (e.g., butadiene next to bromine or chlorine). Incompatible reagents should not be stored next to each other. (See the chemical incompatibility chart in the appendices of this manual.)

√ Storage outside of the cabinet should be limited to materials used in the current process.

√ The vent cap on chemical storage cabinets should not be removed unless the cabinet is attached to an approved ventilation system.

√ If a cabinet is connected to a ventilation system, the connection must either have a thermally actuated damper or sufficient insulation on the vent piping to avoid compromising the fire protection ability of the cabinet.

√ Glass containers should be stored on the bottom shelf of storage cabinets.

Types of Cabinets

√ Flammable liquid cabinets are designed for storage of flammable or combustible liquids.

√ Acid/corrosive cabinets are designed for corrosion resistance.

√ Bulk storage cabinets can be used for storage of flammable and corrosive liquids outside the laboratory setting.

Individual Storage Containers

Selecting the best means of storage for chemical reagents will, to a great extent, depend on that reagent's compatibility with the container.

√ A safety can is an approved container of no more than five gallons (19 liters) capacity. It has a spring-closing lid and spout cover, and is designed to safely relieve pressure buildup within the container.

√ Vent caps may be purchased for original manufacturers' glass containers to help minimize explosion hazards.

Refrigerators

While domestic refrigeration units are appropriate for keeping foods cold, they are not designed to meet the special hazards presented by flammable materials. Therefore, laboratory refrigerators should be carefully selected for specific chemical storage needs. To prevent potential safety hazards, the length of storage of any material should be kept to a minimum. In addition, refrigerators should be periodically inspected. Refrigerators used to house flammable materials must be approved for such use by FM® (Factory Mutual) or UL® (Underwriters Laboratory).

Use and Maintenance

√ Each refrigerator, freezer or other cooling unit should be prominently labeled with appropriate hazard signs to indicate whether it is suitable for storing hazardous chemicals. Label chemical hazard refrigerators with the sign "For Chemical Storage Only. No Food or Drink Allowed."

√ If radioactive materials are to be stored, a refrigerator must be clearly labeled "Caution, Radioactive Material. No Food or Beverages May Be Stored in This Unit."

√ The containers placed in the refrigerator should be completely sealed or capped, securely placed, and labeled. Avoid capping materials with aluminum foil, parafilm, corks, and glass stoppers.

√ Refrigerators should be frost free to prevent water drainage. Enzymes can not be kept in a cycling refrigerator.

Types of Refrigerators

√ Because ignitable vapors can build up in refrigerators, it is important to store flammable and combustible materials in specially-designed units. These refrigerators will have self-contained electrical elements to avoid spark-induced explosions.

√ Explosion-proof or intrinsically safe refrigerators are specifically designed for hazardous environments, featuring enclosed motors to eliminate sparking and bear a FM or UL explosion-proof label.

√ Highly volatile flammable and combustible substances that require refrigeration may be stored **only** in explosion-proof refrigerators especially designed for such use. Such refrigerators must meet the requirements for Class 1 Division 1 Electrical Safety Code (NPFA 70 and NFPA 45) and require direct wiring to the power source via a metal conduit. The same storage requirements apply to any solution or specimen that may release flammable fumes (e.g., the ether-impregnated fur of a dead rat has been known to cause an explosion in a refrigerator).

Eyewash Stations

Eyewash stations provide an effective means of treatment when chemicals come in contact with the eyes. Eyewash stations should be readily available and accessible to all laboratory personnel.

√ The eyewash facility should be clearly marked and no more than 10 seconds away from every lab work station. Laboratory workers should be able to locate the nearest eye wash facility with their **eyes closed** (eye injuries may involve temporary blindness).

√ An eye injury usually accompanies a skin injury. For this reason, eye wash stations should be located near the safety shower and/or drench hose so that eyes and body can be washed.

Use and Maintenance

√ Water/eye solutions should not be directly aimed onto the eyeball, but rather, aimed at the base of the nose. This increases the chance of effectively rinsing the eyes free of chemicals (harsh streams of water may drive particles further into the eyes).

→ Eyelids may have to be **forcibly** opened to attempt eye rinse.

→ Flood eyes and eyelids with water/eye solution for a minimum of 15 minutes.

→ Remove contact lenses as soon as possible to rinse eyes of any harmful chemicals.

→ Eye wash stations must be tested weekly by laboratory personnel and inspected every six months.

Types of Eye Wash Stations

√ Gravity Feed - Self Contained provides the laboratory worker with emergency eye wash treatment in areas **inaccessible to plumbing**.

√ Faucet-mounted (pin or push plate activators) provides continuous water flow while freeing hands to open eyelids. It turns a standard faucet into a practical emergency eye wash station. Run periodically to insure clean, rust free water when needed in an emergency.

√ Laboratory Bench sprays with squeeze handles can be installed through the bench top for instant availability, but does not satisfy OSHA requirements as an accessible eyewash.

√ Swivel Eye Wash mounts on the lab bench or counter top adjacent to a sink. It swivels 90° over the sink for use, or out of the way for storage.

√ Bowl-mounted (pin, push plate or foot pedal activators) provides continuous water flow through a free-standing plumbed unit. The bowl may be directed to a floor drain or connected directly to a sewer connection for easy testing and use.

Safety Showers

Safety showers provide an effective means of treatment in the event that chemicals are spilled or splashed onto the skin or clothing. Safety shower facilities should be installed wherever corrosive chemicals are used (e.g. acids or alkalis) and must be readily available to all personnel.

Use and Maintenance

√ Safety showers should be in a **clearly marked** location. The facility should be no more than 55 feet, or 10 seconds, away from every lab work bench.

- √ Laboratory workers should be able to locate the shower(s) with their **eyes closed** (emergency situations may leave victims temporarily blind).
- √ Safety showers are operated by grasping a ring chain or triangular rod.
- √ The pull mechanism is designed for people of most heights but may require a modification for wheelchair access. It should always be accessible and hang freely.
- √ Safety showers should supply a continuous stream of water to cover the entire body.
- √ Individuals should remove contaminated clothing, including shoes and jewelry, while under an operating shower.
- √ Safety showers should be located AWAY from **electrical panels or outlets**.
- √ If at all possible, safety shower facilities should be installed near appropriate drainage systems.

Types of Safety Showers

- √ Ceiling/Wall Emergency Shower provides a continuous water flow and mounts directly to overhead vertical pipes or horizontal wall pipes.
- √ Floor-Mounted Emergency Combination eye wash/face and body wash mounts directly to horizontal pipes.
- √ Deck-Mounted Drench Hose is a hand operated unit intended to augment a safety shower for quick spot-washing of injuries.

Fire Safety Equipment

Types of Equipment

√ Fire Alarms are designed so that all endangered laboratory personnel and building occupants are alerted by an audible warning (in many buildings there is also visual warning). Fire alarm systems are **not** monitored at a remote location. Fire alarm activations **must be reported** to U.M.B.C. Police **(extension 5-5555)** from a safe location.

→ All employees/students should become familiar with the **EXACT LOCATION** of the **fire alarm pull stations** nearest to their laboratory.

→ Sprinkler systems, smoke detectors and heat detectors may automatically activate the fire alarm. (This **should not** be considered a substitute for manual fire alarm activation.)

√ Fire Extinguishers are spaced and located as required by current fire codes and standards. Multipurpose fire extinguishers can be found in hallways and near exits in most laboratories. Additional or redundant extinguishers will only be provided at a charge to the requester (Note: Special purpose fire extinguishers are provided where necessary).

→ **Only use a fire extinguisher if the fire is very small and you know how to use the extinguisher safely. If you can't put out the fire, leave immediately. Make sure the fire department is called even if you think the fire is out.**

→ In laboratories, fire extinguishers should be securely located on the wall near an exit. The lab occupant should be aware of the condition of the fire extinguishers by observing them for broken seals, damages, low gauge pressure, or improper mounting.

→ A contractor performs monthly inspection and annual maintenance on all fire extinguishers. The last month and year that maintenance was performed is indicated on a tag or sticker on the extinguisher.

→ Occupants of labs should **visually inspect** lab fire extinguishers at least monthly. Units that are missing have broken seals, low pressure or visible damage should be reported toESH immediately for replacement.

→ For fire extinguisher service, requests, training, or any questions call ESH at extension 5-2918.

√ Sprinklers are designed to enhance life safety by controlling a fire until the fire department arrives or, in many cases, completely extinguishes a fire.

→ Sprinklers are automatically activated and laboratory workers should not attempt to shut off or tamper with the system.

→ Items in the laboratory must be stored at least 18 inches below the sprinklers.

→ Items (e.g., wiring or tubing, etc.) must not hang from the sprinklers or sprinkler pipes.

→ Sprinklers must not be painted or otherwise obstructed.

→ Intense heat should not be used near sprinklers.

→ Not all campus buildings use sprinklers.

√ If there are any questions on fire safety equipment call ESH at extension 5-2918. Call Work Control (x 5-2550) to report damage to fire alarm or sprinkler systems.

LABORATORY EQUIPMENT SAFETY

Glassware Accidents involving glassware are a leading cause of laboratory injuries. These can be avoided by following a few simple procedures. In general, be certain that you have received proper instructions before you use glass equipment designed for specialized tasks that involve unusual risks or potential injury. Listed below are some safety rules.

Use and Maintenance

√ Handle and store glassware carefully so as not to damage it or yourself.

√ Properly discard items in glass disposal containers. If glassware has been used to store chemicals, it must be decontaminated prior to disposal.

√ When inserting glass tubing into rubber stoppers, corks or when placing rubber tubing on glass hose connections:

→ protect hands with a heavy glove or towel

→ lubricate tubing or stopper with water or glycerol and be sure that the ends of the glass tubing are fire-polished

→ hold hands close together to limit movement of glass should fracture occur

→ substitute plastic or metal connections for glass ones whenever possible to decrease the risk of injury

→ use glassware designed for vacuum work for that purpose

→ when dealing with broken glass

-- wear hand protection when picking up the pieces
-- use a broom to sweep small pieces into a dustpan
-- package it in a rigid container (i.e. corrugated cardboard box) and seal to protect personnel from injury. Label box "Broken Glass"

√ Never attempt glass-blowing operations without proper facilities.

Heating Devices

Electrical devices that supply heat for reactions or separations are commonly used in laboratories. Electrically heated devices include:

- → hotplates;
- → heating mantles;
- → oil baths;
- → air baths;
- → hot-tube furnaces;
- → hot-air guns; and
- → ovens

Improper use could result in fire or burns to the user.

Use and Maintenance

√ If baths are required to be activated when not attended, they should be equipped with timers to turn them on and off at suitable hours and, if possible, a thermostat to turn off power if the unit overheats.

√ Flammable or combustible solvents should never be used in a heated bath unless housed in a chemical fume hood.

√ Before using any heating device:

- → check to see if the unit has an automatic shutoff in case of overheating;
- → note the condition of electrical cords and have them replaced as required;
- → make sure the apparatus has been maintained as required by the manufacturer;
- → make sure the device maintains an Underwriters' Laboratories (UL®) or Factory Mutual Engineering Division of Associated Factory Mutual Fire Insurance Companies (FM®) certification; and,
- → check to see that all heating units in use without automatic shut-off have been turned off before leaving an area for any extended period of time.

Water Lines

Use and Maintenance

√ All water lines to equipment for cooling, condensing, water baths, etc., must be secured at both ends of the connection with heavy duty clamps.

√ Tubing must be heavy walled.

Vacuum Systems

Use and Maintenance

√ Every laboratory vacuum pump must have a belt guard in place when it is in operation.

√ The service cord and switch, if any, must be free of observable defects.

√ Use a trap on the suction line to prevent liquids from being drawn into the pump.

√ If vapors are being drawn through the pump, a cold trap (which is a tube that will condense vapors passing through it) should be inserted in the suction line to prevent contamination of the pump oil.

√ Place a pan under the pump to catch any oil drips.

Explosion Prevention

In order to prevent explosions:

IF THE PUMP IS USED...	YOU MUST...
for vacuum distillation or filtration of organic liquids	direct the discharge to an operating hood or other exhaust systems. (ie. trap) Any discharge into an enclosed space such as a cabinet can cause an explosion.
in an area where flammable gas, vapor, or dust are present.	ensure that the motor, cord, plug, and all electrical parts are explosion-proof.

Glassware

√ Glassware used for vacuum distillations or other uses at reduced pressure must be properly chosen for its ability to withstand the external pressure of the atmosphere.

→ Only round-bottom vessels may be subjected to vacuum unless specially designed, such as Erlenmeyer-type filtration flasks.

→ Each vessel must be carefully inspected for defects such as scratches or cracks.

√ All vacuum operations must be carried out behind a table shield or lowered fume hood sash because all vacuum equipment is subject to failure by implosion. (Implosion occurs when atmospheric pressure propels pieces inward creating small fragments which are subsequently propelled outward with considerable force.)

√ Dewar vessels have a vacuum between the walls and some types can be dangerous when they fail.

→ Glass types can propel glass into the eyes and should be wrapped from top to bottom with cloth tape such as electrician's friction tape. (Mylar tape can be used if transparency is needed.)

→ Large Dewars encased in metal and stainless steel vacuum containers do not require wrapping.

√ Glass desiccators are often subjected to partial vacuum due to cooling of the contents. Due to glass thickness and the relatively flat surface of the top and bottom, the desiccator is under a constant tension. It is strongly recommended that you either:

→ obtain the available desiccator guard made of perforated metal, or

→ use a molded plastic desiccator which is spherical and has high tensile strength.

Centrifuges

Use and Maintenance

√ Do not attempt to operate a centrifuge until you have received instruction in its specific operation. Read the operation manual, if available, and ask an experienced colleague to demonstrate procedures.

√ Individual users are responsible for the condition of the centrifuge machine and rotors during and at the end of procedures. This responsibility includes proper loading, controlling speed to safe levels, safe stopping, removal of materials, and cleanup.

√ Ultracentrifuge rotors require special cleaning procedures to prevent scratching of surfaces, which can lead to stress points and possible rotor failure during operation.

√ In selecting a centrifuge, carefully consider:

→ location, type, and use

→ balance capability each time the centrifuge is used

→ adequate shielding against accidental "flyaway"

→ suction cups or heel brakes to prevent "walking"

→ accessibility of parts, particularly for rotor removal

→ lid equipped with disconnect switch which shuts off rotor if the lid is opened

→ safeguard for handling flammables and pathogens. (This may include positive exhaust ventilation, a safe location or sealed cups.)

→ positive locking of head

→ electrical grounding

→ locations where vibration will not cause bottles or equipment to fall off shelves

POTENTIAL PROBLEMS TO WATCH FOR

PROBLEM	EFFECT	PRECAUTION AGAINST
Unbalanced load	Damage to seals or other parts	Keep lid closed during operation and shut down and stop the rotor if you observe anything abnormal, such as: --noise --vibration Never walk away from a centrifuge until it has reached maximum speed, to ensure that it is properly balanced.
Broken tubes	Centrifuge contamination and personal injury	When loading the rotor: --examine tubes for signs of stress --discard tubes that look suspicious

FIRST AID AND EMERGENCY PROCEDURES

The first aid and emergency procedures detailed in this section could be life-saving. Become familiar with the information described below, so that disasters can be speedily contained. It is the responsibility of the injured employee or student to report bodily injury or property damage toESH at extension 5-2918 even if a police report is filed. Supervisors of injured employees must complete the "Workers Compensation Employer's First Report of Injury or Illness" form to report on-the-job injury. For more information concerning Workers' Compensation contactESH at extension 5-2918.

For follow-up medical treatment the injured person should be referred to the following institutions:

Faculty, staff, and paid student employees -

CONCENTRA MEDICAL CENTER
1419 Knecht Avenue
Arbutus MD 21227
(410) 247-9595

Retriever Integrated Health
Center For Well-Being
(410)455-2542
(410)455-3230
www.health.umbc.edu

Students not employed by UMBC - Retriever Integrated Health
Center For Well-Being
(410)455-2542
(410)455-3230
www.health.umbc.edu

FIRST AID

Wounds √ Small cuts and scratches

→ Direct pressure -- place sterile pad over wound and apply pressure evenly with the opposite hand.

→ Elevation -- if direct pressure does not control bleeding, raise the area above the level of the heart.

→ Cleanse the area with soap and water.

√ Significant bleeding

→ Call Emergency Rescue (extension 5-5555).

→ Direct Pressure -- place sterile pad over wound and apply pressure evenly with the opposite hand.

→ Elevation -- if direct pressure does not control bleeding raise the area above the level of the heart.

Thermal Burns

√ First degree burns (e.g., sunburn or mild steam burn) are characterized by redness or discoloration of the skin, mild swelling and pain.

→ First Aid procedures for first degree burns are as follows:

→ Apply cold water applications and/or immerse in cold water for at least 10 minutes.

→ Seek further medical treatment as needed.

√ Second and third degree burns are characterized by red or mottled skin with blisters (second degree), white or charred skin (third degree).

→ First aid procedures for second and third degree burns are as follows:

√ Cryogenic Burns

→ Call Emergency Rescue (extension 5-5555).

→ Wrap area in clean, dry material.

Chemical Burns

If hazardous chemicals should come into contact with the skin or eyes, follow the first aid procedures below.

√ Skin

→ Remove the victim's clothes -- don't let modesty stand in the way.

→ Remove the victim's shoes -- chemicals may also collect here.

→ Rinse the area with large quantities of water for at least 15 minutes (sink, shower, or hose).

→ DO NOT apply burn ointments/spray to affected areas.

→ Call Emergency Rescue (extension 5-5555) without delay.

√ Eyes (acid/alkali, e.g., HCl, NaOH)

→ Call Emergency Rescue (extension 5-5555) without delay.

→ Rinse the area of eyes, eyelids, and face thoroughly with lukewarm water for at least 15 minutes at the eye wash station.

Ingestion of Chemicals

√ Call Emergency Rescue (extension 5-5555) IMMEDIATELY.

→ Call the Maryland Poison Center at 1-800-222-1222 for advice on appropriate actions to be taken while awaiting emergency medical assistance.

→ If the victim is unconscious, turn their head or entire body onto their left side. Be prepared to start CPR if you are properly trained, but be cautious about exposing yourself to chemical poisoning via mouth-to-mouth resuscitation. If available, use a mouth-to-mask resuscitator.

Inhalation of Chemicals

√ Evacuate the area and move the victim into fresh air.

→ Call Emergency Rescue (extension 5-5555) without delay.

→ If the victim is not breathing and you are properly trained, perform CPR until the rescue squad arrives. Be careful to avoid exposure to chemical poisoning via mouth-to-mouth resuscitation. Use a mouth-to-mask resuscitator.

√ Treat for chemical burns of the eyes and skin as noted above.

FIRST AID KITS

First aid kits should be standard equipment in every laboratory. Commercial, cabinet-type, or unit-type first aid kits are acceptable. A typical first aid kit for laboratories includes a variety of items specially selected to carry out emergency treatment of cuts, burns, eye injuries, or sudden illness. The first aid kit should contain individually sealed packages for each type of item. Contents of the kit should be checked weekly to ensure that expended items are replaced. Laboratory supervisors are responsible for maintaining the contents of the first aid kit. Kits are available from most general safety or lab supply houses. For assistance in locating supplies, call ESH at extension 5-2918.

No oral medication (including aspirin) should be dispensed from the first aid kit.

CPR TRAINING

CPR Training for adults, children and infants is available to all faculty, staff and student employees at a nominal charge from Emergency Health Services. For registration information or a class schedule call extension 5-3223 or visit ehs.umbc.edu.

EMERGENCY PROCEDURES

NOTE: Emergency assistance for all types of emergencies may be obtained 24 hours a day by dialing the emergency assistance number, **extension 5-5555**, from any campus phone or by simply picking up the receiver of **any emergency phone on campus**. Outside emergency phones may be recognized by blue lights above the telephone. Emergency telephones only reach the emergency dispatcher and may not be used to reach other local or campus numbers.

Chemical Spills

√ General Safety Guidelines. The procedures described below are to be used for small chemical spills where materials for clean-up are available in the lab and if employees have received training in their use. For larger spills call the campus emergency phone number at extension 5-5555. When unsure of how to clean up small amounts of a material, notify your supervisor.

See the "UMBC Emergency Response Procedures for Spills, etc." for more information.

→ Locate spill cleanup materials. Laboratories should be equipped with spill cleanup kits. If your laboratory area does not have such emergency items, the supervisor can assist in obtaining the appropriate material.

→ Wear the appropriate personal protective equipment (e.g., gloves, goggles) when cleaning up spills.

√ Acid Spills

→ Apply neutralizer (or sodium bicarbonate) to the perimeter of spill.

→ Mix thoroughly until fizzing and evolution of gas ceases. NOTE: It may be necessary to add water to the mixture to complete the reaction. Neutralizer has a tendency to absorb acid before fully neutralizing it.

→ Check mixture with pH indicator paper to assure that the acid has been neutralized.

→ Transfer the mixture to a plastic bag, tie shut, fill out a waste label, and place it in the fume hood. Notify the supervisor or call ESH for disposal.

√ Caustic Spills (e.g. NaOH)

→ Apply neutralizer (weak acid) to the perimeter of spill.

→ Mix thoroughly until fizzing and evolution of gas ceases.

→ Check mixture with pH indicator paper to assure that the material has been completely neutralized.

→ Transfer the mixture to a plastic bag, tie shut, fill out a waste label, and place in the fume hood. Notify the supervisor or call ESH for disposal.

√ Solvent Spills

→ Apply activated charcoal to the perimeter of the spill.

→ Mix thoroughly until liquid is absorbed and no evidence of liquid solvent remains.

→ Transfer absorbed solvent to a plastic bag (if compatible), tie shut, fill out and attach a waste label, and place in the fume hood. Notify the supervisor or call ESH for disposal.

√ Mercury Spills

→ Call the lab supervisor andESH to report the mercury spill.

. → To clean up small spills with a mercury spill kit, dampen the mercury sponge with water, then wipe the contaminated area.

→ Do this procedure slowly to allow for complete absorption of all free mercury. A silvery surface will form on the sponge.

→ Place the contaminated sponge in its plastic bag, tie shut, fill out and attach a waste label, and place in the fume hood. Notify the supervisor or call ESH for disposal.

→ Alternatively, sprinkle the area with sublimed sulfur for absorption of the mercury. Collect and seal sulfur in container for proper disposal.

→ For larger spills that cannot be cleaned up by lab occupants, call ESH at extension 2918 or the campus emergency number (extension 5-5555).

Radioactive Material Spills √ In the event of any occurrence out of the ordinary involving radioactive materials or radiation producing equipment contact the UMB Radiation Safety Office (RSO) at (410) 706-7055 during working hours or at (410) 407-0486 after hours. If contaminated, do not leave the area of the spill until you are decontaminated by UMB EHS Radiation Safety unless you have a serious injury. Any event involving radioactive materials must be reported to the RSO as some circumstances require immediate notification to State Authorities.

Biohazard Spills √ Appropriate personal protective measures must be taken for cleanup of potentially-infectious wastes. Laboratories using infectious agents should abide by the appropriate practices and procedures with respect to biosafety level as defined by the Centers for Disease Control and Prevention - National Institutes of Health. Laboratory specific procedures for containing and cleaning up spills of infectious agents can be reviewed by ESH. More information on biological containment, risk assessment, regulatory compliance, and additional biosafety related matters can be found in the UMBC Biosafety Manual and the UMBC Exposure Control Plan located on the ESH website (safety.umbc.edu).

Fire Safety

√ Laboratory supervisors must be knowledgeable of the UMBC Policy Concerning *Plan* Fire Emergencies (see Appendix VI). This official policy describes the procedures occupants must take in the event of fire or other emergencies.

√ Laboratory supervisors should develop a plan which incorporates specific instructions relating to their laboratories into the UMBC Policy Concerning Fire Emergencies. Specific instructions should include:

→ Location of exits and emergency escape routes.

→ Locations of fire alarm pull stations and emergency phones.

→ Operations to be shut down, turned off or secured before evacuation **without placing personnel in danger**.

→ A location for laboratory personnel to meet and the procedure to account for personnel after an evacuation.

→ Laboratory supervisors should review the plan with new employees and students and annually with all personnel.

√ The laboratory-specific fire emergency plan should be posted in the laboratory.

Small Laboratory Fires

√ Small fires which are **contained in beakers or flasks** can be extinguished by covering the fire with a larger beaker if the laboratory personnel are confident to do *so*

→ **DO NOT attempt to fight a fire that cannot be extinguished immediately by covering it with a larger beaker. Initiate the fire emergency procedures located in Appendix VI.**

Individual on Fire	√	The rescuer should instruct the victim to **STOP - DROP - ROLL.** Victims should also place their hands over their face.
	√	The victim should **NOT** run to a fire blanket. If a fire blanket is available, it may be used by a rescuer to smother the flames.
	√	**DO NOT** use fire extinguishers to extinguish a person who is on fire.
	√	**DO NOT** attempt to remove clothing from burned areas.
	√	**Call for emergency assistance (extension 5-5555) immediately.**
	√	**DO NOT** put water on large burns.
	√	Keep burned areas clean and dry.
	√	Keep the victim calm.
	√	For information or questions on fire emergency procedures, call ESH(x5-2918) or the UMBC Police (x5-5555).

The following is a list of the various types of fire extinguishers and their recommended use. Do not use the wrong type of fire extinguisher as this may cause a fire to spread.

Class of Fire Extinguisher Contains	**Kind of Fire**	
Class A 	cardboard, and most ordinary combustibles (Wood, paper, cloth)	Water
Class B  foam	Flammable liquids such as oil, solvents, greases and gasses	Dry Chemicals, carbon dioxide or halogenated agents, to smother the fire with

Class C 	halogenated	Energized electrical equipment, such as electrical boxes, panels, transformers, etc.	Dry Chemicals, carbon dioxide or agents, to smother the fire with foam. Never use water on this kind of fire, because water conducts electricity and causes the fire to spread.
Class D 	powder	Combustible metals	Special liquid or dry agent

PROPERTIES OF HAZARDOUS CHEMICALS

Flammability

Flammability is a measure of how easily a gas, liquid, or solid will ignite and how quickly the flame, once started, will spread. The more readily ignition occurs, the more flammable the material. Flammable liquids themselves are not flammable; rather, the vapor from the liquids is ignited. There are two physical properties of a material which indicate its flammability: flash point and volatility (boiling point).

The ***flash point*** of a material is the temperature at which a liquid (or volatile solid) gives off vapor in quantities significant enough to form an ignitable mixture with air. Given an external source of ignition (i.e., spark, flame), a material can ignite at temperatures at or above its flash point. The flash point of ethyl ether, a highly flammable solvent, is -49°F. Kerosene has a flash point between 100°F and 150°F. Flammable gasses have no flash point, since they are already in an ignitable form.

The ***volatility*** of a material is an indication of how easily the liquid or solid will pass into the vapor stage. Volatility is measured by the ***boiling point*** of the material -- the temperature at which the vapor pressure of the material is equal to the atmospheric pressure. The term volatility is often mistakenly used as a synonym for flammability. There are some materials that are volatile but not flammable such as water, chloroform and mercury.

Some materials are ***pyrophoric,*** meaning that they can ignite spontaneously with no external source of ignition. Potassium metal, for example, can react with the moisture in air. This reaction causes hydrogen gas to be evolved, and the heat generated by the reaction can be hot enough to ignite the hydrogen.

√ Examples of commonly-used flammable chemicals.

→	acetone	→	ethyl ether
→	sodium	→	hydrogen
→	lithium	→	acetylene
→	ethyl alcohol	→	potassium
→	carbon disulfide	→	hydrocarbon solvents

Labeling & Information	√	Each container of flammable liquid should be properly labeled before use.
	√	Product flammability may be indicated on the label by a picture of a flame, a flame in a red diamond, a numeric code in a NFPA Hazard Rating system diamond or by the words flammable or combustible.
	√	Flammability information can be found on the SDS under **Fire and Explosion Data**. Flash point and boiling point information can be found in the section entitled **Physical Properties**.
Storage	√	Flammable materials should never be stored near acids or oxidizers.
	√	Keep storage areas cool to decrease the possibility of formation of vapors in excess of the lower flammable limit for the material or autoignition in the event that vapors mix with air. Adequate ventilation should be provided to prevent vapor build-up under normal storage conditions.
	√	Do not store flammable materials in conventional (non-explosion proof) refrigerators. Sparks generated by internal lights or thermostats may ignite flammable material inside the refrigerator, causing an extremely dangerous explosion hazard.
	√	Storage areas should have spill cleanup materials and an emergency plan nearby, including the location of the nearest fire alarm pull station. Do not attempt to extinguish a fire in a flammable storage area.
	√	Storage areas should be inspected periodically for deficiencies, and storage of flammable materials should be kept to a minimum.
	√	"NO SMOKING" signs should be clearly posted where flammable materials are stored.
	√	Flammable liquids can be separated into 3 classifications based on their flash point and boiling point. Based on these classifications, NFPA has published limits for maximum size and quantity of specific flammable liquid storage containers. OSHA standards enforce these limits for storage in laboratories.

	FLAMMABILITY (°F)		MAX. SIZE PER CONTAINER TYPE				MAX. QTY PER
	Flash Point	Boiling Point	Glass	Metal	Plastic•	Safety Can*	Flammable Cabinet□
Flammable Liquids							

Class IA	below 73	below 100	1 pt.	1 gal.	1 gal.	2 gal.		60 gal.
Class IB	below 73	at or above 100		1 qt.	5 gal.	5 gal.	5 gal.	60 gal.
Class IC	73 - 100	N/A		1 gal.	5 gal.	5 gal.	5 gal.	60 gal.
Combustible Liquids								
Class II	100 - 140	N/A	1 gal.	5 gal.	5 gal.	5 gal.	60 gal.	
Class IIIA	140 - 200	N/A	5 gal.	5 gal.	5 gal.	5 gal.		120 gal.
Class IIIB >	200 or above	N/A	5 gal.	5 gal.	5 gal.	5 gal.		N/A

* U.L. Approved

□ Max. 3 cabinets per fire area

A maximum of 10 gal. of class I and/or II liquids may be stored in any fire area outside of safety cans.
A maximum of 25 gal. of class I and/or II liquids may be stored in any fire area inside of safety cans.

Handling

√ Use gloves and splash-proof safety goggles when handling flammable liquids.

√ Mixtures of flammable or combustible liquids should be treated as though the mixture had the lowest flash point represented.

√ Dispensing of flammable or combustible liquids should only be carried out under a fume hood or in an approved storage room.

√ When transferring or using a flammable liquid, all ignition sources should be removed from the area. **Open flames or hot plates should NOT be used to directly heat flammable liquids**.

√ DO NOT use water to clean up flammable liquid spills.

√ DO NOT dispose of flammable or combustible liquids in the sink or drain. Follow disposal procedures issued by ESH in the "UMBC Hazardous Waste Disposal Guidelines", a copy of which is available in every departmental office.

√ "NO SMOKING" signs should be posted where flammable liquids are being handled.

Corrosivity

Gasses, liquids, and solids can exhibit the hazardous property of corrosivity. Corrosive materials can burn, irritate, or destructively attack skin. When inhaled or ingested, lung and stomach tissue are affected. Corrosive gasses are readily absorbed into the body through skin contact and inhalation. Corrosive liquids are frequently used in the laboratory and have a high potential to cause

external injury to the body. Corrosive solids often cause delayed injury. Because corrosive solids dissolve rapidly in moisture on the skin and in the respiratory system, the effects of corrosive solids depend largely on the duration of contact.

√ Materials with corrosive properties can be either **acidic** (low pH) or **basic** (high pH). Examples of corrosives are listed below:

→	sulfuric acid	→	hydrochloric acid
→	nitric acid	→	ammonium hydroxide
→	sodium hydroxide	→	chromium trioxide

Labeling & Information

√ The corrosive label normally depicts the corrosion of a hand and bar of steel.

√ Information on corrosivity can be found in the SDS under **Health Effects and First Aid**.

Storage

√ Segregate acids from bases, and corrosive materials from both organic and flammable materials.

√ Store corrosive materials near the floor to minimize the danger of falling from shelves.

√ Store in cool, dry, well-ventilated areas and away from sunlight. The storage area should not be subject to rapid temperature changes.

Handling

√ Wear adequate protective equipment (lab apron, appropriate gloves and splash-proof eye protection). If splashing is a definite hazard, face shields must also be worn.

√ Corrosive materials should be handled in a fume hood to protect the user from the possible generation of hazardous or noxious fumes.

√ Add reagents slowly. Always add acids to water (never water to acid). During the addition of reagents, allow acid to run down the side of the container and mix slowly.

√ Corrosive materials should be transported in unbreakable containers.

√ For cleaning corrosive spills, refer to Emergency Procedures.

Reactivity

Explosives

√ Explosive materials are chemicals that cause a sudden, almost instantaneous release of pressure, gas and heat when subjected to sudden shock, pressure or high temperature.

√ Some substances, under certain conditions of shock, temperature or chemical reaction, can explode violently. Such explosions present many hazards to laboratory personnel, Inc:

- → flying glass can seriously lacerate skin
- → fires can result from burning gasses
- → corrosive or toxic substances can be liberated

√ Before working with explosive materials, understand their chemical properties, know the products of side reactions, the incompatibility of certain chemicals, and monitor possible environmental catalysts (such as temperature changes).

√ Examples of materials that may be explosive under some conditions of use:

→ acetylene	→ azide compounds
→ hydrogen	→ some nitro compounds
→ ammonia	→ peroxides
→ perchlorates	→ bromates

Labeling & Information

√ Information on explosives can be found on the SDS under **Fire and Explosion Data**.

Storage & Handling

√ Explosion hazards. AVOID:

- → allowing picric acid to dry out
- → mixing flammable chemicals with oxidants
- → flammable gas leaks

→ heating compressed or liquefied gas

→ uncontrollable or fluctuating temperatures during experiments using explosive chemicals

→ bringing hot liquid (e.g., oil) into sudden contact with a material possessing a lower boiling point

→ contacting flammable materials with catalysts (e.g., acids or bases catalyze an explosive polymerization of acrolein)

→ explosive peroxide generation products that build up in solvent containers during storage

→ mixing nitric acid with acetone

→ distilling ethers unless free from peroxides

√ Carefully plan a procedure for working with explosive materials.

→ Insert experimental apparatus into a dry glove box or gas blanket.

→ Minimize storage of ethers.

→ Keep specified fire extinguishing equipment near the explosive chemical work space.

→ Determine all explosive hazards prior to experimental work, including the stability of reactants/products.

√ For more information, contactESH at extension 5-2918.

Oxidizers

An oxidizing agent is a chemical that initiates or promotes combustion in materials, thereby causing fire either of itself or by the release of oxygen or other gasses. Because they possess varying degrees of chemical instability, oxidizing agents are explosively less predictable and, therefore, represent a particularly hazardous threat.

√ Examples of oxidizing agents:

→ peroxides

→ hyperperoxides

→ peroxyesters

√ Oxidizers can react violently when in contact with organics. For this reason, avoid unplanned/uncontrolled interactions between oxidizers and organic materials. Examples of organic-reactive oxidizers include nitric acid, chromic acid, and permanganates.

Peroxides

√ Some organic compounds, such as ethers, can react with oxygen from the air, forming unstable peroxides. Peroxide formation can occur under conditions of normal storage, when compounds become concentrated by evaporation, or when mixed with other compounds. The accumulated peroxides can then violently explode when exposed to shock, friction, or heat. Pure compounds will accumulate peroxides more readily than compounds containing impurities.

√ Examples of organic compounds that can form hazardous peroxides:

- → aldehydes, ketones
- → ethers
- → compounds with allylene ($CH_2 = CHCH_2R$) structure
- → alkali metals, alkoxides, amines
- → vinyl and vinylidene compounds
- → compounds with benzylic hydrogen atoms

√ Examples of chemicals that form hazardous peroxides during exposure to air:

- → ethyl vinyl ether
- → decalin
- → tetralin
- → tetrahydrofuran (THF)
- → p-Dioxane
- → ethyl ether
- → isopropyl ether

√ Destruction of the listed chemicals is recommended after 6 months after opening, or by the expiration date (whichever comes first) without any testing for peroxide content.[1]

→ Acetal

→ Diethyl ether

1

→ Allyl ether
→ Allyl phenyl ether
→ Isoamyl benzyl ether
→ Benzyl n-butyl ether
→ Dibenzyl ether
→ Benzyl ethyl ether
→ Benzyl 1-naphthyl ether
→ *p*-Dibenzyloxybenzene
→ 1,2-Dibenzyloxyethane
→ Chloroacetaldehydediethylacetal
→ 2-Chlorobutadiene
→ Cyclohexene
→ Cyclooctene
→ Decalin
→ Diethoxymethane
→ Diethyl fumarate
→ Dioxane
→ 1,3-Dioxepane
→ 1,2-Epoxy-3-isopropoxypropane
→ Vinylidene chloride
→ Isophorone
→ Dimethoxymethane
→ 2,2-Dimethoxypropane
→ 1,3,3-Trimethoxypropene
→ Di-n-propoxymethane
→ beta-Isopropoxyproprionitrile
→ Diisopropyl ether
→ n-Propyl isopropyl ether
→ Tetralin

√ Discard opened containers of peroxidizable compounds not listed above within 6 months after opening or before the expiration date provided by the manufacturer. For disposal, call ESH at extension 5-2918.

Labeling & Information

√ A pictorial oxidizer label depicts a flaming letter "O" on a yellow background.

√ Information on oxidizing agents can be found on the Material Safety Data Sheet (SDS) under the heading **Reactivity Data**.

Storage & Handling

√ Order ether in small quantities and use quickly.

√ Include the date of purchase on containers of peroxidizable compounds. Note the date of opening on the label.

- √ When possible, store peroxidizable compounds (except certain inhibited vinyl monomers) under a nitrogen atmosphere. Keep away from heat, light, and ignition sources.

- √ Store in a cool, dry, well-ventilated area, out of direct sunlight. Protect from extreme temperatures and rapid temperature changes. DO NOT SMOKE or allow open flames/sparks near oxidizers.

- √ Store in amber glass or inert containers, preferably unbreakable. Containers should be tightly sealed. DO NOT use corks or rubber stoppers to cap containers.

- √ Before opening glass bottles, look for the presence of solids (crystals) or viscous liquid at the bottom of the bottle. These are good indicators of peroxide formation. Do not open a container that is suspect -- call ESH at extension 5-2918 for disposal.

- √ Isolate reactive chemicals from incompatible materials.

    - → organic materials
    - → flammable solvents
    - → corrosives (i.e., nitric, chromic acids)

- √ Avoid friction, grinding and all forms of impact while working with oxidizers.

- √ Avoid mixing oxidizing agents with other chemicals during disposal procedures.

- √ To detect the presence of peroxides, the following procedure can be used. In a 25 ml glass-stoppered cylinder (colorless, protected from the light), add 1 ml of freshly prepared 10% aqueous potassium iodide solution to 10 ml of the suspect organic solvent. View the cylinder transversely against a white background. If a yellow or brown color appears, peroxide is present. call ESH for disposal.

Toxicity

The concept of toxicity is unique because it can be applicable to all chemical substances used in the laboratory. The terminology explained below can assist laboratory workers in assessing the degree of hazard and provide guidance in the selection of appropriate personal protective equipment.

Toxicity is defined as the ability of a substance to cause: damage to living tissue, impairment of the central nervous system, severe illness, or in extreme cases, death when ingested, inhaled, or absorbed through the skin.

√ The administration of a particular dosage of a chemical, and the subsequent response by experimental animals, can help predict that chemical's toxic effect on humans. The dose-response behavior is represented by a dose-response curve, which demonstrates that not all individuals will respond to a particular dose of a chemical in the same manner. Some people will be more sensitive than others, and a specific dosage that may be lethal to one person may not be lethal to another.

The point on the curve where 50% of the test animals have died as a result of a particular chemical dosage is referred to as the Lethal $Dose_{50}$, or ***LD_{50}***. The LD_{50} is usually indicated in terms of milligrams of substance ***ingested*** per kilogram of body weight (mg/kg). The lower the LD_{50}, the more toxic the material.

√ Inhalation of toxic substances can cause a great deal of tissue damage. Each lung is composed of a large surface area of folded tissue, which is vulnerable to assault by toxic vapors and airborne particles. The toxicity of a substance via ***inhalation*** is represented by ***TLV***s,(Threshold Limit Values) or ***PELs*** (Permissible Exposure Limits). TLVs are compiled by the American Conference of Governmental Industrial Hygienists (ACGIH) based on available research, and are considered the industry standards. PELs are determined by the Occupational Safety and Health Administration (OSHA) and promulgated as enforceable standards.

→ Both measures are expressed in parts per million (ppm) of the substance in air, or milligrams of substance per cubic meter of air.

→ The exposure limits are identified as ***time-weighted averages*** (TWA) and the ***short-term exposure limits*** (STEL) or ***ceilings*** (C).

→ The TWA of a substance is the average concentration to which a worker can be exposed throughout an eight-hour work day without adverse effects. An important point to keep in mind is that the adverse effects of over-exposure to a material can range from headache or nausea to more severe disabilities. For this reason, time-weighted averages should be considered only as a guide in controlling health hazards in the laboratory, not as definitive marks between "safe" and "dangerous" concentrations.

→ The STEL of a substance is the maximum amount to which a worker can be exposed in a fifteen-minute period without adverse effects. Again, this is intended only as a rough guideline.

→ The Ceiling limit of a substance is the concentration that should not be exceeded during any part of the work day.

√ The toxicity of a substance via ***skin absorption*** can be determined several ways. Often, the threshold limit values of a substance will have a "skin" notation, indicating they are rapidly absorbed through the skin. Absorption can also be indicated by the solubility of the material in water. Materials that are extremely soluble in water can dissolve in skin moisture and be transported through the skin's surface. For instance, dimethyl sulfoxide (DMSO) rapidly absorbs into the skin. If any toxic materials are present in this solvent or on the surface of the skin, DMSO will transport these contaminants into the body as well.

√ A substance can have either ***acute*** or ***chronic*** toxicity. A substance that is acutely toxic will have immediate effects on the health of an over-exposed individual, (e.g., phosgene causes immediate throat irritation at a concentration of 3 ppm and immediate death at 50 ppm). A substance that has chronic toxicity will eventually affect the health of a person due to long-term exposure to that material (e.g., phosgene in concentrations less than 1 ppm over a long period of time are a potential trigger for emphysema).

Poisons

A poisonous compound is a substance that causes death or serious injury if relatively small amounts are inhaled, ingested or have contacted the skin. All substances can be poisons in some quantity or condition of use.

Labeling & Information

√ Any substance that carries the international poison symbol (skull and crossbones) should be treated as hazardous.

√ Information on the poisonous nature of chemicals can be found in the SDS **Health Hazard Data** section.

Storage & Handling

√ Treat poisonous compounds with extreme caution. Wear protective lab coats, gloves and safety glasses, and work in a functioning fume hood.

√ For specific substance information call the Maryland Poison Control Center at 1-800-222-1222.

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SPECIAL CLASSES OF HAZARDOUS SUBSTANCES

Carcinogens

Carcinogens are substances that will cause cancer in humans or animals given appropriate exposures. Suspect carcinogens are substances that have chemical similarities with known carcinogens or have shown preliminary evidence of carcinogenic activity. Carcinogens can represent an insidious hazard in the laboratory since they can cause disease with exposures that do not produce acute toxic effects. There may be a long latency period between exposure and the appearance of cancer.

The consequence of exposure to carcinogens varies according to the species, the physiological and metabolic state of the organism, and the dosage of the carcinogen (including duration and route of exposure, concurrent exposure to other agents, and other factors). There is continuing scientific debate regarding the minimum exposure required to produce cancer, as well as the relevance of experimentally-induced animal cancers to a human situation. The complex interaction of such determinants makes risk assessment of human exposure to carcinogens exceedingly difficult. Due to these uncertainties, assurance of laboratory safety requires strict limitation of human exposure to carcinogenic
substances.

Some compounds are carcinogenic only in combination with certain other compounds. It is known that particular chemicals promote the carcinogenic action of others. Since the potential for synergistic action of most chemicals is unknown, it is essential that caution be exercised with all organic compounds and metals when used in combination with carcinogens.

Labeling & Information

√ The following terms, defined by the International Agency for Research on Cancer (IARC), are used to describe material carcinogenicity:

- → Sufficient positive: Those chemicals that were found to promote and increase incidence of malignant tumors in multiple species or strains of lab animals.
- → Limited positive: Those chemicals found to promote either malignant tumors in a single strain, or benign tumors in single or multiple species or strains.
- → Inadequate: Insufficient evidence to make a decision.
- → Equivocal: Almost no supporting evidence.
- → Negative: Limited or sufficient significant negative evidence.

√ Examples of known or suspected carcinogens are listed below. The risk factor associated with these compounds is high, and alternative compounds should be used whenever possible.

→ 4-Nitrobiphenyl → α- and β-Naphthylamine *

→	Methylchloromethyl ether	→	3,3'-Dichlorobenzidine *
→	bis(chloromethyl) ether *	→	Chloroform *
→	Benzidine *	→	4-Aminodiphenyl
→	Ethyleneimine *	→	β-Propiolactone
→	Benzene *	→	Dimethylaminoazobenzene
→	Vinyl chloride *	→	1,2-dibromo-3-chloropropane *
→	Arsenic *	→	Acrylonitrile *
→	N-Nitrosodimethylamine *	→	Formaldehyde *

* Designates a "Listed Hazardous Waste" (EPA).

√ The Occupational Safety and Health Administration (OSHA) regulates the carcinogens listed below:

→ 2-Acetylaminofluorene	→ 4-Dimethylaminoazobenzene
→ Acrylonitrile	→ Ethylenimine
→ 4-Aminodiphenyl	→ Inorganic arsenic
→ Asbestos	→ 4,4'-Methylene bis(2-chloroaniline)
→ Benzene	→ Methyl chloromethyl ether
→ Benzidine	→ alpha-Naphthylamine
→ bis-Chloromethyl ether	→ beta-Naphthylamine
→ Coke oven emissions	→ 4-Nitrobiphenyl
→ 1,2-dibromo-3-chloropropane	→ n-Nitrosodimethylamine
→ 3,3'-Dichlorobenzidine	→ beta-Propiolactone
(and its salts)	→ Vinyl chloride
→ Cadmium	→ Ethylene Oxide
→ Formaldehyde	→ Methylenedianiline
→ 1,3-Butadiene	→ Methylene Chloride

Note: Anyone contemplating work with these carcinogens must contact theESH at extension 5-2918 to make arrangements for a hazard assessment consisting of initial environmental monitoring or engineering control evaluation. Depending on the results, laboratories

may be required to meet the OSHA regulations on training, record keeping, personal monitoring and medical surveillance.

Access Control

√ Entrances into areas where known carcinogens are used must be posted as designated areas.

√ Laboratory Supervisors/Principal Investigators are required to designate locations within the lab for use of carcinogens. The designation must include consideration of necessary control measures.

√ Allow only authorized persons in the laboratory. Close all doors and restrict traffic in the work area when the carcinogen is being used.

√ Place warning labels such as "Carcinogen" or "Cancer Suspect Agent" on all stock, dilution, and hazardous waste disposal containers.

√ Visitors should be notified about carcinogen use in the laboratory work area.

√ Housekeeping personnel must be informed of any possible hazards or special cleaning procedures that are required.

√ All work with carcinogens should stop and the area and equipment decontaminated before Facilities Management personnel are permitted to repair or work on equipment, drains,or ventilation ducts.

Personal Protection

√ In some high-risk operations involving carcinogens, special engineering controls may be required.

√ Wear protective clothing such as

-- gloves
-- lab coats
-- safety glasses with side shields
-- respirators

when handling carcinogens. Do not wear them outside of the laboratory.

√ Under normal working conditions, no carcinogen should contact gloves or clothing. They are the last line of defense.

√ Check the manufacturer's description to be sure that the type of glove or respirator planned to be worn truly forms a barrier against the carcinogen being used. This is particularly true when using organic solvents, acids and bases.

√ There should be no eating, drinking, smoking or other unnecessary hand-to-mouth contact.

√ Only small amounts of carcinogens should be kept in stock. Only minimal amounts should be kept at work stations.

√ Wash hands with soap after procedures involving a carcinogen.

Storage & Handling

√ Containers of carcinogens should be clearly labeled and kept in a separate (preferably locked) storage location. Designated work areas appropriate for carcinogen use should be clearly demarcated.

√ Conduct work involving volatiles, aerosols or dust in a chemical fume hood exhausted to the outside so that the possibility of entry into the supply air intake of any building is minimized.

√ Check fume hoods, biological safety cabinets (laminar flow hoods) and glove boxes for leaks, air-flow rate and air-flow patterns prior to using them. Follow-up with periodic checks.

√ All work surfaces on which carcinogens are used should be stainless steel or covered with plastic trays or dry absorbent plastic-backed paper.

√ Laboratory supervisors are responsible for training laboratory workers on proper carcinogen-handling techniques.

√ Each laboratory worker must adhere to proper operations, emergency procedures, monitoring of lab work and required medical examinations. Medical records must be accurately maintained when working with carcinogens.

√ Before working with suspected or known carcinogenic compounds, obtain health hazard information for each compound from SDS. In addition, compile spill cleanup emergency procedures for your laboratory.

Mutagens and Teratogens

Mutagens Mutagens are chemical and physical agents that induce mutations in DNA and in living cells. This affects the genetic system in such a way as to cause cancer or hereditary changes in chromosomes. Individuals exposed to chemicals with mutagenic properties may develop genetic damage to the extent that future offspring may be affected.

√ Two forms of somatic (body/organ) cell interference may be noted.

→ Leukemias: White blood cells are produced far more rapidly than they can be removed from the blood, interfering with normal body functions.

→ Cancers: Cells that do not normally divide during adult life begin to proliferate to the extent that such division displaces or invades normal tissues.

√ Examples of mutagens:

→ Arsenic	→ Ethidium Bromide
→ Ionizing Radiation (gamma, x-rays)	→ Alkylating agents (i.e., dimethyl sulfate)

Teratogens Teratogens are chemical and physical agents that interfere with normal embryonic development. Teratogens differ from mutagens in that there must be a developing fetus. Damage to the fetus (embryo) is most likely to occur early in pregnancy, during the first 8 - 10 weeks. Teratogens may produce congenital malformations or death of the fetus without inducing damage to the pregnant woman.

√ In general, carcinogenic chemicals should be considered as a hazard to reproductive health. Even though OSHA has established exposure limits for dangerous materials, a developing fetus may be adversely affected by lower doses than those considered acceptable for adult exposure. Toxicology is still not well developed to evaluate reproductive health hazards. However, as of 1985, OSHA has identified three substances as teratogens:

→ Dibromochloropropane

→ Lead

→ Ethylene oxide

√ Examples of several other materials that are thought to be associated with reproductive health disorders are listed below.

→ Antimony	→ Carbon disulfide
→ Ethylene thiourea	→ Polychlorinated biphenols (PCBs)

→ Nitrous oxide → Formaldehyde

→ Ethylene dibromide → Ionizing radiation

See precautions as listed under carcinogens.

Handling & Storage

√ Before working with suspected or known mutagenic or teratogenic compounds, obtain health hazard information for each compound. In addition, compile spill cleanup emergency procedures for your laboratory.

√ Exercise extreme caution, as you would with carcinogens. Wear personal protective clothing and equipment, and work in a well ventilated area.

Biohazards √ The laboratory supervisor is responsible for the safety of laboratory workers in their area. In handling biohazardous materials, the supervisor should consider:

→ The biosafety level established for the lab.

→ Current OSHA, NIH, EPA, and other pertinent requirements pertaining to biohazard use. This includes CDC-NIH guidelines as described in the Biosafety in Microbiological and Biomedical Laboratories (BMBL). See Appendix IV for summary of biosafety level recommendations.

→ Education/training provisions to introduce laboratory workers to biohazard use and disposal.

→ Access to these areas should be limited to <u>authorized personnel only</u>.

→ The concept of "universal precautions" must be observed when infectious materials or by-products are present.

√ It is the responsibility of the laboratory supervisor to post the international biohazard symbol on all entrances to biohazard work areas along with pertinent emergency information and entry requirements.

√ Individuals who have contact with human blood or blood products must comply with the UMBC Exposure Control Plan. ContactESH for more information at extension

5-2918.

Biological, Pathological or Medical Waste

All laboratories involved in the use of human pathogenic microorganisms and recombinant DNA must be approved for the appropriate biosafety level determined upon review by the Institutional Biological Safety Committee (IBC). More information on IBC approval can be found on the Office or Research Protections and Compliance website, contact compliance@umbc.edu for additional information.

√ Transport and disposal of infectious waste must be done in accordance with UMBC waste disposal guidelines. Biological, Pathological or Medical Waste (BPMW) includes but is not limited to the following waste:

→ Cultures and stock of infectious agents and associated biologicals including culture from medical, pathological, research and teaching laboratories; waste from the production of biologicals; discarded live and attenuated vaccines; and culture dishes and devices used to transfer, inoculate and mix cultures.

→ Blood and blood products. Waste consisting of human blood, human blood products (includes serum, plasma, etc.) and items contaminated by free-flowing human blood are BPMW.

→ Pathological waste. All pathological waste and all waste that are human tissues, organs, body parts, or body fluids that are removed during surgery, autopsy or other teaching or research procedures, and specimens of the above including their containers are BPMW.

→ Sharps. Used or unused hypodermic needles, syringes, scalpel blades, Pasteur pipettes, transfer pipettes, transfer pipette tips, scalpel blades, razor blades, blood vials, needles attached to tubing, needles used with sutures, culture dishes regardless of presence or absence of infectious materials, broken glass and similar devices likely to be contaminated with organisms that are pathogenic to healthy humans and all sharps used in patient care are BPMW.

→ Animal waste. All animal carcasses, body parts, potentially contaminated bedding, and related wastes are BPMW.

→ Any residue or contaminated soil, water, or other debris resulting from the cleanup of a spill of any BPMW.

→ Isolation waste. Biological waste and discarded materials contaminated with blood, excretions, exudates, or secretions of humans or animals who are isolated to protect others from highly communicable diseases, or isolated animals infected with highly communicable diseases.

→ Any waste contaminated by or mixed with BPMW.

√ All biological materials, including recombinant DNA, must be autoclaved or otherwise decontaminated using proven methods prior to discarding.

Decontamination of Material

√ Materials known or suspected to be contaminated with an infectious agent must be sterilized by the generator. In general, autoclaving is the most effective and convenient form of sterilization but other proven methods may be utilized. Refer to the UMBC Biosafety Manual for additional information on material decontamination.

Wet Heat (Steam)

√ Also known as autoclaving, this method requires a chamber temperature of at least 250°F(121°C). The processing time begins when the materials being sterilized reach the predetermined temperature for a specific amount of time. Monitoring of steam sterilization effectiveness can be done with an approved biological indicator.

Chemical Sterilization

√ Chemicals may be used to sterilize equipment and certain BPMW. It is important to keep in mind the 3 C's of sterilization (Chemical, Concentration, Contact time). More information on chemical sterilization can be found in the UMBC Biosafety Manual located on the ESH website.

Disinfectants The following table lists a description of commonly used disinfectants:

SUBSTANCE	DESCRIPTION
Alcohols	Ethyl or isopropyl alcohols at 70-80% concentration are good general purpose

	disinfectants; not effective against bacterial spores.
Quaternary Ammonium Compounds	Cationic detergents are strongly surface-active and extremely effective against lipoviruses; not effective against gram negative bacterial organisms and may be neutralized by anionic detergents (soaps).
Chlorine	Low concentrations (50-500 ppm) are effective against vegetative bacteria and most viruses; higher concentrations (5000 ppm) are required for bacterial spores; corrosive to metal surfaces; must be prepared fresh; laundry bleach (5.25% chlorine) may be used as a disinfectant.
Iodine	Recommended for general use; effective against vegetative bacteria and viruses; poor activity against bacterial spores. Betadine is a good disinfectant for washing hands.

Ethylene Oxide Gas(ETO)

√ ContactESH at extension 5-2918 prior to using ETO for sterilization activities to assure compliance with OSHA regulation and BSC guidelines.

√ ETO gas is lethal for all known microorganisms, but is best used to sterilize heat-resistant organisms or heat-sensitive equipment. ETO sterilization is recommended only when an alternate sterilization method is not possible. Oftentimes Hydrogen Peroxide gas is a more suitable and less hazardous alternative to ETO. Contact ESH for more information.

Disposal

√ For information on proper disposal procedures, see UMBC's waste disposal guidelines or call ESH at extension 5-2918.

Radioactive Materials and Radiation-Producing Equipment

All researchers wishing to work with radioactive compounds must complete training and submit a fully completed application to the UMB Radiation Safety Office (RSO) (410-706-7055). There are federal and state regulations that are very strictly enforced, so be sure you are doing things correctly. All use of radioactive materials and radiation-producing equipment must be authorized by the Radiation Safety Officer. Individuals must be approved as Authorized users or work under the direct supervision of qualified personnel. Authorized Users are responsible for all safety aspects of radioactive materials handling. Periodic surveys of laboratories are conducted, and personal exposures are monitored by badge for anyone working with radioactive materials.

√ All requests for radiation measurements should be directed to the RSO at (410) 706-7055.

√ All purchasing, approvals, receiving and shipment of radioactive materials is done through the RSO of UMB Emergency Health Services at 714 West Lombard Street, Baltimore MD 21201.

√ For information on proper disposal procedures, see the UMB Radiation Safety Policy or call UMB Environmental Health & Safety at extension (410) 706-7055.

√ For more information concerning radiation safety requirements, call the RSO at (410) 706-7055.

Compressed gasses

The purpose of this section is to assist the laboratory worker with identification, storage, maintenance and handling of compressed gasses. Compressed gasses can be hazardous because each cylinder contains large amounts of energy and may have high flammability and toxicity potential.

Labeling & Information

√ Compressed gas containers may be labeled in five ways:

→ flammable gasses are designated by a flame on a red label;

→ non-flammable gas labels depict a gas canister on a green background

→ poison gas labels depict a skull and crossbones

→ oxygen-containing gasses are designated by the letter "o"

→ chlorine gas is distinctly labeled.

√ Know the contents of the cylinder and be familiar with the properties of the gas.

√ The contents of the cylinder of compressed gas should be clearly marked and identified with proper labels or tags on the shoulder of the cylinder. **Those cylinders or compressed gasses that do not comply with identification**

requirements should be returned to the manufacturer.

√ If two labels are associated with one cylinder, affix the labels 180 degrees apart on the shoulder of each cylinder. Label all empty cylinders "EMPTY" or "MT" and date the tag. Treat an empty cylinder in the same manner that you would if it were full.

√ For removal of an empty tank, contact your departmental laboratory supply manager or ESH (Ext 5-2918).

√ All regulators, gauges, valves, manifolds, must be designed for the specific pressure and gas involved. They should bear the inspection seal of either Underwriters' Laboratories (UL®) or Factory Mutual Engineering Division of Associated Factory Mutual Fire Insurance Companies (FM®).

Storage & Handling

√ All cylinders should be stored in cool, dry, well-ventilated surroundings and away from all flammable substances including oil, greases, and gasoline. DO NOT subject any part of a cylinder to a temperature higher than 125° F.

√ Cylinders should not be located where objects may strike or fall on them.

√ Cylinders should not be stored in damp areas, or near salt, corrosive chemicals, fumes, heat or direct sunlight.

√ Store cylinders by gas type, separating oxidizing gasses from flammable gasses. Store flammable and oxidizing gasses either 20 ft apart or separated by a 30 minute fire wall, five feet high.

√ Keep a minimum number of cylinders on hand.

√ All cylinders and compressed gasses (full or empty) should be properly fastened and supported by straps, belts, buckles or chains to prevent them from falling and causing bodily harm or becoming a projectile. A maximum of two cylinders per restraint is preferred.

√ Close valves and relieve pressure on cylinder regulators when cylinders are not in use.

√ Valve handles must be in place when cylinders are in use.

√ DO NOT smoke in areas where there are flammable gasses.

- √ DO NOT extinguish a flame caused by a gas until the gas source has been shut off.

- √ A cylinder should only be moved while strapped to a wheel cart to ensure stability. When storing or moving cylinders, always attach safety caps.

- √ DO NOT heat the cylinder or place a cylinder where it may become part of an electrical circuit. Compressed gasses must be handled as high-energy sources and dangerous projectiles.

- √ All cylinders should be checked for damage prior to use. DO NOT repair damaged cylinders yourself. Damaged or defective cylinders, valves, etc., must be taken out of use immediately and returned to the manufacturer for repair.

- √ Each regulator valve should be inspected annually. Never force valve or regulator connections. Threads and the configuration of valve outlets are different for each family of gasses to prevent mixing of incompatible gasses.

- √ When opening a cylinder, direct the cylinder opening away from personnel and open slowly.

- √ DO NOT use lubrication on valve regulators.

- √ Do not refill a cylinder with a material other than that originally contained in the cylinder.

- √ Do not alter cylinder labeling.

- √ Do not alter the cylinder pressure by use of an external heat source.

- √ If an inert, flammable or toxic gas cylinder develops a **small** leak at the valve, carefully remove the cylinder to a hood or open space outdoors away from any possible source of ignition and all populations. Call your lab supervisor or ESH for assistance.

Cryogenic Materials

Cryogenic materials have special properties that make them hazardous to use. They are characterized by extremely low temperature (-60°C to -270°C). Cryogenic temperatures are achieved by liquefaction of gasses, most commonly helium, hydrogen, nitrogen, argon, oxygen or methane.

Storage & Handling

√ The severely cold temperatures associated with cryogenic liquids (-60°C to -270°C) can damage living tissue on contact and embrittle structural materials.

√ Liquefied under pressure, cryogenic liquids must be kept in specially designed, high pressure vessels that contain fittings to relieve overpressure. When located in moist areas, ice formation can plug pressure release devices and pose an explosion hazard. For this reason, store vessels in a dry place and periodically check for ice formation.

√ Cryogenic liquids present fire and explosion hazards. A flammable mixture, cooled in the presence of air with liquid nitrogen or liquid oxygen, can cause oxygen to condense and thereby present an explosion hazard. Keep away from ignition sources. Flammable liquids will support combustion in both the liquid and gaseous states. If allowed to depressurize, cryogenic liquids will rapidly and violently expand.

√ Store and work with cryogenic liquids in a well-ventilated area to prevent the accumulation of flammable, toxic or inert gasses as evaporation and condensation occur near the cryogenic tank.

√ Safety glasses and face shields should be used. For handling of cryogenic materials, use potholders or appropriate thermal gloves. (Check with the glove manufacturer to assure the gloves will protect against the extreme temperatures of cryogenic material used. For example: Liquid Nitrogen will freeze an inappropriate glove to the hand.

√ Cushion glassware in a protective covering to prevent injury caused by flying glass in the event of implosion/explosion.

√ Transport fragile cryogenic containers with caution -- use a hand truck if appropriate.

√ Vent cryogenic storage containers outdoors or into a chemical fume hood system.

√ Cryogenic gasses ALWAYS pose a high pressure hazard since they are stored near boiling point. Liquid to gas evaporation causes high pressures to build up

Asbestos-Containing Materials

Since the early 1900's, asbestos has been used extensively in the construction materials of buildings. Due to its low cost, fire and chemical resistance, insulation, and strengthening qualities, this "magic" mineral has been added to over 3,500 products found in the construction industry. The prolonged inhalation of asbestos fibers from these products has been linked to several lung diseases, including asbestosis, lung cancer and mesothelioma.

Although the federal government banned the use of certain "friable" types of asbestos-containing materials (ACM) in 1978, many UMBC buildings were constructed and renovated prior to this time. Friable means that the material may be reduced to powder by hand pressure. Non-friable ACM will not be subjected to a total ban until 1997. For these reasons, nearly all buildings built in this time frame contained asbestos in some form. The key to living safely with ACM is proper management.

ESH has developed an asbestos management plan for all University buildings. This plan includes an operations and maintenance program, training in recognition, training for staff members who actually work with ACM, and a record keeping system for reporting and recording locations and conditions of these materials. Some types of building materials that commonly contain asbestos include sprayed-on fireproofing; acoustical plaster; pipe, tank and boiler insulation; lab bench tops; fume hood panels; ceiling and floor tile, and sheet floor covering. Provided asbestos materials are not disturbed in a manner which creates airborne dust, they cannot harm your health. If disturbance becomes necessary, such as during renovation projects or computer cable installation, only properly trained and protected personnel should perform these tasks.

Should you encounter damaged suspect or ACM in your workplace, or if you may need to disturb or remove suspect materials, please contact ESH for assistance at extension 5-2918.

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LABELING, MATERIAL SAFETY DATA SHEETS, INFORMATION, AND TRAINING

Labeling

LABELS should be the primary initial source of warning for employees when handling hazardous chemical substances. Federal and State regulations mandate that all labels on original/stock containers of hazardous chemicals include the name of the hazardous chemical, appropriate hazard warnings, and the name and address of the manufacturer or other responsible party.

√ Substances regulated by a **specific** OSHA standard must be labeled by the manufacturer according to the requirements of that standard.

Example: OSHA 1910.1018 -- The Inorganic Arsenic Standard states that containers of inorganic arsenic must have a label which bears the following information:

DANGER
CONTAINS INORGANIC ARSENIC
CANCER HAZARD
HARMFUL IF INHALED OR SWALLOWED
USE ONLY WITH ADEQUATE VENTILATION

Hazard Information

√ Hazard warnings found on the labels of hazardous chemical containers may be composed of **pictures**, **symbols** and **words**, or any combination thereof which convey the hazard(s) of the chemical.

√ Picture hazard warnings help to identify the following properties and classes of hazardous compounds.

→	explosives	→	poisons
→	oxidizers	→	compressed gasses
→	flammables	→	radioactive substances
→	corrosives	→	biohazards

√ Symbol hazard warnings provide basic information in determining what precautionary measures to use when handling hazardous chemical substances and/or dealing with a fire.

Example: The National Fire Protection Association (NFPA) uses a symbol system designed as a diamond-shaped label containing four differently colored squares:

BLUE SQUARE → HEALTH HAZARD

RED SQUARE → FLAMMABILITY

YELLOW SQUARE → REACTIVITY

WHITE SQUARE → "SPECIAL HAZARDS"

A number (0 - 4) is added to each square indicating the order of hazard severity:

0 = NO SPECIAL HAZARDS
4 = SEVERE HAZARD
3 = MODERATE HAZARD
2 = SLIGHT HAZARD
1 = MINIMAL HAZARD

√ Word hazard warnings contain a word or words intended to capture the worker's **immediate attention** (e.g., flammable, poison, fatal if swallowed). These word labels should be in English, but other languages may be used where needed.

→ Signal words are warnings used to designate the degree of hazard.

DANGER → Highest degree of hazard (Red)

WARNING → Intermediate degree of hazard (Orange)

CAUTION → Lowest degree of hazard (Yellow)

Label Use

√ Laboratory supervisors should ensure that all incoming containers of hazardous chemicals bear a label specifying:

→ the name of the hazardous chemical.

→ the appropriate hazard warning.

→ the name and address of the manufacturer or other responsible party.

√ Laboratory workers should not remove or deface labels on containers of hazardous chemicals.

√ When chemicals are transferred from the manufacturer's original container to a secondary container, that new container should be appropriately labeled as to chemical identity and hazard warning.

→ EXCEPTION: Unless the contents of the secondary vessel are to be used during the workshift by the person who performed the original transfer, in which case the secondary vessel need only be labeled with the chemical identity.

Safety Data Sheets (SDSs)

SDSs are a major product-specific information resource for chemicals purchased for use in UMBC laboratories. OSHA requires chemical manufacturers and importers to produce an SDS for each hazardous chemical they manufacture or import. All SDSs should be maintained by the lab. ESH can assist individual labs in assembling individual SDSs or a set of SDS for the chemicals located in the lab upon request, call ESH at extension 5-2918

SDS Requirements √ The SDS must include the following information:

- → The identity of substance designated on the container label.
  - → Single substance: chemical and common names.
  - → Mixtures tested as a whole: chemical and common names of all ingredients which are health hazards, in concentrations of 1% or greater.
  - → Mixtures untested as a whole: chemical and common names of all ingredients which are health hazards and which are in concentrations of 1% or greater; carcinogens in concentration of 0.1% or greater; hazard determinations are based upon the characteristic of the individual products instead of the combined mixture.
- → Physical and chemical characteristics of the hazardous chemicals.
- → Physical hazards (potential for fire, explosion, etc.)
- → Known acute and chronic health effects and related health information.
- → Primary routes of entry into the body.
- → Information on exposure limits.
- → Whether a hazardous chemical is considered a carcinogen by OSHA, the International Agency for Research on Cancer, or the National Toxicology Program.
- → Precautions for safe handling.
- → Generally acceptable control measures (engineering controls, work practices, personal protective equipment).
- → Emergency and first aid procedures.
- → Date of SDS preparation, or most recent change.
- → Name, address, and phone number of the party responsible for preparing and distributing the SDS.

√ A SDS may be used for similar mixtures with essentially the same hazards and contents.

√ Copies of SDSs must be readily accessible during work hours.

Information and Training

In accordance with Federal and State regulations, all laboratory personnel have the right to be informed and trained on the chemical hazards present in their work area. The responsibility for apprising laboratory workers of the necessary precautions to take when using or handling hazardous materials rests with the Laboratory Supervisor (LS) or Principal Investigator (PI) in charge of the laboratory. Ultimately your safety in the lab depends on you! So take the time to learn about the hazards, the precautions to be taken, and carry out your role safely. If you have questions, ask your supervisor, or call ESH at extension 5-2918.

Employee

√ ESH will assist until general background training as required. Federal *Orientation* regulations mandate that all laboratory personnel complete these trainings, and that records of completion be kept.

√ Chemical safety information and training should be provided at the time of a laboratory worker's initial arrival to the lab area, and prior to new exposure situations. This can only be done by the Laboratory Supervisor or Principal Investigator in charge of the lab. ESH will provide assistance if necessary. You may contact ESH at 5-2918

Employee Information

Before working in the laboratory setting, all laboratory workers should know the following:

√ All procedures in the work area where hazardous materials are present, including emergency procedures.

√ Location and availability of known reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory. These references include the SDSs.

√ How to review SDSs, where they are kept, and how to obtain an SDS for a particular chemical.

√ Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory.

√ Permissible exposure limits (PEL) for OSHA regulated substances or recommended exposure limits for other hazardous chemicals where there is no specific OSHA standard.

√ If you have any specific questions about SDSs, laboratory safety, or chemical hazards, call ESH .

√ Proper waste disposal procedures

√ Applicable emergency response plans and contact information.

Employee Training √ All laboratory workers have the right to be trained on any potentially hazardous chemical or product used in the work area. Training should include:

→ Methods and observations that may be used to detect the presence or release of a hazardous chemical (i.e., continuous monitoring devices, visual appearances, or odors of hazardous chemicals when being released).

→ Physical and/or health hazards associated with hazardous materials in the work area.

→ Safety measures laboratory workers may use to protect themselves such as appropriate work practices, emergency procedures, and personal protective equipment.

Record-keeping √ At the conclusion of any general information/training session with laboratory workers, ESH will keep records of attendance for insertion into employees' personnel files. Faculty members/laboratory supervisors who provide specific training are advised to obtain a signed statement from employees indicating that they have received the appropriate training.

Access to SDSs

√ You may access SDSs by any of the following methods:

→ Use the World Wide Web to access the SDS database. Instructions for access can be found on safety.umbc.edu , contact ESH at 5-2918 for more information

→ Call ESH at extension 5-2918 to receive phone information, have an SDS faxed to you or have a SDS mailed to your campus address. If emergency assistance is necessary call extension 5-5555 for 24-hour service.

→ Contact your Laboratory Supervisor or Principal Investigator. A department or laboratory set of SDSs may be available for your use.

→ Contact the product manufacturer, importer or distributor and request a copy.

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Appendix I

Types of Respirators. The following is a description of different types of respirators. Please contact ESH to help you evaluate the respirator that best fits your needs.

Commonly Used Respirators (Air Purifying)

→ Disposable Dust masks are worn over the nose and mouth to protect the respiratory system from certain nuisance dusts, mists, etc. They can only provide protection against particular contaminants as specified by the manufacturer (e.g., general dust, animal hair, fiberglass, etc.). These dust masks cannot be fit tested, and are generally single use.

→ Half-Face Respirators with interchangeable filter cartridges can protect the respiratory system from hazardous dusts, fumes, mists, etc. They can only provide protection against certain contaminants up to limited concentrations specified by the manufacturer for the particular cartridge type used (e.g., toluene, acetone). These operate under negative pressure within the respirator which is created by the wearer's breathing through the filter cartridges. Protection is only gained if there is a proper seal of the respirator face piece. This type requires fit testing prior to respirator assignment and a fit check prior to each use.

→ Full-Face Respirators operate under the same principle and requirements as the half-face type, however, they offer a better facepiece fit and also protect the wearer's eyes from particularly irritating gasses or vapors.

→ Full-face, helmet or hood type powered air purifying respirators (PAPRs) operate under positive pressure inside the facepiece using a battery operated motor blower assembly to force air through a filter cartridge into the wearer's breathing zone. Use of these respirators is also subject to the manufacturers' guidelines.

Air Supplying Respirators

→ Air-Line Respirators supply clean air through a small diameter hose from a compressor or compressed air cylinders. The wearer must be attached to the hose at all times, which limits mobility. Use of these respirators is subject to the manufacturers' guidelines.

→ Self-Contained Breathing Apparatus (SCBA) respirators supply clean air from a compressed air tank carried on the back of the wearer. These types of respirators are highly mobile and are used primarily for emergency response or rescue work, since only a limited amount of air can be supplied by a single tank, generally 20-60 minutes. Units must be thoroughly inspected on a monthly basis and written records must be kept of all inspections, operator training, etc. Use of these respirators is subject to the manufacturer's guidelines.

Appendix II

GLOVE CHEMICAL RESISTANCE GUIDE[1]

	Silver Shield (4 Mil)			**Viton** (9 Mil)			**Butyl** (17 Mil)			**Nitrile** (11 Mil)			**Neoprene**(22 Mil)			**PVC** (20 MIL)		
CHEMICAL	D	BT	PR	D	BT	PR	D	BT	PR	D	BT	PR	D	BT	PR	D	BT	PR
Acetaldehyde	E	>6h	ND	P	0m	281.9	E	9.6	0.07	F	4m	161	E	21m	18	ID	ID	ID
Acetone	E	>6h	ND	P	ID	ID	E	>17h	ND	P	ID	ID	E	12m	35	P	>1m	>>
Acetonitrile	E	>8h	ND	ID	ID	ID	E	>8h	ND	ID	ID	ID	E	40m	7	ID	ID	ID
Acrylic Acid	ID	ID	ID	G	5.9h	0.23	E	>8h	ND	F	ID	ID	ID	ID	ID	ID	ID	ID
Acrylonitrile	E	ID	ID	F	1m	176	G	3.1h	<0.01	P	3m	176	ID	ID	ID	ID	ID	ID
Aldehyde	E	>6h	ND	P	0m	281.9	E	9.5h	0.07	P	4	161	ID	ID	ID	ID	ID	ID
Aniline	E	>8h	ID	G	10m	18.7	F	>8h	ND	P	1.1h	45	E	>8h	ND	G	>8h	ND
Benzaldehyde	ID	ID	ID	F	9.9h	4	E	9h	ND	P	ID	ID	ID	ID	ID	ID	ID	ID
Benzene	E	>8h	ND	G	6h	0.012	P	31m	32.3	P	ID	ID	ID	16m	133	ID	2m	250
Benzoyl Chloride	ID	ID	ID	E	>8h	ND	F	6.2h	16.6	P	ID	ID	ID	ID	ID	ID	ID	ID
Bromobenzene	E	ID	ID	E	8h	ND	P	32m	39.8	P	13m	9.1	ID	ID	ID	ID	ID	ID
Butyl Acetate	E	>6h	ND	P	ID	ID	G	1.9h	7.61	P	29m	54.4	ID	52m	53	ID	ID	ID
p-t Butyltoluene	E	>8h	ND	E	>8h	ND	G	1.7h	8	P	ID	ID	ID	ID	ID	ID	ID	ID
Butyraldehyde	E	ID	ID	P	54m	9	E	>15h	ND	P	ID	ID	ID	ID	ID	ID	ID	ID
Carbon Disulfide	G	>8h	ND	E	>8h	ND	P	7m	98	P	1m	51	ID	ID	ID	ID	ID	ID
Carbon Tetrachloride	E	>6h	ND	E	>13h	ND	P	ID	ID	G	3.4h	5	F	31m	252	ID	ID	ID
Cellosolve	G	>6h	ND	F	ID	ID	G	ID	ID	P	ID	ID	E	5.9h	3	ID	ID	ID
Chlorobenzene	E	ID	ID	E	>8h	ND	P	35m	308	P	ID	ID	ID	ID	ID	ID	ID	ID
Chloroform	P	10m	O.OO9	E	9.5h	0.46	P	ID	ID	P	4m	352	P	12m	220	ID	ID	ID
Chloronaphthalene	E	>8h	ND	E	>16h	ND	P	ID	ID	P	2.9h	>1.3	ID	ID	ID	ID	ID	ID
Chloroprene	ID	ID	ID	ID	>8h	ND	P	28m	18	ID	ID	ID	ID	ID	ID	ID	ID	ID
Cyclohexane	E	>6h	ND	E	>7h	ND	P	1.1h	20.3	P	ID	ID	E	2.7h	7	ID	16m	17
Cyclohexanol	E	>6h	ND	E	>8h	ND	E	>11h	ND	E	>16h	ND	ID	ID	ID	ID	ID	ID
Cyclohexanone	E	>6h	ND	P	29m	86.3	E	>16h	ND	P	ID	ID	ID	ID	ID	ID	ID	ID
Dibutylphthalate	E	>6h	ND	E	>8h	ND	E	>16h	ND	E	>16h	ND	ID	ID	ID	ID	ID	ID
1,1,Dichloroethane	ID	2.4h	6	G	1.5h	31	ID	ID	ID	P	ID	ID	ID	ID	ID	ID	ID	ID
1,2,Dichlorothane	E	>6h	ND	E	6.9	0.81	P	2h	53	P	8m	311	P	33m	247	ID	ID	ID
Diethylamine	E	>8h	ND	P	35m	852	P	47m	46	F	ID	ID	ID	ID	ID	ID	ID	ID
Diethylaminoethanol	E	ID	ID	E	>8h	ND	E	>8h	ND	E	>8h	ND	ID	ID	ID	ID	ID	ID
1,4-Diethylene Dioxide	ID	>8h	ND	P	23m	26.8	E	>20h	ND	P	28m	77.1	ID	28m	62	ID	8m	250
Diethyleneltriamine	ID	ID	ID	E	>8h	ND	E	>8h	ND	P	ID	ID	ID	ID	ID	ID	ID	ID
Diisobutyl Ketone 80%	E	>6h	ND	F	1.2h	90.6	G	3.3h	41.2	F	3h	48.9	ID	ID	ID	ID	ID	ID
Dimethyl Acetamide	ID	1.5h	0.728	P	25m	3	ID	>8h	ND	ID	ID	ID	ID	ID	ID	ID	ID	ID
Dimethyl Formamide	E	>8h	ND	P	8m	6.5	E	>8h	ND	F	1m	>15	ID	ID	ID	ID	ID	ID
Dimethylsulfoxide	G	ID	ID	F	1.5h	5	E	>8h	ND	F	ID	ID	ID	ID	ID	ID	ID	ID
Dioxane	E	>8h	ND	F	23m	26.8	E	>20h	ND	P	28m	77.1	ID	28m	62	ID	8m	250
Divinyl Benzene	E	>8h	ND	E	>17h	ND	F	2.2h	238	P	ID	ID	ID	ID	ID	ID	ID	ID
Epichlorohydrin	ID	ID	ID	P	2h	4	G	>8h	ND	P	ID	ID	ID	ID	ID	ID	ID	ID
Ether	ID	>6h	ND	P	12m	21.5	P	8m	92.2	P	14m	21.8	ID	ID	ID	ID	ID	ID
Ethyl Acetate	E	>6h	ND	P	ID	ID	G	7.6h	3.4	P	8m	145	G	34m	178	ID	ID	ID
Ethyl Ether	ID	>6h	ND	P	12m	21.5	P	8m	92.2	P	14m	21.8	E	18m	51	ID	ID	ID
Ethylamine 70%	E	47m	7.64	P	ID	ID	E	>12h	ND	F	1.1h	30.1	ID	ID	ID	ID	ID	ID
Ethylene dibromide	E	ID	ID	E	>8h	ND	F	3.3h	6	P	ID	ID	ID	ID	ID	ID	ID	ID
Formaldehyde 37%	E	>6h	ND	E	>16h	ND	E	16h	ND	E	>21h	ND	E	>8h	ND	G	8h	ND
Furan	ID	ID	ID	P	20m	23	P	1.3h	10	P	ID	ID	ID	ID	ID	ID	ID	ID
Furfural	E	>8h	ND	F	3.6h	14.8	E	>16h	ND	P	28m	265	ID	ID	ID	ID	ID	ID
Glutaraldehyde	E	ID	ID	E	>8h	ND	E	>8h	ND	P	ID	ID	ID	ID	ID	ID	ID	ID
n-Hexane	E	>6h	ND	ID	>11h	ND	P	ID	ID	E	ID	ID	E	39m	5	ID	ID	ID
Hydrazine 70%	G	>6h	ND	P	ID	ID	E	>8h	ND	G	>8h	ND	E	>8h	ND	E	8h	ND
Hydrochloric Acid 37%	E	>6h	ND	E	ID	ID	E	ID	ID	P	ID	ID	E	>8h	ND	E	>8h	ND
Hydrofluoric Acid 50%	G	>6h	ND	G	ID	ID	F	ID	ID	P	ID	ID	E	>8h	ND	E	1.8h	0

Chemical (cont.)	D	BT	PR	D	BT	PR	D	BT	PR	D	BT	PR	D	BT	PR	D	BT	PR
Isobutyl Alcohol	E	ID	ID	E	>8h	ND	E	>8h	ND	G	>8h	ND	ID	ID	ID	ID	ID	ID
Isobutyraldehyde	E	ID	ID	P	4m	11.5	E	>8h	ND	P	ID	ID	ID	ID	ID	ID	ID	ID
Methacrylic Acid	ID	ID	ID	F	>8h	ND	G	>8h	ND	P	1.7h	23	ID	ID	ID	ID	ID	ID
Methacrylonitrile	E	ID	ID	F	4m	462	G	6.8h	0.001	P	7m	560	ID	ID	ID	ID	ID	ID
Methyl Chloroform	ID	>6h	ND	E	>15h	ND	P	ID	ID	P	41m	76.4	P	27m	197	ID	ID	ID
Glove Perm Chart Continued	**Silver Shield (4 Mil)**			**Viton (9 Mil)**			**Butyl (17 Mil)**			**Nitrile (11 Mil)**			**Neoprene (22 Mil)**			**PVC (20 Mil)**		
Methyl Cyanide	ID	>8h	ND	ID	ID	ID	E	>8h	ND	ID	ID	ID	E	40m	7	ID	ID	ID
Methyl Ethyl Ketone	E	>24h	ND	P	ID	ID	E	>8h	ND	P	ID	ID	G	22m	155	ID	1m	>>
Methyl Isocyanate	ID	ID	ID	P	4m	121	P	1.1h	9	P	ID	ID	ID	ID	ID	ID	ID	ID
Methylamine 40%	F	1.9h	2	E	>16h	ND	E	>15h	ND	G	>8h	ND	ID	ID	ID	ID	ID	ID
Methylene Chloride	G	>8h	ND	F	1h	7.32	P	24m	133	P	4m	766	F	6m	239	ID	ID	ID
Methylene Dianiline	E	>24h	ND	E	>8h	ND	E	>24h	ND	F	ID	ID	ID	ID	ID	ID	ID	ID
Methylene Dichloride	ID	1.9h	0.002	G	1.9h	7.32	P	ID	ID	P	4m	766	ID	ID	ID	ID	ID	ID
Morpholine	E	>8h	ND	G	ID	97	E	>16h	ND	P	48m	206	ID	ID	ID	ID	ID	ID
Nitric Acid, 3 Molar	E	>6h	ND	G	>8h	ID	F	ID	ID	P	ID	ID	E	>8h	ND	E	1.9h	0
Nitrobenzene	E	>8h	ND	E	21m	ND	E	>23	ND	F	33m	1.7	G	1h	20	ID	ID	ID
Nitropropane	E	>8h	ND	P	>8h	26.1	E	>8h	ND	P	16m	29.5	ID	ID	ID	ID	ID	ID
Oxalic Acid	E	>8h	ND	E	>8h	ND	E	>8h	ND	G	ID	ID	ID	ID	ID	ID	ID	ID
PCB, Aroclor 1254 50%	E	>8h	ND	E	>13h	ND	P	ID	ID	F	ID	ID	ID	ID	ID	ID	ID	ID
Pentachlorophenol 1%[2]	E	>8h	ND	ID	>8h	ND	P	ID	ID	E	>13h	ND	ID	8h	ND	ID	ID	ID
n-Pentane	E	>6h	ND	E	>17h	ND	P	ID	ID	E	ID	ID	ID	38m	3	ID	9m	17
Perchlorethylene	E	>6h	ND	E	>15h	ND	P	ID	ID	F	>1.3h	5.5	ID	28m	75.5	ID	ID	ID
Phenol 85%, water sat	G	>6h	ND	E	ID	ND	E	>20h	ND	P	39m	>1500	E	>8h	ND	ID	32m	13
Propyl Acetate	E	>6h	ND	P	ID	ID	G	2.7h	2.86	P	17m	72.5	ID	ID	ID	ID	ID	ID
Propyelenediamine	ID	ID	ID	E	38m	ND	E	>8h	ND	F	ID	ID	ID	ID	ID	ID	ID	ID
Pyridine	ID	ID	ID	P	ID	74	G	>8h	ND	P	ID	ID	ID	28m	117	ID	1m	>>
Red Fuming Nitric Acid	P	35m	ID	P	ID	ID	P	ID	ID	P	ID	ID	ID	ID	ID	ID	ID	ID
Sodium Hydroxide 50%	E	>6h	ND	G	ID	ID	E	ID	ID	G	ID	ID	E	>6.7h	ND	E	8h	ND
Styrene	G	>4h	ND	G	ID	ID	P	ID	ID	P	ID	ID	ID	ID	40	ID	27m	40
Sulfuric Acid, 3 Molar	E	>6h	ND	E	ID	ID	G	ID	ID	P	ID	ID	E	>6.7h	ND	E	>8h	ND
Tetrachloroethylene	E	>6h	ND	E	>17h	ND	P	ID	ID	F	1.3h	5.5	ID	28m	75.5	ID	ID	ID
Tetraethylenepentamine	ID	ID	ND	E	>8h	ND	E	>8h	ND	F	ID	ID	ID	ID	ID	ID	ID	ID
Tetrafluoroethylene	E	ID	ID	E	>8h	ND	E	>8h	ND	ID	ID	ID	ID	ID	ID	ID	ID	ID
Tetrahydrofuran	E	>8h	ND	P	4m	327	F	31m	112	P	4m	167	P	11m	671	ID	1m	>>
Thiophene	ID	>6h	ND	E	>8h	ND	P	1.8h	17	P	ID	ID	ID	ID	ID	ID	ID	ID
Toluene	E	>6h	ND	E	>16h	ND	F	21m	22.1	P	11m	68.1	ID	14m	576	ID	3m	350
Toluene Diisocyanate	E	>8h	ND	E	>16h	ND	E	>8h	ND	G	3.7h	1.8	ID	ID	ID	G	>6.7	ND
Trichloroethane	E	>6h	ND	G	7.4h	0.24	P	18m	550	P	8m	283	ID	11m	881	ID	ID	ID
1,1,1 Trichloroethane	E	>6h	ND	E	>15h	ND	P	ID	ID	F	41m	76.4	P	27m	197	ID	ID	ID
1,1,2 Trichloroethane	ID	ID	ID	E	>8h	ND	P	5.7h	7	P	ID	ID	ID	ID	ID	ID	ID	ID
Triethylamine	ID	ID	ID	E	>8h	ND	P	ID	ID	E	>8h	ND	ID	ID	ID	ID	ID	ID
Vinyl Chloride	E	>8h	ND	G	4.4h	0.098	P	ID	ID	G	5.7h	0.14	ID	ID	ID	ID	ID	ID
Xylene	E	>24h	ND	E	>8h	ND	P	ID	ID	P	ID	ID	ID	23m	135	ID	4m	383

[1]The data for Silver Shield™, Viton™, Butyl and Nitrile gloves were provided by Siebe North Inc, Charleston, SC; information on Neoprene and Polyvinyl Chloride (PVC) gloves were supplied by Pioneer Industrial Products, Williard, OH.

[2]In Kerosene

E=Excellent; **G**=Good; **F**=Fair; **P**=Poor; **ND**=None detected; **ID**=Insufficient Data; **D**=Degradation; **BT**=Breakthrough, amount of elapsed time after initial exposure before the chemical can be analytically detected on the inside surface of the glove; **PR**=Permeation Rate is expressed in mg/m^2/sec. PR can be used for estimating glove thickness required; for a given material, thicker is more resistant.

Note: Silver Shield gloves may be worn as liners under other glove types to enhance protection.

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Appendix III

RADIATION EMERGENCY PROCEDURES

Radiation Safety Office (RSO)
714 West Lombard Street
Baltimore MD 21201

Emergency Numbers
(410) 706-7055

TYPE OF EMERGENCY	HAZARD	IMMEDIATE PRECAUTIONS	FOLLOW UP
Minor Spills	RADIATION: No immediate radiation hazard to personnel	1. Notify all persons in room 2. Confine spill immediately 3. Notify RSO	Permit no one to work in area until approval of RSO
Major Spills	RADIATION: May be great hazard to personnel	1. Notify personnel to vacate room 2. Make no attempt to clean up spill 3. Switch off fans and vacate room 4. Provide temporary barricade 5. Notify the RSO	Decontamination of personnel and equipment (including spill itself) as prescribed by the RSO
Accident Involving: Dust, Mist Fumes, Vapors gasses	RADIATION: Internal hazard due to possible ingestion and inhalation CONTAMINATION: Easily spread when airborne	1. Notify others to vacate room 2. Close windows and shut off air 3. Provide temporary barricade 4. Notify RSO	Do not re-enter until RSO gives approval
Injuries Involving: Radiation Hazards Contaminations	CONTAMINATION: Wounds usually greatest hazard	1. Wash wound immediately under running water 2. Call Physician 3. Notify RSO	Permit no one involved in accident to return to work without approval of RSO and Physician
Fires Involving Radioactivity	RADIATION: Internal hazard from airborne activity CONTAMINATION: May be spread by fire fighting techniques	1. Pull fire alarm to notify all persons in room and building to evacuate at once 2. Call the Fire Department (FD) extension 5-5555 from a safe location 3. Notify RSO 4. Meet the FD outside	Govern emergency activities by the restrictions of the RSO
X- RAY Injuries	RADIATION: Superficial and/or deep tissue burns	1. Shut off machine (DO NOT alter machine configuration until RSO 2. Call Physician 3. Notify RSO	Permit no one involved in accident to return to work without inspection) approval of RSO and Physician

Appendix IV

Summary of Biosafety Levels Recommended for Infectious Agents

BSL	Agents	Special Practices[a]	Primary Barrier and Personal Protective Equipment[a]	Facilities (Secondary Barriers)[a]
1	Well-characterized agents not known to consistently cause disease in immunocompetent adult humans and present minimal potential hazard to laboratory personnel and the environment.	Standard microbiological practices	No primary barriers required; protective laboratory clothing; protective face, eyewear, as needed	Laboratory doors; sink for handwashing; laboratory bench; windows fitted with screens; lighting adequate for all activities
2	Agents associated with human disease and pose moderate hazards to personnel and the environment	Limited access; occupational medical services including medical evaluation, surveillance, and treatment, as appropriate; all procedures that may generate an aerosol or splash conducted in a BSC; decontamination process needed for laboratory equipment	BSCs or other primary containment device used for manipulations of agents that may cause splashes or aerosols; protective laboratory clothing; other PPE, including respiratory protection, as needed	Self-closing doors; sink located near exit; windows sealed or fitted with screens; autoclave available
3	Indigenous or exotic agents; may cause serious or potentially lethal disease through the inhalation route of exposure	Access limited to those with need to enter; viable material removed from laboratory in primary and secondary containers; opened only in BSL-3 or ABSL-3 laboratories; all procedures with infectious materials performed in a BSC	BSCs for all procedures with viable agents; solid front gowns, scrubs, or coveralls; two pairs of gloves, when appropriate; protective eyewear, respiratory protection, as needed	Physical separation from access corridors; access through two consecutive self-closing doors; hands-free sink near exit; windows are sealed; ducted air ventilation system with negative airflow into laboratory; autoclave available, preferably in laboratory
4	Dangerous and exotic agents that pose high individual risk of aerosol-transmitted laboratory infections and life-threatening disease that are frequently fatal, for which there are no vaccines or treatments; and related agents with unknown risk of transmission	Clothing change before entry; daily inspections of essential containment and life support systems; all wastes decontaminated prior to removal from laboratory; shower on exit	BSCs for all procedures with viable agents; solid front gowns, scrubs, or coveralls;[b] gloves;[b] full-body, air-supplied, positive- pressure suit[c]	Entry sequence; entry through airlock with airtight doors;[c] walls, floors, ceilings form sealed internal shell; dedicated, non-recirculating ventilation system required; double-door, pass-through autoclave required

a. Each successive BSL contains the recommendations of the preceding level(s) and the criteria in the cell.

b. Applies to Cabinet Laboratory

c. Applies to Suit Laboratory

A full description of each biosafety level recommendation is available through the U.S. Department of Health and Human Services, Centers for Disease Control and the National Institutes of Health publication "Biosafety in Microbiological and Biomedical Laboratories" or throughESH .

Appendix V

TABLE OF INCOMPATIBLE CHEMICALS

The following substances may react violently with one another and must be kept apart.

Chemical	Is Incompatible with
Acetic acid	Chromic acid, nitric acid alcohols, ethylene glycol, perchloric acid, peroxides, permanganates
Acetone	Concentrated nitric and sulfuric acid mixtures
Acetylene	Chlorine, bromine, fluorine, copper, silver, mercury
Acids	Bases
Activated Carbon	Calcium hypochlorite, oxidizing agents
Alkali Metals	Water, carbon tetrachloride and other halogenated alkanes, carbon dioxide, halogens
Aluminum Alkyls	Water
Ammonia,	Mercury (e.g., in pressure gauges), laboratory gas chlorine, calcium hypochlorite, iodine, bromine, hydrogen fluoride
Ammonium	Acids, powered metals, flammable liquids, chlorates, nitrates, sulfur, fine-particulate organic Nitrate or combustible materials.
Aniline	Nitric acid, hydrogen peroxide
Azides	Acids
Bases	Acids
Bromine	See chlorine
Carbon Tetrachloride	Sodium
Chlorates	Ammonium salts, acids, powered metals, sulfur, fine-particulate organic or combustible substances
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane, hydrogen, petroleum benzine, benzene, powered metals
Chromic Acid	Acetic acid, naphthalene, camphor, glycerol, petroleum benzine, alcohols, flammable liquids
Copper	Acetylene, hydrogen peroxide
Cumene Hydroperoxide	Acids, both organic and inorganic

Cyanides	Acids
Flammable Liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Fluorine	Store separately
Hydrocarbons (butane, propane, benzene, etc.)	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
Hydrogen Fluoride	Ammonia (laboratory gas or solution)
Hydrogen Peroxide	Copper, Chromium, iron, metals and metals salts, alcohols, acetone, organic substances, aniline, nitromethane, combustibles (solid or liquid)
Hydrogen Sulfide	Fuming nitric acid, oxidizing gasses
Iodine	Acetylene, ammonia (laboratory gas or solution)
Mercury	Acetylene, ammonia
Nitric Acid, Conc.	Acetic acid, aniline, chromic acid, prussic acid, hydrogen sulfide, flammable liquids and gasses
Oxalic Acid	Silver, mercury
Perchloric Acid	Acetic anhydride, bismuth and its alloys, alcohols, paper, wood
Phosphorus	Sulfur, oxygen-containing compounds with such as chlorates
Potassium	See alkali metals
Potassium Chlorate	See chlorates
Potassium Perchlorate	See chlorates
Potassium Permanganate	Glycerol, ethylene glycol, benzaldehyde, sulfuric acid
Silver	Acetylene, oxalic acid, tartaric acid, ammonium compounds.
Sodium	See alkali metals

Please note: This is not an exhaustive list of incompatible chemicals. See the specific lab standard operating procedures or your Lab Supervisor/Principal Investigator to determine additional material incompatibilities of which to be aware.

Appendix VI

UMBC POLICY CONCERNING FIRE EMERGENCIES

A. Purpose. This is a statement of official University policy for the reporting of fire emergencies and for the evacuation of campus buildings during fire emergencies, in compliance with local, state, and federal regulations.

B. Policy. A fire emergency exists whenever:

1. A building fire evacuation alarm is sounding;

2. An uncontrolled fire or imminent fire hazard occurs in any building or area of the campus;

3. There is the presence of smoke, or the odor of burning;

4. There is spontaneous or abnormal heating of any material, an uncontrolled release of combustible or toxic gas or other material, or a flammable liquid spill.

C. Procedures.

Campus buildings shall be immediately and totally evacuated whenever the building evacuation alarm is sounding.

1. Upon discovery of evidence that a fire emergency exists, an individual shall accomplish, or cause to be accomplished, the following actions:

(a) SOUND AN ALARM. Activate the building fire alarm in buildings equipped with a manual fire alarm system. Shout a warning and knock on doors as you evacuate in buildings not equipped with a fire alarm.

(b) SHUT OFF ALL MACHINERY AND EQUIPMENT IN YOUR AREA.

(c) LEAVE THE BUILDING AT ONCE.

(d) CALL THE FIRE DEPARTMENT FROM A SAFE PLACE.

(1) On Campus phones DIAL extension 5-5555.

(2) Off Campus phones and campus pay phones DIAL (410) 455-5555.

(3) Use Campus emergency phones;

Indoors Gray COURTESY wall phones with red "EMERGENCY" markings (some corridors).

Outdoors Yellow phone boxes with red "EMERGENCY" markings, under blue lights.

(4) When the emergency operator answers, ask for the fire department, give as much specific information as possible. State that you are calling from UMBC and include the proper name of the building and room number, floor, or other specific area. Do not hang up until released by the dispatcher. A PHONE CALL MUST BE MADE! ALL BUILDING FIRE ALARMS DO NOT NOTIFY THE FIRE DEPARTMENT.

(e) MEET THE FIRE DEPARTMENT OUTSIDE AND DIRECT THEM TO THE EMERGENCY.

(f) ALL FIRES, EVEN IF EXTINGUISHED OR FOUND EXTINGUISHED, MUST BE REPORTED.

(g) ALL FIRE ALARMS, EVEN IF SUSPECTED TO BE FALSE OR ACCIDENTAL, MUST BE REPORTED TO THE FIRE DEPARTMENT.

2. The evacuation procedures shall be as follows:

(a) It shall be the responsibility of every person to immediately leave a University building whenever the fire alarm is activated or a fire emergency exists.

All students, faculty, and staff are required to leave the building and remain outside until the emergency is over. No one shall restrict or impede the evacuation.

(b) Department heads are expected to review annually all fire prevention and fire survival information with faculty and staff, or to schedule a presentation with ESH. Such information is available from ESH for use and distribution.

3. Whenever it is brought to the attention of the staff of residential buildings, or departmental personnel, that the fire alarm or sprinkler system is inoperable or has been placed out of service, a firewatch shall be established.

(a) Responsible personnel (residential staff, safety committee, etc.) shall be assigned to the firewatch.

(b) The entire building shall be toured at least one time during each hour of the firewatch.

(c) The emergency dispatcher (extension 5-5555) shall be notified each hour that the watch has been performed.

(d) The firewatch shall be maintained at all times that the building is occupied until the fire protection system is repaired.

4. INTERRUPTION OF FIRE ALARM:

(a) No person may shut off any fire protection or alarm system during a fire emergency incident without the permission of the fire department officer in charge.

(b) No person may shut off any fire protection or alarm system during a bomb threat emergency without the permission of the police officer in charge.

(c) It shall be the responsibility of the University Facilities Management Department to reset or repair any fire protection or alarm system after an emergency incident when notified by the fire or police department in charge. Facilities Management shall inspect each such system immediately after every emergency incident and place the system in serviceable condition.

(d) The fire and police departments may reset an alarm system only if there is no damage to the system and when it is within their technical capabilities to do so.

(e) Any person desiring to interrupt service to any fire protection or alarm system must obtain permission from Facilities Management and ESH. The Work Control Center shall notify the fire and police departments of every such interruption.

(f) Fire or police departments must submit a request to Facilities Management to repair or reset a fire protection system, via the Work Control Center.

5. INFORMATION RELEASE TO MEDIA AND THE PUBLIC:

All information regarding University fires will be released through ESH in cooperation with the Public Information Office. No other University agency or employee may release official statements regarding the cause, origin, or nature of campus fires/incidents.

D. Information.

Assistance will be provided by ESH to any Department requiring help and advice in its implementation of this UMBC policy.

Appendix VII

GLOSSARY

Absolute A chemical substance that is relatively free of impurities.

Absorb The penetration of a solid substance by a liquid as by capillary, osmotic, solvent or chemical action. Chemicals are readily absorbed into the human blood stream through the eyes or cuts in the skin.

Acid An organic or inorganic compound with a pH of less than 7. Acidic materials are corrosive to human tissue.

Action Level A concentration designated in 29 CFR part 1910 for a specific substance, calculated as an eight (8)-hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

Acute Toxicity Refers to adverse effects suffered as the result of a short, one-time exposure to toxic materials. It occurs within a relatively short period. Exposure is measured in seconds, minutes, or hours relative to inhalation or skin absorption.

Adsorb Collection of gas or liquid molecules on the surface of another material. For sampling of most organic vapors, activated charcoal is a good absorbent.

Base Chemical compounds that have a pH of greater than 7. Bases are also referred to as alkalis or caustic materials and can be corrosive to human tissue.

Boiling Point The temperature at which the vapor pressure of a liquid is equivalent to the surrounding atmospheric pressure, and the liquid rapidly becomes a vapor. Flammable substances possessing low boiling points are considered fire hazards.

Carcinogen A chemical is considered to be a carcinogen if:

(a) it has been evaluated by the International Agency for Research on Cancer [IARC] and found to be a carcinogen or potential carcinogen;

(b) It is listed as a carcinogen or potential carcinogen in the *Annual Report on Carcinogens* published by the National Toxicology Program (NTP) (latest edition); or

(c) It is regulated by OSHA as a carcinogen.

Caustic Any strongly alkaline material that produces either corrosion or irritation to living tissue.

Chemical Hygiene Plan A written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment, and work practices that are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace.

Chemical Reactivity The ability of a material to chemically change, possibly resulting in explosion hazards or the liberation of toxic fumes.

Chronic Toxicity Adverse health effects resulting from repeated or long-term exposure to toxic materials.

Combustible Liquid Any liquid having a flashpoint at or above 100°F (37.8°C) but below 200°F (93.3°C), except any mixture having components with flashpoints of 200°F (93.3°C), or higher, the total volume of which make up 99 percent or more of the total volume of the mixture by OSHA and NFPA definition.

Compressed Gas (a) A gas, or mixture of gasses having in a container, an absolute pressure exceeding 40 psi at 70°F (21.1°C); or

(b) A gas, or mixture of gasses having in a container, an absolute pressure exceeding 104 psi at 130°F (54.4°C) regardless of the pressure at 70°F (21.1°C); or

(c) A liquid having a vapor pressure exceeding 40 psi at 100°F(37.8°C) as determined by ASTM D-323-72.

Corrosive A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.

Cryogenic Liquid Severely cold (-60°C to -270°C) and pressurized liquids. They present an explosion hazard due to high pressures and can cause thermal damage to living tissue.

Designated Area An area that must be assigned by the Principle Investigator or Lab Supervisor for the use of "select carcinogens" reproductive toxins, or substances which have a high degree of acute toxicity. A designated area may be the entire laboratory, an area of a laboratory or a device such as a laboratory hood.

Embryotoxin A substance shown to adversely affect a developing embryo at a particular concentration, but does not affect the pregnant female.

EPA The Environmental Protection Agency federally regulates and enforces environmental protection.

ESH Environmental Safety & Health

Explosive A chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

Flammable Gas A gas that forms a flammable mixture with air at a concentration of 13 percent by volume or less, or forms a range of flammable mixtures with air that are wider than 12% by volume, regardless of lower flammable limit.

Flammable Liquid Any liquid having a flashpoint below 100°F (37.8°C) except any mixture having components with flashpoints of 100°F (37.8°C) or higher, the total of which make up 99 percent or more of the total volume of the mixture.

Flammable Solid A solid that is liable to cause a 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 burns so vigorously and persistently as to create a serious hazard.

Flammability The ease with which a liquid, solid, or gas will ignite, either spontaneously (pyrophoric) or as the result of a spark or an open flame. The more flammable a material, the more readily ignition occurs.

Flashpoint The minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite.

Fume Hood A device located in a laboratory, enclosure on five sides with a movable sash or fixed partial enclosed on the remaining side; constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory; and allows chemical manipulations to be conducted in the enclosure without insertion of any part of the employee's body other than hands and arms.

Hazardous Chemical 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 systems, and agents which damage the lungs, skin, eyes, or mucous membranes.

Highly Toxic A chemical falling within any of the following categories:

(a) A chemical that has a median lethal dose (LD50) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

(b) A chemical that has a median lethal dose (LD50) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.

(c) A chemical that has a median lethal concentration (LC50) in air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

Hood A device/location in a laboratory, enclosed on five sides, to draw air from the laboratory and to prevent or minimize the escape of the air contaminants into the laboratory. Chemical manipulations may be conducted in the enclosure without inserting any portion of the employees body other than hands and arms.

Infectious Waste Waste that is capable of producing disease. For waste to be considered infectious, it must contain oncogenic viruses or other pathogenic microorganisms with sufficient virulence and quantity that exposure to the waste could result in an infectious disease.

Irritant Chemical substances that cause tissue inflammation or soreness upon absorption, inhalation, or ingestion.

LD_{50} The quantity of material that when ingested, injected, or applied to the skin as a single dose, will cause death of 50% of the test animals. The test conditions should be specified, the value is expressed in g/kg or mg/kg of body weight.

LEL Lower Explosive Limit - same definition as LFL.

LFL Lower Flammable Limit - The lower limit of flammability of a gas or vapor at ordinary ambient temperatures expressed in percent of the gas or vapor air by volume. This limit is assumed constant for temperatures up to 250°F(120°C) and is normally listed on a product's material safety data sheet.

LS Laboratory Supervisor

MOSH Maryland Occupational Safety and Health Administration - the state agency charged with worker health and safety. MOSH promulgates Maryland occupational safety and health standards.

SDS Material Safety Data Sheets are produced by chemical manufacturers and importers. They relay chemical, physical, and hazard information about specific chemicals.

Mutagen Chemical compounds that induce mutations in DNA and living cells.

Neutralize To alter acidic or basic compounds to a pH of 7, making them chemically neutral.

Organic Materials Any chemical compound containing carbon.

OSHA Occupational Safety and Health Administration - the branch of federal government charged with worker health and safety. Maryland has a state operated program that also maintains jurisdiction over UMBC known by the acronym MOSH.

Oxidizer A chemical that initiates or promotes combustion in materials, thereby causing fire either of itself or by the release of oxygen or other gasses.

Oxidizing Agent Oxygen-containing material that decompose, generating oxygen.

PEL Permissible Exposure Limits for the work place, set by regulation and enforced by OSHA. Most of these limit values were originally set, by consensus, by the ACGIH to assist industrial hygienists in implementing exposure control programs. As law, these are listed in 29 CFR 1910.1000 and subject to revision through the regulatory process.

PI Principal Investigator

Poison Any substance that is harmful to living tissue when applied in small doses. Determining factors include concentration, exposure time, particle size, the substance's affinity for tissue, and sensitivity of the exposed tissue to that compound.

Pyrophoric Material Any solid or liquid that has the property of spontaneous ignition in air.

Radioactivity Nuclear transformation, either by natural or artificial means, resulting in emission of energy in the form of alpha, beta, or gamma rays. Amounts of radioactive material are described by the rate of radioactive decay, the Curie (Ci), or in metric multiples and fractions thereof.

Reactivity The proclivity of a compound to react chemically with other substances or itself, which may result in the liberation of energy. Can cause the formation of toxic or corrosive materials, pressure buildup, and temperature fluctuations.

Reproductive Toxins Chemicals that affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

Sensitizer A chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

STEL Short Term Exposure Limit, a 15-minute time-weighted average exposure which should not be exceeded at any time during a work day, even if the eight-hour time-weighted average is within the TLV.

Teratogen Chemical and physical agents that interfere with normal embryonic development. Teratogens may produce congenital malformations or death of the fetus without inducing damage to the pregnant female.

TLV Threshold Limit Value indicates the concentration of a chemical substance in the atmosphere that is considered non-hazardous in a person's normal working life.

TWA Time Weighted Average is the concentration for a normal 8-hour working day (40 hours/week) to which workers may be exposed without anticipated adverse effect.

Toxic A chemical falling within any of the following categories:

(a) A chemical that has a median lethal dose (LD50) of more than 50 milligrams per kilogram but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

(b) A chemical that has a median lethal dose (LD50) of more than 200 milligrams per kilogram but not more than 1000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.

(c) A chemical that has a median lethal concentration (LC50) in air of more than 200 parts per million but not more than 2,000 parts per million by volume of gas or vapor, or more than two milligrams per liter but not more than 20 milligrams per liter of mist, fume, or dust, when administered by

continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

Ultraviolet Light Radiation in the electromagnetic spectrum with wavelengths of 100 - 3900 Ångstroms.

Volatility The tendency of a liquid or solid to pass into the vapor state at a particular temperature.

Water Reactive A chemical that reacts with water to release a gas that is either flammable or Presents a health hazard.

Appendix VIII

REFERENCES

American Chemical Society. Safety in Academic Chemistry Laboratories, 8th Edition, 2017.

American National Standards Institute. ANSI Z358.1-2014 American National Standard For Emergency Eyewash and Shower Equipment, New York, NY, 2014.

American National Standards Institute. ANSI Z87.1 2020 American National Standard for Occupational and Educational Eye & Face Protection, New York, NY, 2020.

Benedetti, Robert P., ed. Flammable and Combustible Liquids Code, National Fire Protection Association, 2021.

Bretherick, L., eds. Hazards in the Chemical Laboratory, London: Royal Society, 1986.

Bretherick, L. Handbook of Reactive Chemical Hazards, London: Butterworths, 1981.

Centers for Disease Control-National Institutes of Health. Biosafety in Microbiological and Biomedical Laboratories, 6th Edition, US Public Health Service, May, 2020.

Committee on Hazardous Substances in the Laboratory Assembly of Mathematical and Physical Sciences; National Research Council. Prudent Practices for Handling Chemicals. Washington D.C. National Academy Press, 1981.

Department of Environmental Health and Safety, University of Louisville. Laboratory Safety Manual. January 1989.

Freeman, N.T. And J WhiteHead. Introduction to Safety in the Chemical Laboratory. Orlando. Academic Press Inc., 1982.

Office of Environmental Health and Safety, University of Virginia. Laboratory Survival Manual, 3rd ed., 1993.

Right-to-Know Pocket Guide for School and University Employees. Genium Publishing Corporation, Schenectady, NY 1990

Singer, James; Pesticide Safety: Guidelines for Personnel Protection; Davis, October, 1982.

Supervisors Safety Manual. 11th ed. Chicago: National Safety Council, 2018.

US Department of Health and Human Services et al. Schoo;l Chemistry Laboratory Safety Guide Oct. 2006.

US Department Centers for Disease Control.; NIOSH Health and Safety Guide for Pesticide Formulators; Cincinnati, May, 1977.

US Environmental Protection Agency, Private Pesticide Applicators: Training Manual, February, 1994.

Young Jay A., ed. Improving Safety in the Chemical Laboratory, A Practical Guide 2nd ed., Wiley & Sons, Inc., New York, 1991.

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