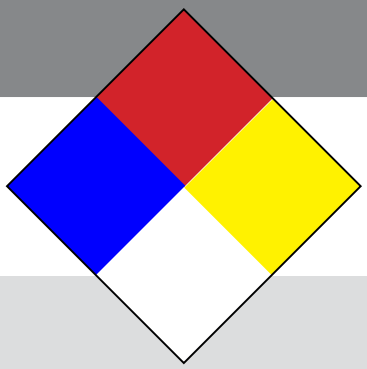
Eberly College of Arts and Sciences

Laboratory Safety Manual



Eberly College Safety Website:
http://Safety.Eberly.WVU.edu

Contact the College Safety Officer at:
ECAS-Safety@mail.wvu.edu

West Virginia University (WVU) is not bound by the United States Occupational Safety and Health Administration (OSHA) and its related administrative regulations. However, the State of West Virginia has enacted statutes and regulations that adopt the standards set forth in the referenced OSHA regulations. These State statutes and regulations govern WVU.

Table of Contents

Chapter 1. Principles of Laboratory Safety

Section 1. Introduction - OSHA Laboratory Standard

The Occupational Safety and Health Administration (OSHA) standard (29 CFR 1910.1450), Occupational Exposure to Hazardous Chemicals in Laboratories, set a standard for safe work practices and safety accountability in academic and research laboratories in colleges and universities. Laboratory personnel must take personal responsibility to ensure a culture of safety within their laboratory work space. They must actively participate in careful planning, risk assessment, risk management, and preparation for emergency scenarios. A successful safety program requires the participation, support, and daily commitment of college administrators, faculty, postdoctoral research associates, staff, graduate students, and undergraduate students.

The Eberly College Laboratory Safety Manual (LSM) was developed to meet the requirements of the OSHALaboratory Standard. The LSM establishes general rules for the safe handling, storage, and disposal of hazardous chemicals and sets forth prudent work practices that are designed to protect the employee from exposure to chemical hazards and unsafe work practices in the laboratory. This manual is intended to be the principal laboratory safety document for the Eberly College of Arts and Sciences.

Section 2. Working with Hazardous Chemicals

According to OSHA, a hazardous chemical is 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 persons.

Many of the chemicals and solutions that are routinely used in laboratories can present a significant health hazard when handled improperly. The Swiss physician and alchemist Theophrastus Phillippus Aureolus Bombastus von Hohenheim (1493-1541), who took the name Paracelsus later in life in homage to Celsus, a Roman physician, is known as "The Father of Toxicology." Paracelsus is famous for his quote, "What is it that is not poison? All things are poison and nothing is without poison. It is the dose alone that makes a thing not a poison."

Engineering controls (i.e., chemical fume hoods and glove boxes), administrative controls (i.e., safety rules, LSM, Standard Operating Procedures, and laboratory inspections), and personal protective equipment (PPE) (i.e., gloves, lab coats, chemical splash goggles, and face shields) are designed to protect laboratory workers from exposure to hazardous materials. Routes of exposure to hazardous materials include contact with skin and eyes, inhalation, ingestion, and injection.

The effect of an exposure to a hazardous material can be acute or chronic, depending upon the hazardous material and the length of time that one was exposed to the hazardous material. Acute exposure is defined as short durations of exposure to high concentrations of hazardous materials in the work place. Acute health effects can appear rapidly after only one exposure and can result in rashes, dizziness, coughing, and burns. Chronic exposure is defined as continuous exposure over a long period of time to low concentrations of hazardous materials in the work place.

Chronic health effects may take months or years before they are diagnosed. Symptoms of chronic exposure can include joint paint, neurological disorders, and tumors.

A chemical allergy is an adverse reaction (i.e., rash or hives) to a chemical. Some persons have developed chemical sensitivities to certain chemicals or types of chemicals, including ammonia, iodine, bromine, and sulfur. Such reactions are usually the result of a previous sensitization to that particular chemical, or one that is similar in nature.

The protein in soft, flexible latex rubber gloves can cause mild or severe, life-threatening latex allergic reactions in some persons.

Section 3. Physical Hazards

Examples of physical hazards in the laboratory include gas cylinders, cryogenic liquids, electrical equipment, lasers, magnetic fields, and reactions that involve high pressure or vacuum lines. Another type of physical hazard is the presence of spilled liquids or broken glassware on the floor or in the work space. Good housekeeping practices serve to eliminate these physical hazards. Laboratory workers must follow all departmental safety rules and policies to avoid injuries associated with physical hazards.

Section 4. Safety Data Sheets

Important information about handling a chemical can be found on the label of the chemical container and in the Safety Data Sheet (SDS). A SDS is designed to provide laboratory and emergency personnel with the proper procedures for handling, storage, and disposal of a particular hazardous material. A Safety Data Sheet is a document that contains relevant information about a material, as referenced by OSHA 29 CFR, *Occupational Safety and Health Standards: Hazard Communicatio*n, Part 1910.1200. For consistency purposes, a 16-section standard format has been established by ANSI (ANSI Z400.1):

1. Product Identification
2. Composition/ Information on Ingredients
3. Hazards Identification
4. First Aid Measures
5. Fire Fighting Measures
6. Accidental Release Measures
7. Handling and Storage
8. Exposure Controls and Personal Protection
9. Physical and Chemical Properties
10. Stability and Reactivity
11. Toxological Information
12. Ecological Information
13. Disposal Considerations
14. Transport Information
15. Regulatory Information
16. Additional Information

Be Prepared to Work Safely

Always READ and HEED the information on the product label and the Safety Data Sheet before using a chemical for the first time.

A comprehensive file of Safety Data Sheets (SDS) must be kept on file in the laboratory or be readily accessible to all employees during all work shifts. SDS can be made available to employees via the Internet. Helpful SDS Web sites include:

Vermont SIRI	http://hazard.com
Sigma-Aldrich	http://www.sigmaaldrich.com/safety-center.html
Iowa StateUniversity	http://avogadro.chem.iastate.edu/MSDS/
VWRScientific Products	https://us.vwr.com/store/search/searchAdv.jsp
Thermo Fisher Scientific	http://new.fishersci.com/ecomm/servlet/msdssearchhome?LBCID=52974917&showMSDSSearch=Y&storeId=10652
Alfa Aesar	http://www.alfa.com/en/go160w.pgm?srchtyp=msds
Airgas	http://www.airgas.com/content/msds.aspx
Flinn Scientific	http://www.flinnsci.com/msds-search.aspx?
Multiple listings	http://www.ilpi.com/msds/index.html

Laboratory workers should always READ and HEED the label and the Safety Data Sheet before using a chemical for the first time. Know the types of PPE that you will be required to wear when handling the chemical. Ensure that the ventilation in the laboratory will be adequate for your needs. Be familiar with the college LSM and the building Emergency Action Plan in the event of a chemical spill, fire, or explosion.

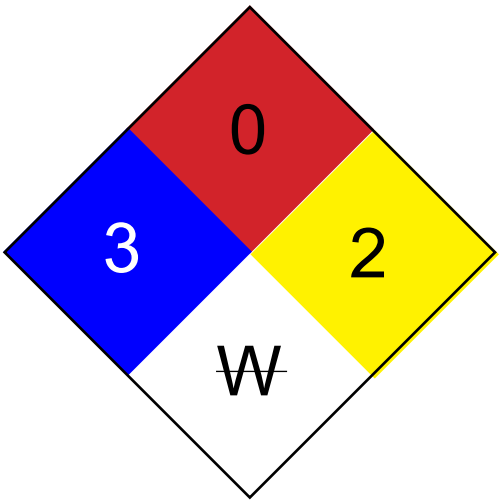
Section 5. NFPA Classification System

In the event of a fire or an explosion in a laboratory, the National Fire Protection Association (NFPA) universal hazard diamond is designed to provide information to emergency responders regarding the chemical contents of a laboratory. The hazard diamond provides information on the degree of danger for health hazards, fire hazards, and instability hazards.

The NFPA hazard diamond is commonly displayed on chemical labels, secondary container labeling, and on the SDS. Additionally, it is posted on the laboratory door or other highly visible location. When posted on the laboratory door, the numerical ratings refer to the contents of the entire laboratory, not to a specific chemical within the laboratory.

NFPA CLASSIFICATION SYSTEM

Source: NFPA 704 (2012)



BLUE - HEALTH HAZARD
4=Can be lethal
3=Can cause serious or permanent injury
2=Can cause temporary injury
1=Can cause significant irritation
0=Offers no hazard

RED - FLAMMABILITY HAZARD
4=Will rapidly vaporize and burn
3=Can be ignited under almost all ambient temperature conditions
2=Must be moderately heated or exposed to high ambient temperatures
1=Must be preheated before ignition
0=Materials that will not burn

YELLOW - INSTABLITY HAZARD
4=Readily capable of detonation or explosive decomposition at normal temperatures and pressures
3-Capable of detonation or explosive decomposition but must be heated
2=Readily undergoes violent chemical change at elevated temperatures and pressures
1=Normally stable, but can become unstable at elevated temperatures and pressures
0=Normally stable, even under fire conditions

WHITE - SPECIAL HAZARD
OX = Materials that possess oxidizing properties
~~W~~ = Materials that react violently or explosively with water

Chapter 2. ECAS Laboratory Safety Responsibilities

Section 1. Dean of the Eberly College of Arts and Sciences

- Ensures that safety programs are established and maintained in each science department where researchers, staff, and students are engaged in the laboratory use of hazardous materials.
- Meets with the College Safety Officer (CSO) to discuss safety inspection results and compliance issues.
- Appoints one or more Chemical Hygiene Officer(s) (CHO) for each department or unit. Provides the Chemical Hygiene Officers with the support necessary to implement and maintain their laboratory safety programs.
- Ensures that each department remains in compliance with the ECAS lab safety program.
- Provides budgetary arrangements, as needed, to ensure the health and safety of the employees of the college.

Section 2. ECAS College Safety Officer (CSO)

- Serves as the Dean's liaison with college chairs, directors, faculty, staff, and students regarding safety and health issues.
- Provides guidance and safety training to ECAS personnel and students.
- Oversees the development of and subsequent revisions of the ECAS Laboratory Safety Manual, emergency plans, and safety rules and regulations.
- Oversees the annual chemical inventory update for the college and submits all chemical inventories to EHS.
- Conducts laboratory inspections and submits detailed inspection reports to the Principal Investigator/ Laboratory Supervisor. Conducts follow-up inspections, as appropriate.
- Serves as the Eberly College liaison with the Department of Environmental Health and Safety.

Section 3. Chemical Hygiene Officer (CHO)

- Establishes and maintains a culture of safety that will serve to promote a safe and healthy environment in which to teach, learn, and conduct research. Seeks ways to improve the laboratory safety program.
- Distributes the ECAS Laboratory Safety Manual (LSM) to all employees. Maintains a file of LSM sign-off sheets.
- Maintains the departmental chemical inventory. Oversees the annual chemical inventory update and forwards the revised inventory to the College Safety Officer upon request.
- Conducts regular inspections of all laboratories, prep rooms, gas cylinder rooms, and chemical storage rooms with the College Safety Officer to ensure departmental compliance with all applicable policies and codes.
- Maintains a comprehensive list of laboratory personnel. Using training records provided by EHS, sends reminders to laboratory workers to attend the mandatory annual HazComm/Lab Safety/Haz Waste training.
- Creates and revises safety rules and regulations, as requested, which are reviewed by the department chair and the College Safety Officer before distribution to departmental personnel or students.
- Requests funding for safety-related purchases or training, as appropriate.
- Monitors procurement, use, storage, and disposal of chemicals.
- Maintains inspection, personnel training, and inventory records.
- Assists laboratory supervisors in developing and maintaining adequate facilities.
- Keeps current of legal requirements concerning regulated substances.
- Notifies employees of the availability of medical attention under the following circumstances:
    - Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory.
    - Where exposure monitoring reveals an exposure level routinely above the action level for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements.
    - Whenever a spill, leak, explosion, or other occurrence resulting in the likelihood of a hazardous exposure occurs, the employee may have a medical consultation to ascertain if a medical examination is warranted.
        - If medical attention is necessary, the CHO provides the attending physician the identity of the hazardous substance to which the employee may have been exposed; a description of the conditions under which the exposure occurred; and the signs and symptoms that the employee may be experiencing.
        - The CHO will notify affected employees in writing of any monitoring results either individually or by posting results in an appropriate location accessible to employees. This information shall be distributed within five working days upon receipt of the results from EHS.

- Attends CHO meetings and training sessions that are conducted by the College Safety Officer and by EHS.
- Encourages laboratory employees to attend specialized training that is provided by the institution (i.e., first-aid training, fire extinguisher training, and gas cylinder safety training).

Section 4. Department Chairperson

- Assumes overall responsibility for personnel engaged in the laboratory use of hazardous materials.
- Provides the Chemical Hygiene Officer with the support necessary to implement and maintain the laboratory safety program.
- After receipt of laboratory inspection report from the ECAS Director of Laboratory Safety, meets with laboratory supervisors to discuss cited violations and to ensure timely actions to protect laboratory workers and facilities and to ensure that the department remains in compliance with all applicable federal, state, university, local, and departmental codes and regulations.
- Provides budgetary arrangements to ensure the health and safety of the departmental employees, visitors, and students.

Section 5. Laboratory Supervisor/Principal Investigator

- Ensures that laboratory workers comply with the LSM and do not operate equipment or handle hazardous chemicals without proper training and authorization.
- Always wears personal protective equipment that is compatible to the degree of hazard of the chemical. Ensures that personal protective equipment is available and properly used by each laboratory employee and visitor.
- Follows all pertinent safety rules when working in the laboratory to set an example for his or her supervisees.
- Reviews laboratory procedures for potential safety problems before assigning to other laboratory workers.
- Ensures that visitors and visiting scholars complete the Visiting Scholars Agreement (Appendix A) and follow all applicable safety rules. Assumes responsibility for the laboratory visitors and visiting scholars.
- Maintains and implements safe laboratory practices.
- Monitors the facilities and the chemical fume hoods to ensure that they are maintained and function properly. Promptly contacts the appropriate person, as designated by the Department Chairperson, to report problems with the facilities or the chemical fume hoods.
- The PI is responsible for taking the appropriate steps to close out the laboratory space in the event that he or she chooses to retire or leave WVU. Laboratory close-outs must be performed in a timely manner and according to established guidelines (Appendix B.).

Section 6. Laboratory Worker (Technical Staff, Graduate Students, Visiting Scholars, and Undergraduate Students on Payroll)

- Reads, understands, and follows all safety rules and regulations that apply to the work area.
- Plans and conducts each operation, laboratory class, or research project in accordance with the LSM.
- Promotes good housekeeping practices in the laboratory or work area.
- Communicates appropriate portions of the LSM to students in the work area.
- Notifies the supervisor of any hazardous conditions or unsafe work practices in the work area.
- Uses personal protective equipment as appropriate for each procedure that involves hazardous materials or operations.
- Immediately reports any job-related illness or injury to the supervisor.

Chapter 3. Standard Operating Procedures

Section 1. How to Avoid Routine Exposure to Hazardous Chemicals

1. Thoroughly review all proposed laboratory procedures to determine the potential health and safety hazards before beginning work in the laboratory. Refer to the SDS for guidance on chemical storage, handling, and disposal. Avoid underestimation of risk when handling hazardous materials.
2. Minimize all chemical exposure. Avoid ingestion, injection, inhalation, eye contact, and skin contact with hazardous materials.
3. Observe the PEL (Permissible Exposure Limit) and TLV (Threshold Limit Value) of each hazardous material in the laboratory. These limits are listed in the SDS.
4. The choice of chemicals to be used in the laboratory should be appropriate to the facilities and should not exceed the capacity of the exhaust system.
5. Do not smell or taste chemicals. When instructed to smell a chemical, gently waft the vapors toward your nose. Do not directly inhale the vapors.
6. Vent apparatuses which may discharge chemicals (vacuum pumps, distillation columns, etc) into local exhaust or hoods.
7. Inspect gloves and glove boxes before use.
8. Do not allow release of toxic substances into cold rooms since these rooms recirculate the air.
9. Always wash exposed areas of skin after chemical usage and before exiting the laboratory.
10. Never wear gloves or lab coats outside of the laboratory or into areas where food is stored and consumed. Laboratory workers should wash laboratory apparel separately from personal clothing.
11. Eating, smoking, using smoke-less tobacco products, drinking, chewing gum, or applying cosmetics in areas where laboratory chemicals are present is prohibited.
12. Food and beverages should not be stored in chemical storage areas or laboratory refrigerators.
13. Do not use glassware or utensils used for laboratory work for any other purpose (i.e., drinking from beakers).
14. Keep chemical containers closed when not in use.

Section 2. General Housekeeping Practices in the Laboratory

1. Access to exits, emergency equipment, and utilities must never be blocked. Coats, bags, and other personal items must be stored in the proper area, not on the benchtops or in the aisle ways.
2. Properly label chemicals and equipment for use and storage. Repair or replace any damaged labels immediately. Secondary containers must be labeled with the chemical name, manufacturer's name, hazard class, and any other special warnings.
3. The floors should be cleaned on a regular basis. Promptly wipe up all liquid spills and ice on the floor.
4. Keep work areas clean and uncluttered. Benchtops and hoods should remain clear of broken glass, spilled chemicals, paper litter, etc.
5. Chemical hazards should be maintained at least two inches from the edge of the bench tops.
6. Hallways and stairways should not be used as storage areas.
7. Do not store materials or chemicals on the floor.
8. Do not block the sink drains. Place rubber matting in the bottom of the sinks to prevent breakage of glassware and avoid injuries.
9. Wear appropriate gloves to clean glassware. Do not pile up dirty glassware in the laboratory. Wash glassware carefully. Dirty water can mask glassware fragments.

Handle and store laboratory glassware with care. Promptly discard cracked or chipped glassware.

10. Clean up work areas at the end of the operation or day.
11. Properly dispose of broken glass and sharps (i.e., needles and razor blades). If broken glassware is contaminated with a hazardous substance, the glassware must be treated as a hazardous substance.
12. To avoid accidents, drawers and cabinets must be kept closed.
13. Properly dispose of all waste chemicals. Never pour waste chemicals down the drains.
14. Formal housekeeping and laboratory inspections will be conducted on a regular basis by the Chemical Hygiene Officer and the College Safety Officer.

Section 3. Personal Apparel

1. Clothing should be worn that is appropriate to the degree of hazard that is present in the laboratory. If there is a risk of chemical splash or exposure, one should wear clothing that sufficiently covers the upper and lower body, including long pants (or long skirt) and the equivalent of a t-shirt. Shorts and short skirts are inappropriate apparel in the laboratory if there is a risk of chemical splash or spill.
2. Wear shoes at all times in the laboratory.
   Do not wear perforated, open-toed, open-backed, or high-heeled shoes, clogs, or sandals.
3. For your protection, jewelry (i.e., rings, bracelets, necklaces, and watches) should not be worn in the laboratory. Chemicals can seep under the jewelry and cause injuries to the skin. Jewelry can become caught in machinery and can conduct electricity. Chemicals can ruin jewelry and change its composition (i.e., when mercury comes into contact with gold).
4. Hair longer than shoulder length and loose sleeves must be confined in the laboratory to prevent contact with chemicals and moving parts in equipment.

Section 4. Personal Protective Equipment (PPE)

The laboratory supervisor should conduct a risk assessment in the laboratory and determine the appropriate personal protective equipment that should be worn by laboratory workers to protect them from exposure to hazardous materials and hazardous operations and equipment.

1. Always review new procedures and refer to the SDS to determine the degree of PPE that is required for each chemical or mechanical operation that will be performed in the laboratory.
2. Wear chemical splash goggles that conform to ANSI Z87.1, Occupational and Educational Personal Eye and Face Protection Devices, at all times (over eyeglasses) when working with chemicals that might present a splash hazard, vapors, or particulates in the laboratory.

Chemical splash goggles protect the face and eyes in the event of a chemical splash and broken glass.

Safety glasses do not protect the face and eyes from chemical splashes and broken glass.

Impact goggles are designed for use in a woodworking shop and do not protect the eyes from chemical splashes.

3. A face shield (in addition to chemical splash goggles) should be used when there exists a possibility of fire, explosion, or implosion.
4. Protective safety glasses with UV-absorbing lenses should be worn when working with radiation of wavelengths shorter than 250 nm.
5. Gloves that are appropriate to the degree of hazard (according to the SDS) must be worn at all times (see glove selection chart, below). Inspect gloves for defects before wearing. Remove gloves before handling pens, notebooks, doorknobs, radios, computer keyboards, and telephones. Remove gloves before exiting the laboratory.

Glove Selection for Specific Chemicals

Excerpt from LabCliQ Lab Safety Manual

Chemical	Incidental Contact	Extended Contact
Acetic acid	Nitrile	Neoprene, Butyl rubber
Acetic anhydride	Nitrile (8 mil), double glove	Butyl rubber, Neoprene
Acetone	1Natural rubber (Latex) (8 mil)	Butyl rubber
Acetonitrile	Nitrile	Butyl rubber, Polyvinyl acetate (PVA)
Acrylamide	Nitrile, or double Nitrile	Butyl rubber
bis-Acrylamide	Nitrile	
Alkali metals	Nitrile	
Ammonium hydroxide	Nitrile	Neoprene, Butyl rubber
Arsenic salts	Nitrile	
Benzotriazole, 1,2,3-	Nitrile	
Bismuth salts	Nitrile	
Butanol	Nitrile	Nitrile, Butyl rubber
Butyric acid	Nitrile	Butyl rubber, Neoprene
Cadmium salts	Nitrile	
Carbon disulfide	Nitrile (8 mil), double glove, or 15 mil or heavier	Viton, Polyvinyl acetate (PVA)
Carbon tetrachloride	Nitrile (8 mil), double glove, or 15 mil or heavier	
Catechol	Nitrile	Viton
Chloroform	Nitrile (8 mil), double glove, or 15 mil or heavier	Viton, Polyvinyl acetate (PVA)
Chlorosulfuron	Nitrile	
Chromium salts	Nitrile	
Cobalt chloride	Nitrile	Nitrile
Cobalt salts	Nitrile	
Copper (Cupric) sulfate	Nitrile	
Cyrogenic liquids	Cryogloves	
3,3'-Diaminobenzidine (DAB)		
Diazomethane in Ether	Nitrile (8 mil), double glove, or 15 mil or heavier	
Dichloromethane	Nitrile (8 mil), double glove	Polyvinyl acetate (PVA) or Viton
2,4-Dichlorophenoxy acetic acid		
Diethyl pyrocarbonate	Nitrile	Nitrile, double glove
Dimethyl sulfoxide	1Natural rubber (15-18mil)	Butyl rubber
1,4-Dioxane	Nitrile (8 mil), double glove, or 15 mil or heavier	
Dithiothreitol	Nitrile	
Ethanol	Nitrile	
Ethidium bromide (EtBr)	Nitrile	Nitrile, double glove
Ethyl acetate	Nitrile (8 mil), double glove	Butyl rubber, PVA
Ethyl ether	Nitrile (8 mil), double glove, or 15 mil or heavier	
Formaldehyde	Nitrile	
Formamide	Nitrile	Butyl rubber
Formic acid	Nitrile (8 mil), double glove	Butyl rubber, Neoprene (.28-.33mm)
Gallic acid	Nitrile	
Geneticin	Nitrile	
Glutaraldehyde	Nitrile	
Heavy metal salts	Nitrile	Nitrile, double glove
Heptane	Nitrile (8 mil), double glove, or 15 mil or heavier	Nitrile (35 mils or thicker), Viton, PVA
Hexamethylenediamine (1,6-Diaminohexane)	Nitrile (8 mil)	Neoprene
Hexane	Nitrile (8 mil), double glove, or 15 mil or heavier	Nitrile (35 mils or thicker), Viton, PVA
Hydrochloric acid	Nitrile	Neoprene, Butyl rubber
Hydrofluoric acid (HF)	Nitrile (8 mil), double glove, or 15 mil or heavier	Nitrile or Rubber sleeves
Hypophosphorous acid	Nitrile (4mil), double glove or 8 mil or heavier	

Chemical	Incidental Contact	Extended Contact
Isoamyl alcohol	Nitrile	
Isoctane	Nitrile	Heavy weight Nitrile
Isopropanol	Nitrile	
Kananmycin	Nitrile	
Lactic acid	Nitrile	Nitrile (double glove), or Neoprene or Butyl rubber
Laser dyes	Nitrile	
Lead acetate	Nitrile	Nitrile, double glove Lead salts Nitrile
Mercuric chloride	Nitrile	Nitrile, double glove Mercury Nitrile
Mercury salts	Nitrile Methanol (Methyl alcohol)	Nitrile
Methylene chloride	Nitrile (8 mil), double glove	Polyvinyl acetate, Viton
Methylphosphonic acid	Nitrile (4 mil), double glove	8 mil or heavier Nitrile
Methyl sulfonic acid, Ethyl ester (EMS) (Ethyl methanesulfonate)	Nitrile	Nitrile, double glove
Monoethanolamine	Nitrile	
Nickel chloride	Nitrile	Nitrile, double glove
Nickel salts	Nitrile	Nitrile, double glove
Nitric acid	Nitrile (8 mil), double glove	Heavy weight (.28-.33mm) Butyl rubber or Neoprene
N-Methylethanolamine	Nitrile (8 mil), double glove	Viton, Neoprene, Butyl rubber
Octane	Nitrile	Heavy weight Nitrile or Viton
Organophosphorous compounds	Nitrile (8 mil), double glove, or 15 mil or heavier	
Osmium salts	Nitrile	
Osmium tetroxide	Nitrile	Nitrile, double glove
Paraformaldehyde	Nitrile	
Pentane	Nitrile (8mil), double glove	Heavy weight Neoprene, or Viton
Perchloroethylene (tetrachloroethylene)	Nitrile (8 mil), double glove	Nitrile (22mil or heavier)
Pesticides	heavy weight, unlined Nitrile (8-20 mils), or glove specified by pesticide label.	
Petroleum ether	Nitrile	Heavy weight Nitrile or Viton
Phenol	Nitrile (8 mil), double glove	Neoprene, Butyl rubber
Phenol-Chloroform mixtures	Nitrile (8 mil), double glove, or 15 mil or heavier	Viton
Phenylmethylsulfonyl fluoride (PMSF)	Nitrile	Nitrile, double glove
Phosphonic acid	Nitrile (4 mil), double glove, or 8 mil or heavier single	
Phosphoric acid	Nitrile (4 mil), double glove, or 8 mil or heavier	
Picloram (4-amino-3,5,6-trichloropicolinic acid)	Nitrile	
Polychlorinated Biphenyls (PCB's)	Nitrile (8 mil) glove over a Neoprene glove	Neoprene (20 mil)
Polyoxyethylene-sorbital-n-monolaurate (Tween 20)	Nitrile	
Potassium ferricyanide	Nitrile	
Potassium ferrocyanide	Nitrile	
Potassium permanganate	Nitrile	
Propanol	Nitrile	
Propionic acid	Nitrile	Neoprene or Butyl rubber
Propylene oxide	heavier weight (17 mil or greater) Butyl rubber or Neoprene	Norfoil
Psoralen	Nitrile	Nitrile, double glove
Pump oil	Butyl rubber	
Silane based silanization or derivatization compounds	Nitrile (8 mil), double glove, or 15 mil or heavier single	
Silver nitrate	Nitrile	Nitrile, double glove
Silver salts	Nitrile	
Sodium dodecyl sulfate (SDS)	Nitrile	
Sodium azide	Nitrile, or double glove	
Spermidine	Nitrile	
Sulfuric acid	Nitrile (8 mil)	Neoprene, Butyl rubber (20 mil

Chemical	Incidental Contact	Extended Contact
		or greater)
Tetrahydrofuran (THF)	Nitrile (8 mil), double glove, or 15 mil or heavier	Norfoil
3,3',5,5'-Tetramethyl-benzidine (TMB)	Nitrile	Nitrile, double glove
N,N,N',N'-Tetramethyl-ethylenediamine (TEMED)	Nitrile	Nitrile, double glove
Timetin	Nitrile	
Toluene	Nitrile (8 mil), double glove, or 15 mil or heavier	Viton, Polyvinyl acetate (PVA)
Trichloroethylene	Nitrile (8 mil), double glove	Viton, Polyvinyl acetate (PVA)
Trichloromethyl chloroformate (diphosgene)	Nitrile (8 mil) over Butyl rubber glove	This material must be used in a glove box.
Triton-X100	Nitrile	
Uranium salts	Nitrile	
Valeric acid	Nitrile	Nitrile, double gloves, or Neoprene or Butyl rubber
Xylene	Nitrile	Polyvinyl acetate (PVA), Viton

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

6. Lab coats or aprons must be worn when working with corrosive or caustic materials that may present a splash hazard.
7. All photographs that are taken in a laboratory setting must depict laboratory workers who are wearing proper personal protective equipment (i.e., goggles, gloves, and laboratory coat).

Section 5. General Safety Rules

1. Employees are not permitted to deviate from the assigned work schedule without prior authorization from the Laboratory Supervisor. Unauthorized experiments are strictly forbidden.
2. Plan appropriate protective procedures and plan the positioning of all equipment before beginning any operation. Follow the appropriate Standard Operating Procedures (SOP) at all times in the laboratory.
3. Read the SDS and the label before using a hazardous chemical in the laboratory for the first time.
4. Report all injuries, accidents, incidents, and near-misses to the Chemical Hygiene Officer.
5. Know the location and proper use of the safety equipment, (i.e., eyewash station, safety shower, fire extinguisher, first-aid kit, and fire blanket) emergency telephone, and fire alarm in the laboratory in which you are working.
6. Appropriate personal protective equipment must be worn at all times in the laboratory.
7. Appropriate eye protection (chemical splash goggles and/or a face shield) must be worn by all persons (including visitors) where chemicals are used or stored.
8. Wear appropriate gloves when handling toxic materials. Inspect all gloves for holes and defects before using.
9. The use of contact lenses in the laboratory is strongly discouraged. If an employee must wear contact lenses when working with hazardous substances, the employee must notify his or her supervisor so that all special precautions can be taken.
10. Do not wear synthetic finger nails in the laboratory. Synthetic finger nails are made of extremely flammable polymers which burn to completion and are not easily extinguished.
11. Notify your supervisor if you experience any sensitivities to any chemicals.
12. When heating a test tube or other apparatus, never point the apparatus toward yourself or your laboratory colleagues.
13. Always protect your hands when cutting glass tubing. Do not attempt to dry glassware by inserting a glass rod wrapped with paper towels. Always lubricate glassware with soap or glycerin before inserting rods, tubing, or thermometers. Hot glass looks just like cold glass. Be sure that your glassware has cooled before you touch it.
14. Dilute concentrated acids and bases by slowly pouring the acid or base into the water with stirring.
15. Secure all water, gas, air, and electrical connections in a safe manner.
16. Avoid working alone in the laboratory.
17. Do not pipet any substance by mouth in the laboratory; use a pipet aid.
18. Properly dispose of all chemical wastes. Do not pour chemicals down the drains.
19. Report any unsafe conditions to the Laboratory Supervisor or Chemical Hygiene Officer.
20. Unauthorized persons are not permitted in the laboratory.

Section 6. Unattended Operations

1. Obtain permission from the supervisor prior to conducting any unattended operations.
2. Leave lights on and post a sign on the door announcing an unattended operation.
3. Return periodically to check on the unattended operation.
4. Provide for the containment of toxic substances in the event of equipment or utility failure.
5. The laboratory door should be posted with emergency contact names and telephone numbers.

Section 7. Signs and Labels

1. Emergency signs shall be posted on all laboratory and prep room doors. The signs must contain the names and telephone numbers of all emergency contact personnel.
2. Label all secondary containers, including waste receptacles, with the contents, manufacturer's name, appropriate warnings, and hazard class.
3. Provide designated location(s) for safety shower, eye wash, fire extinguisher, first-aid station, fire blanket, and emergency telephone.
4. Post warning signs for areas of special or unusual hazards.

Section 8. Laboratory Equipment

1. Electrical equipment should be maintained only by trained individuals. Properly ground all electrical equipment. Report any electrical failure or suspicious heating of equipment to the Laboratory Supervisor immediately. Periodically inspect electrical equipment. Ensure quick access to electrical equipment shut-offs in the event of an emergency. Ensure that all electrical hand tools are double insulated or grounded.
2. Centrifuges should be anchored securely to the bench top. Close the lid before operating and remain with the centrifuge until full operating speed is attained. If vibration occurs, stop the centrifuge and check the counter-balance load. Periodically clean the buckets and rotors to avoid contamination.
3. Securely lock down all balances and computers to avoid theft.
4. Take extra precautions when using Dewar flasks; shield or wrap them with tape to contain implosions.
5. Use laboratory equipment for the intended purpose only.
6. Periodically clean and examine all laboratory equipment.
7. Do not block walkways or aisles with extension cords. Periodically inspect extension cords for visible defects.
7. When using lasers, always wear appropriate eye protection and do not look directly at the source of the beam. Do not aim the laser by sighting along the beam. Keep the laser beam at or below chest height. Reflective materials should not be allowed near the beam. Hang warning signs when lasers are in use.
9. When using UV lamps, wear UV-absorbing eye protection, as described in the operating procedures for the instrument. Cover exposed skin.

Section 9. Environmental Monitoring

1. Regular employee exposure monitoring shall be provided by EHS upon request.
2. Regular monitoring for airborne substances may be appropriate when testing a new ventilation system or when redesigning laboratory hoods.
3. Regular monitoring may be appropriate if a hazardous substance is stored in the laboratory or if the substance is used routinely (three times a week or more).

Section 10. Medical Monitoring Program

The institution has established an Employee Medical Monitoring Program (http://ehs.wvu.edu/r/download/70484). In compliance with OSHA 29 CFR 1920.20, employee records will be maintained for the length of employment plus 30 years. The employee will be monitored:

- if the employee develops signs and symptoms of exposure associated with a hazardous chemical.
- when exposure monitoring routinely exceeds the action level for an OSHA regulated substance.
- in the event of a spill, leak, explosion, or other occurrence resulting in the likelihood of exposure.

Section 11. Record Maintenance

Accident report forms should be submitted to the Chemical Hygiene Officer and the College Safety Officer. Medical records are to be retained by the institution. The Chemical Hygiene Officer and EHS will retain copies of all personnel training records. The Chemical Hygiene Officer, the College Safety Officer, and EHS will retain an up-to-date copy of the chemical inventory for each department. The CHO will retain RCRA/HazComm training completion records for departmental personnel.

Chapter 4. Chemical Management Program

Section 1. Introduction

The prudent management of hazardous materials, from their procurement to their disposal, is a critical element of a successful laboratory safety program. Chemical management includes the following processes:

1. Chemical Procurement
2. Chemical Storage
3. Chemical Handling
4. Chemical Inventory
5. Transportation of Chemicals
6. Chemical Waste

Section 2. Chemical Procurement

When preparing to order a chemical for an experiment, there are several questions that one should ask, including:

- Do I really need to order this chemical?
- How much do I really need to order to perform my experiment? **(REMEMBER THAT WHEN ORDERING CHEMICALS, LESS IS ALWAYS BEST)** Order the least amount of chemicals that will be needed to save storage space, money, and disposal costs.
- What personal protective equipment (PPE) is required when handling this chemical? Is the proper PPE available in the laboratory?
- What is the level of training that is required to use this chemical?
- Are there special handling precautions?
- Does the laboratory have the proper storage facilities?
- Does the laboratory chemical fume hood provide proper ventilation?
- Are there special containment considerations in the event of a spill, fire, or flood?
- Will the institution provide disposal of this chemical? Are there additional costs related to the disposal of this chemical?

According to the OSHA Lab Standard, Appendix A, Section D.2. (Chemical Procurement, Distribution, and Storage; included in this document as Appendix B), "Information on proper handling, storage, and disposal should be known to those who will be involved before a substance is received. Only containers with adequate identifying labels should be accepted. Ideally, a central location should be used for receiving all chemical shipments." Only authorized personnel should purchase chemicals and other hazardous materials, such as gas cylinders. Ultimately, the purchaser of the chemical accepts responsibility for the ownership of the chemical.

Section 3. Chemical Storage

In the event of a chemical spill or fire, incompatible chemicals that are stored in close proximity can mix to produce fires, toxic fumes, and explosions. To protect the laboratory worker, chemicals must be separated and stored according to hazard category and compatibility. Read the SDS and heed the precautions regarding the storage requirements of the chemicals in your laboratory. A detailed compatibility table is included in *Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards*.
http://www.nap.edu

All chemical containers must be properly labeled. To avoid accidents and potentially costly fines from federal regulatory agencies, all secondary container labels should contain:

- Chemical name
- Hazard warnings
- Name of manufacturer
- Name of researcher in charge
- Date of transfer to the vessel

Promptly date all incoming chemical shipments and rotate stock to ensure use of older chemicals. Peroxide- formers should be dated upon receipt and dated again when the container is opened so that the user can dispose of the material according to the recommendations on the Safety Data Sheet. Store peroxide-formers away from heat and light in sealed, airtight containers with tight-fitting, non-metal lids. Test regularly for peroxides and discard before expiration dates.

When storing chemicals on open shelves, always use sturdy shelves that are secured to the wall and contain ¾" lips. To avoid accidents, do not store liquid chemicals over five feet in height on the open shelves. Do not store chemicals within 18 inches of the sprinkler heads in the laboratory. Use secondary containment devices (i.e., chemical-resistant trays) where appropriate. Do not store chemicals in the laboratory fume hood. Do not store chemicals on the floor, aisle ways, hallways, areas of egress, or on the bench top. Store chemicals away from heat and direct sunlight.

Only laboratory-grade explosion-proof refrigerators and freezers may be used to store chemicals that require cool storage in the laboratory. The chemicals that are stored in the refrigerator must be placed in sealed and properly labeled containers. Periodically clean and defrost the refrigerator/freezer to ensure maximum efficiency. Never use domestic refrigerators and freezers to store chemicals since they possess ignition sources and can cause dangerous and costly laboratory fires and explosions. Do not store food or beverages in the laboratory refrigerator. Label all refrigerators that contain radioactive materials with the appropriate symbols and warnings. Conduct regular testing and inspections of the refrigerators to ensure that they are not contaminated with radioactive materials.

Highly toxic chemicals must be stored in a well-ventilated, secure area that is designated for this purpose. Cyanides must be stored in a tightly closed container and securely locked in a cool, dry, cabinet. Access to the cabinet must be restricted. Protect cyanide containers against physical damage and separate them from incompatibles. Follow good hygiene practices and regularly inspect your PPE. Use proper disposal techniques.

Hydrofluoric acid (HF) has the potential to produce serious health effects if splashed on the skin or into the eyes, ingested, or if inhaled. HF solutions are clear and colorless and have the ability to dissolve glass. Always use and store HF in plastic containers (polyethylene or polypropylene) and store this container inside of a secondary container made of plastic. A unique toxicological property of HF is due to the fluoride ion which causes soft tissue and bone damage by binding calcium. HF quantities in the laboratory must be kept at a minimum for the planned usage and keep the container capped when not in use. Always work with HF in a properly functioning chemical fume hood. The fume hood should be labeled with a clearly visible sign to indicate that HF is currently in use in this hood. Wear appropriate clothing that covers your body, a lab coat, a chemical-resistant apron, chemical splash goggles and face shield, and butyl or neoprene high quality double gloves when working with HF. Always consult the manufacturer's glove guide when selecting gloves for HF handling. Check the gloves for tears before using and continuously check your gloves for tears or leaks. Personnel must be trained on the proper techniques to handle HF. Never work alone when using HF. All laboratory personnel should be trained on how to properly handle HF, the dangers that are involved, and how to treat exposures. Emergency procedures should be posted in the laboratory. A safety shower and eyewash station must be available for use by all personnel who handle HF. **It is mandatory that all HF users have fresh Calcium gluconate gel (2.5%) in the laboratory for treatment purposes in the event of an exposure. Check the expiration date periodically and purchase fresh stock as needed**. Standard first-aid treatments for acid burns do not apply to an HF exposure. Rinse with cool water for five minutes only, apply the calcium gluconate gel using nitrile gloves, and immediately seek medical attention, even if you do not immediately feel any pain. **All HF exposures require immediate medical attention.**

Ethanol (200 proof, 100%) must be stored in a securely locked cabinet within the laboratory. Minimize quantities and restrict access.

Flammable liquids should be stored in approved flammable liquid containers and storage cabinets and National Fire Protection Association (NFPA) limits on the quantity of flammables per cabinet, lab space, and building must be observed. Store odiferous materials in ventilated cabinets. Chemical storage cabinets may be used for long- term storage of limited amounts of chemicals.

Rooms that are used specifically for chemical storage and handling (i.e., prep rooms, storerooms, waste collection rooms, and laboratories) are controlled-access areas. Chemical storage rooms should be professionally designed and must provide proper ventilation. The chemical storage room must be a spark-free environment and one must use only spark-free tools within the room. Special grounding must be installed to prevent static charge while dispensing solvents.

Section 4. Chemical Handling

Important information about handling chemicals can be found in the Safety Data Sheets (SDS). A comprehensive file of SDS must be kept on file in the laboratory or be readily accessible online to all employees during all work shifts. Workers should always READ and HEED the label and the Safety Data Sheet before using a chemical for the first time. Know the types of PPE that you will be required to wear when handling the chemical. Ensure that the ventilation in the laboratory will be adequate for your needs. Be familiar with the departmental Emergency Action Plan in the event of a chemical spill, fire, or explosion.

Section 5. Chemical Inventory

Why do we maintain chemical inventories in our labs? The OSHA Lab Standard, Appendix A, Section D.2. (Chemical Procurement, Distribution, and Storage), states, "Prudent management of chemicals in any laboratory is greatly facilitated by keeping an accurate inventory of the chemicals stored. Unneeded items should be discarded or returned to the storeroom."

What are the benefits of performing annual chemical inventory updates?

- Ensure that chemicals are stored according to compatibility tables.
- Eliminate unneeded or outdated chemicals.
- Ability to share chemicals in emergency situations.
- Update the NFPA 704 posting on the laboratory door.
- Promote more efficient use of lab space.
- Check expiration dates of peroxide-formers.
- Check the integrity of the shelving and storage cabinets.
- Encourage lab supervisors to make "Executive Decisions" about dusty bottles of chemicals.
- Repair/replace labels and caps.
- Many research groups plan a "clean the lab" day in concert with the inventory update.
- Ensure compliance with all federal, state, and local record keeping regulations.
- Promote good relations and a sense of trust with the community and your emergency responders.
- Reduce the risk of exposure to hazardous materials and ensure a clean and healthy laboratory environment.

The amounts of hazardous materials should be carefully monitored in the laboratory. A physical chemical inventory should be performed at least annually, or as requested by the Chemical Hygiene Officer. A thorough inventory will eliminate unneeded or outdated chemicals and will ultimately result in more efficient use of laboratory storage space. The WVU chemical inventory form is located at: http://ehs.wvu.edu/forms

Safety Issues Related to the Chemical Inventory Process

- Wear appropriate PPE and have extra gloves available.
- Use a chemical cart with side rails and secondary containment.
- Use a laboratory step stool.
- Read the Emergency Action Plan and be familiar with the institution's safety equipment.
- If necessary, conduct a work stand down while you perform the inventory.

Section 6. Transportation of Chemicals

Always use a secondary containment device (i.e., rubber pail) when transporting chemicals from the storeroom to the laboratory or even short distances within the laboratory. Use carts with attached side rails and trays of single piece construction at least two inches deep to contain a spill that may occur. Bottles of liquids should be separated to avoid breakage and spills. Never transport liquid chemicals in basket-type carts. Do not overfill carts. Avoid high traffic areas when moving chemicals within the building. Plan your work to avoid class changing times and other times when students are in the hallways. When possible, use freight elevators when transporting chemicals. Always ground the drum and receiving vessel when transferring flammable liquids from a drum to prevent a static charge buildup.

Submit all chemicals and hazardous materials to be shipped outside the department, either domestically or internationally, to a certified DOT IATA shipper. The U.S. Department of Transportation oversees the shipment of hazardous materials and will impose significant fines and citations in the event of non-compliance. For a list of certified shippers, contact EHS at 293-3792.

To protect faculty, staff, and students, all planned chemistry demonstrations and chemistry magic shows that will be performed by chemistry personnel that are not a part of normal instructional activities must be pre approved and authorized by the Chairperson and the Chemical Hygiene Officer. Faculty who are interested in participating in such activities and plan to use departmental chemicals and apparatus must submit the following information, in writing and two weeks in advance of the planned event, to the Chemical Hygiene Officer:

- The location of the demonstration
- The date of the event
- The age of the intended audience
- The number of persons who will attend the event
- The degree of audience participation

• The demonstrations that will be performed
• A list of chemicals that will be transported to the demonstration site
• The personal protective equipment that will be worn and by whom

All chemicals that are transported to the demonstration site must be handled in a prudent manner, packaged appropriately, properly labeled, and transported back to Clark Hall for disposal via the university chemical waste disposal system. Under no circumstances should any chemicals that originated at the Department of Chemistry be left at the demonstration site or disposed of at the demonstration site. Prior to the planned event, event organizers should ensure that, in the event of an accident involving chemicals in their personal vehicles, they will be covered under their personal insurance policies. Many insurance policies forbid the transport of any chemicals from the workplace in personal vehicles.

The American Chemical Society (ACS) publication, "National Chemistry Week (NCW) and Community Activities Safety Guidelines" provides an excellent resource for personnel who perform demonstrations and magic shows and is included in Appendix F.

Section 7. Chemical Waste

Do not dispose of waste chemicals in the sink drains or in the wastebasket. It is the policy of the Eberly College of Arts and Sciences that no chemicals or solutions are poured down the drains or placed in the general wastebaskets in the laboratory. Waste chemicals must be collected in appropriate containers and must be stored in the assigned location within the laboratory. Properly label all waste containers. Each waste container must have a "Hazardous Waste" sticker and a label that includes the complete contents of the container. Chemical waste containers must be capped at all times except when adding material.

A. The West Virginia Department of Environmental Protection (WV DEP) considers chemical containers that are dusty to be waste-like in manner since it would appear that they are no longer being used. They have stated that dusty containers should be considered waste and should be disposed.

B. Included in this document in Appendix C is a list of chemicals that the U.S. Environmental Protection Agency has designated as "Acutely Hazardous" and they have placed special restrictions on their accumulation and disposal. These "P-Listed" wastes *and their empty containers* must be disposed of as hazardous waste through the WVU EH&S Hazardous Waste Program. You must label even empty containers of P-Listed wastes as "Hazardous Waste" and submit an EHS waste disposal form. Do not rinse these empty containers because the rinsate that is created is a "P-listed waste" and is then treated as a hazardous waste.

EHS Hazardous Waste Guide for Satellite Accumulation Areas

1. EHS will pick up unwanted chemicals and chemical wastes.
2. Chemicals must be compatible with the container.
3. Containers must be labeled with the words "Waste <chemical name(s)>". Use the common or IUPAC name of each chemical (no formulas).
4. Containers must always be kept closed unless actively adding waste.
5 Containers should be no more than 95% full to allow for expansion.
6. Containers must have a screw cap closure or equivalent.
7. Date container when it is full.
8. Submit the online Hazardous Waste Disposal Form. Forms are available at http://ehs.wvu.edu

HAZARDOUS WASTE
Contains:

_____
_____
_____
_____
_____

Date when full: ____/____/____
For Disposal: ehs.wvu.edu

Metal Waste

All metal wastes (turnings and fines) must be properly labeled and disposed in order to remain in compliance with West Virginia Department of Environmental Protection (DEP) regulations. By definition, turnings are long, ribbon-like pieces of metal that are produced when using a lathe and fines are very small particles from grinding or drilling activities. If you should have questions regarding the proper labeling and disposal of metal wastes, you should contact EHS at 304-293- 3792.

1. EHS will provide 55-gallon sealable containers for coarse metal cuttings and 5-gallon sealable containers for fine cuttings.
2. The shop supervisor will provide a shop vacuum for cleaning each of the machine areas. These vacuum cleaners will be used exclusively in each of the rooms where metal is collected and will not be available for general use or for use in other areas. The goal is to keep coarse and fine cuttings from each area separate from each other. The contents of the vacuum cleaners will be dumped into the 5-gallon containers at the end of each week or sooner if the vacuum cleaner is full.
3. Once one or more of the 55- or 5-gallon containers are full, the shop supervisor will request a waste pickup by EHS using the online form for that purpose. EHS will pick up the waste and replace the containers. EHS will test the waste, as appropriate, before it is disposed to determine whether it is hazardous. Results of those tests will be sent to the shop supervisor and the department Chair.
4. Machine shop requests must specify the material to be used in the drawings. The shop supervisor will keep a spreadsheet file of each job and the materials used for each one. If the raw materials are provided by the requestor, the requestor must provide documentation for the type of material. Machine shop users must keep a log of all materials that are machined. The shop supervisor will provide each area with a log sheet that each user must complete that specifies the type of material that will be used.
5. Large pieces of excess metal should be recycled, when possible. When the containers that hold large pieces of metal need to be emptied, the shop supervisor should submit a waste disposal form and EHS will manage the material.
6. Cleaning cloths that are used to clean equipment, if heavily soiled with oils, or solvents, or unknown contaminants, should be collected and placed into a container that EHS will provide for this purpose. Label this container as “Hazardous Waste” and keep the container closed when not adding additional cloths.

Chapter 5. Engineering Controls

Section 1. Laboratory Design

1. The laboratory facility will have an appropriate ventilation system to avoid intake of contaminated air.
2. The stockrooms and storerooms must be well ventilated.
3. The laboratory will include proper storage cabinets and storage areas for chemicals.
4. The laboratory will have available properly functioning chemical fume hoods and laboratory sinks.
5. Safety equipment in the laboratory may include fire extinguishers, safety showers, fire blankets, and eyewash stations.
6. Experimental work should be appropriate to facilities available.
7. Modifications to the laboratory facility cannot be undertaken without consultation with the department Chair, the Chemical Hygiene Officer, and personnel from EHS.

Section 2. Laboratory Ventilation

1. Laboratory procedures involving hazardous chemicals must not be started if there is a possibility that the ventilation system cannot handle the emissions from the procedure.
2. General ventilation provides a source of breathing air and a source for make-up air for local ventilation devices. The laboratory ventilation should have a performance level of 10-20 room changes per hour. An inadequate ventilation system can cause an increased risk by creating a false sense of security in the laboratory. Laboratory air must not be recirculated within the building.
3. There should be 2.5 linear feet of hood space for each worker who spends the majority of his or her time working with hazardous chemicals.
4. Hood face velocity should be 80-120 linear feet per minute.
5. All chemical fume hoods will be tested on an annual basis by EHS personnel and inspection results will be posted on the fume hood.
6. To ensure their safety and health, all personnel must properly use and maintain the chemical fume hoods.
   - When using the hood, the sash opening should be kept at a minimum to ensure the efficiency of the operation.
   - All chemicals and equipment should be placed at least six inches from the hood face to ensure proper air flow.
   - Use the hood when there is a possibility of release of toxic chemical vapors, dusts, or gases.
   - Use the hood when working with any volatile or noxious substances.
   - Keep hoods closed when not in use.
   - Do not store chemicals or equipment in the hood.
   - Workers should be discouraged from walking in front of a hood that is in use.

   Such behavior disrupts the air flow in front of the hood.
   - Keep your head and body outside of the hood face and listen for changes in the air flow.
   - Do not rely on the hood for protection against explosions. Plan your experiments wisely.
   - Keep the sash glass clean and to not obstruct the view of the hood with posters, decals, or other items.

Section 3. Building Security

1. All doors must be closed and locked when workers or students are not present.
2. If you are working in a laboratory or office and leave for any reason or any length of time, you must close and lock the door.
3. Do not loan your building keys or employee ID card to anyone else for the purpose of gaining entry into the facility and its laboratories.
4. Immediately report the loss or theft of your keys or ID card to the department Chemical Hygiene Officer.
5. Do not permit unauthorized persons to enter laboratories or offices.
6. Do not prop open doors or leave doors ajar to allow unauthorized access to the facilities.
7. If an employee should discover that criminal activity has occurred in the building, he or she should immediately notify the Chemical Hygiene Officer.
8. Employees will be notified via email or meetings with the department chair or Chemical Hygiene Officer of any criminal action that has occurred in the facilities.

Chapter 6. Compressed Gas Safety Program

Section 1. General

All laboratory workers must know and understand the properties, uses, and safety precautions of the gas before using the gas and/or associated equipment. Consult the supplier and the Safety Data Sheets for the particular gases being used. The Laboratory Supervisor should provide proper training and instruction for all personnel handling compressed gases. Chemical splash goggles and leather gloves are recommended for handling compressed gas cylinders.

Section 2. Gas Cylinder Handling

Never drag or slide a gas cylinder, even for short distances. Cylinders should be moved by using a suitable hand cart. Securely fasten the cylinder cap prior to transporting a gas cylinder. Never drop cylinders or permit them to strike each other violently. The valve protection cap must be left in place until the cylinder has been secured against a wall or bench, placed in a cylinder stand, or on a cylinder cart and is ready to be used. Cylinders must be secured at all times. Do not tamper with safety devices in valves or cylinders and never permit oil, grease, or other readily combustible substances to come in contact with cylinders, valves, or regulators for oxidizing gases. Do not remove or deface the product identification labels or decals, or change the cylinder color. Never lift a cylinder by the cap. Promptly return empty or unneeded cylinders to the gas cylinder room.

Section 3. Storage of Gas Cylinders

Cylinders should be stored in an upright position. Cylinders should be assigned to a definite, isolated area for storage and the area should be posted with the names of the stored gases. Separate cylinders of gases belonging to various categories, taking into account the nature of the gases. The area should be dry, cool, and well-ventilated, and preferably fire-resistant. Keep cylinders protected from excessive temperatures by storing them away from radiators or other sources of heat. Cylinders must be secured while in storage. Store only the amount of flammable or toxic gas required for a specific application. Store cylinders containing flammable gases away from other combustible materials. Cylinders containing flammable gases and mixtures should be properly grounded. Store empty and full cylinders separately and arrange full cylinders so that old stock is used first. Ensure that an adequate supply of water is available for first-aid, fire action, or dilution of corrosive material in the event of a spill.

Section 4. Use of Gas Cylinders

The cylinder decal or label is the only positive way to identify the gas contained in a cylinder. Color coding of cylinders is an identification method used for the convenience of the cylinder supplier only. Do not use cylinders as rollers for moving material or other equipment. Never attempt to mix gases in a cylinder. Never transfer gases from one cylinder to another. Never use oxygen as a substitute for compressed air. No part of a cylinder should be subjected to temperatures above 130°F (54°C). Prevent sparks or flames from welding or cutting torches or any other source from coming in contact with cylinders. Do not permit cylinders to come in contact with electrical apparatus or circuits. Use regulators and pressure relief devices when connecting cylinders to systems of lower pressure service ratings. Only regulators approved for the specific gas should be used.

Open the cylinder valve before adjusting the pressure on the regulator. Always open the cylinder valve slowly. Valves should be closed on cylinders and all pressure released from equipment connected to the cylinder at the end of a task or any time an extended nonuse period is anticipated. If a cylinder protective cap is extremely difficult to remove, do not apply excessive force or pry the cap loose with a bar inserted into the ventilation openings. Attach a label or tag to the cylinder identifying the problem and return the cylinder to the supplier. Wrenches should not be used on valves equipped with an handwheel. If the valve is faulty, attach a label or tag to the cylinder identifying the problem and return the cylinder to the supplier. Use only oxygen-compatible threading compounds such as Teflon tape on valve threads for oxygen service.

Section 5. Gas Regulators

1. General

Most regulators are similar in appearance, however, a principle difference occurs at the inlet connection. Inlet connection standards are established by the Compressed Gas Association (CGA). It is important that the inlet connection of the regulator is properly mated with the supply valve connection, as specified by the established standards for the service intended. Checking proper mating will avoid putting the regulator into the wrong service.

2. Selecting a Regulator

Select a regulator which is suited for the particular gas service. CGA valve outlets are noted for each gas and gas mixture and the CGA inlet for the regulator must correspond. Never use regulators with gases other than those for which they were intended.

3. Using a regulator

Identify the regulator. Check the label and the inlet and outlet gauges. Ascertain that the high pressure gauge is suitable for the pressure of the cylinder or source system. Inspect the regulator for evidence of damage or contamination. If there is evidence of physical damage or foreign material inside the regulator, return it to the supplier. Inspect the cylinder valve for evidence of damage. Attach the regulator to the cylinder and tighten the inlet nut securely. Close the regulator by turning the adjusting knob to the full counterclockwise position. The regulator must be closed before opening the cylinder valve.

4. Safety Check the System

Make sure that the regulator adjusting knob is turned fully counterclockwise. Standing with the cylinder valve between yourself and the regulator, place both hands on the cylinder valve and open it slowly, allowing the pressure to rise gradually in the regulator. When the high pressure gauge indicates maximum pressure, open the cylinder valve fully. Always close the cylinder valve when it is no longer necessary to have it open. Do not leave it open when the equipment is unattended or not in operation.

5. Adjusting the Pressure

Turning the adjusting knob clockwise, establish the required use pressure by referring to the low pressure gauge. Make sure that the cylinder valve is easily accessible. Never exchange the discharge (low pressure) gauge for one of lower pressure. The gauge may rupture if the adjusting knob is unintentionally turned too far.

6. Precautionary Measures

Check diaphragm regulators for creep (leakage of gas from the high pressure side when the low pressure side is turned off). Provide check valves. Gas from a high pressure system may back up, so backpressure protection is needed to prevent damage to a regulator.

7. Removing the Regulator from Service

Close the cylinder valve. Vent the gases in the regulator and/or system, or isolate the system and vent the gases in the regulator by turning the adjusting knob clockwise to make certain that no pressure is trapped inside the regulator. If the gas is flammable, an oxidant, corrosive, or toxic, take appropriate measures to render it innocuous by employing a suitable disposable system before venting the gas to the atmosphere. After relieving all the gas pressure, turn the adjusting knob counterclockwise as far as possible. All low pressure equipment connected to sources of high pressure should be disconnected entirely or, if not, independently vented to the atmosphere as soon as the operation is completed or shut down for an extended period of time. Disconnect the regulator. If the regulator is to remain out of service, protect the inlet and outlet fittings from dirt, contamination, or mechanical damage. Replace the cylinder valve cap.

Section 6. Basic Emergency Action Procedures Involving Gas Cylinders

1. Pre-Emergency Planning

Be prepared. Dealing with compressed gas emergencies begins with planning. An emergency response plan should be developed for the laboratory. The plan should include:

- Emergency telephone numbers
- Emergency response organizational charts
- Emergency procedures
- Listing of key personnel
- Training schedules and documentation
- Hazardous materials lists (including storage locations, quantities, etc.)
- Emergency response equipment lists
- Facility maps

2. Fire Extinguishing Methods

Before working with any flammable material, first notify the Chemical Hygiene Officer about the type of material being handled and the best method to use in fighting that particular kind of fire. If an emergency should occur in which gas

is burning, **stop the flow of gas *before* extinguishing the fire**. If the fire is extinguished before the gas is turned off, an explosive mixture with air may be formed, which could result in more extensive damage. However, if the fire must be extinguished before an immediate shutoff of the gas supply can be accomplished, use carbon dioxide or dry chemical extinguishers. Cool the surrounding area with water spray to prevent ignition of other combustible materials. The possibility of oxidizing gases, nonflammable toxic gases, or nonflammable corrosive gases being present in the area or being involved in a fire is another important safety consideration. Develop procedures to eliminate or minimize the hazards associated with these products.

3. **Handling of Leaking Cylinders**

Most leaks occur at the valve used in the top of the cylinder. Areas that may be involved are:

- Valve threads
- Safety device
- Valve stem
- Valve outlet

If a leak develops, immediately notify the Chemical Hygiene Office and effect emergency action procedures. Never attempt to repair a leak at the valve threads or safety device. Consult the supplier for instructions if the leak is located at the valve stem or valve outlet. **The following general procedures are for leaks of minimum size where the indicated action can be taken without serious exposure to personnel.**

- If a leak develops in a cylinder containing flammables, inerts, or oxidants, ensure that there is adequate ventilation to dissipate the gas. Move the cylinder to an isolated area (away from combustible material if it is a flammable or oxidizing gas) and post signs that describe the hazards and state warnings.
- Some corrosives are also oxidants or flammables, adding to the seriousness of the leak. If the product is corrosive, the leak may increase in size as the gas is released. Move the cylinder to an isolated, well-ventilated area and use suitable means to direct the gas into an appropriate chemical neutralizer. Post signs that describe the hazards and state warnings.
- Follow the same procedure for toxic gases as for corrosive gases. Move the cylinder to an isolated, well-ventilated area and use suitable means to direct the gas into an appropriate chemical neutralizer. Post signs that describe the hazards and state warnings.
- If it is necessary to move a leaking cylinder through populated portions of the building, place a plastic bag, rubber shroud, or similar protection over the top and tape it (preferably with duct tape) to the cylinder to confine the leaking gas. Basic action for large or uncontrollable leaks should include the following steps:
    - Notify the Chemical Hygiene Officer
    - Evacuation of personnel
    - Rescue of injured personnel by crews equipped with adequate protective clothing and breathing apparatus
    - Fire-fighting action
    - Emergency repair
    - Decontamination

Section 7. Cryogenics

The temperature used to distinguish between cryogenics and refrigeration depends on the source to which one is referring. Temperatures as low as -150°C (-238°F) are used as the upper limit for defining a fluid as cryogenic. The most commonly used temperature is -73°C (-100°F).

1. **General Safety Precautions**

Because they are all extremely cold, cryogenic liquids and their cold "boil-off" vapor can rapidly freeze human tissue, and can cause many common materials such as carbon steel, plastics, and rubber to become brittle or even fracture under stress. Care must also be given to the method of joining (welding, etc.) the materials. Cryogenic liquids in containers and piping at temperatures at or below the boiling point of liquefied air (-194°C or -318°F) can actually condense the surrounding air to a liquid. The extremely cold cryogenic fluids (liquid hydrogen and liquid helium) can solidify air or other gases.

All cryogenic liquids produce large volumes of gas when they vaporize. If these liquids are vaporized in a sealed container, they can produce enormous pressures which could rupture the vessel. For this reason, pressurized cryogenic containers are usually protected with multiple devices for pressure relief. Common protective devices are pressure relief valves for primary protection and frangible discs for secondary protection. Vaporization of all liquid cryogenics,

except oxygen, in an enclosed work area can create an oxygen-poor atmosphere. Vaporization of liquid hydrogen in an enclosed work area can create a flammable mixture with air.

Personnel should be thoroughly instructed and trained in the nature of cryogenic hazards and the proper steps to avoid them. This should include emergency procedures, operation of equipment, safety devices, knowledge of the properties of materials used, and personal protective equipment required.

Equipment and systems should be kept scrupulously clean and contaminating materials (oil, grease, etc.) avoided as these may create a hazardous condition upon contact with cryogenic fluids or gases used in the system.

Mixing of gases or liquids should be strictly controlled to prevent the formation of flammable or explosive mixtures. As the primary defense against fire or explosion, extreme care should be taken to avoid contamination of a fuel with an oxidant or contamination of an oxidant with a fuel.

When flammable gases are being used, potential ignition sources must be carefully controlled.

2. **Handling**
   Always handle cryogenic liquids carefully. At their extremely low temperatures, they can produce cryogenic burns on the skin and freeze tissues. When spilled on a surface they tend to cover it completely and therefore cool a large area. The vapors from these liquids are also extremely cold and can produce burns. Use both hands when handling cryogenics. Do not use a cell phone when handling cryogenics or allow yourself to be distracted in any other manner.

   Exposure to these cold gases which is too brief to affect the skin of the face or hands can affect delicate tissues, such as those of the eyes. Stand clear of boiling or splashing liquid and its issuing cold gas. Boiling and splashing always occur when charging a warm container or when inserting objects into the liquid. Always perform these operations slowly to minimize boiling and splashing. Never allow any unprotected part of your body to touch uninsulated pipes or vessels containing cryogenic liquids; the extremely cold material may stick fast and tear the

   flesh when you attempt to withdraw it. Even nonmetallic materials are dangerous to touch at low temperatures. Use tongs to withdraw objects immersed in a cryogenic liquid. In addition to the hazards of frostbite or flesh sticking to cold materials, objects that are soft or pliable at room temperature, such as rubber or plastics, are easily broken because they become hard and brittle at these extremely low temperatures. Carbon steels become brittle at low temperatures and may easily fracture when stressed.

3. **Protective Clothing**
   Chemical splash goggles must be worn during the transfer process and during normal handling of cryogenic liquids. If severe spraying or splashing may occur, a face shield should be worn for additional protection. Dry leather gloves or fiberglass gloves should always be worn when handling anything that comes in contact with cold liquids or vapor. Gloves should be loose fitting so that they can be removed quickly if cryogenic liquids are spilled into them. Depending on the application, special clothing may be advisable. Wear trousers on the outside of shoes. Personnel working with cryogenic fluids should not wear watches, rings, bracelets, and other jewelry.

4. **Containers**
   Cryogenic liquids are stored, shipped, and handled in several types of containers, depending upon the quantity required by the user. The most common containers for laboratory use are the dewar or the liquid cylinder. Since heat leak is always present, vaporization takes place continuously. Rates of vaporization may be as low as 0.4% and as high as 3% of container content per day, depending upon the design of the container and the volume of the stored product. Customized containers must be designed and constructed to withstand the weights and pressures that will be encountered, and adequately ventilated to permit the escape of evaporated gas. They should also be equipped with rupture disks on both inner and outer vessels to release pressure if the safety relief valves should fail. As there is always some gas present when using liquefied gases, container capacity should be designed to include an allowance for that portion which will be in the gaseous state.

   - **Dewars**
     This type of container is considered a nonpressurized container. The unit measure of capacity of the dewar is the liter Five- to 200-liter dewars are available. Product may be removed by pouring from the smaller dewars. Product should be removed from the 50-liter and large capacity dewars by means of low pressurization and a transfer tube. A dust cap over the outlet of the neck tube prevents atmospheric moisture from plugging the neck tube. These containers cannot be used for liquid helium or liquid hydrogen.

Chapter 7. Electrical Safety Guidelines

(with permission from Princeton University)

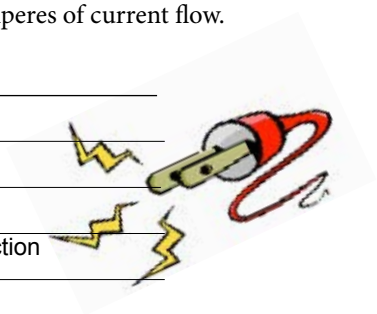
Electrically powered equipment, such as hot plates, stirrers, vacuum pumps, electrophoresis apparatus, lasers, heating mantles, ultrasonicators, power supplies, and microwave ovens are essential elements of many laboratories. These devices can pose a significant hazard to laboratory workers, particularly when mishandled or not maintained. Many laboratory electrical devices have high voltage or high power requirements, carrying even more risk. Large capacitors found in many laser flash lamps and other systems are capable of storing lethal amounts of electrical energy and pose a serious danger even if the power source has been disconnected.

Electrical Hazards

The major hazards associated with electricity are electrical shock and fire. Electrical shock occurs when the body becomes part of the electric circuit, either when an individual comes in contact with both wires of an electrical circuit, one wire of an energized circuit and the ground, or a metallic part that has become energized by contact with an electrical conductor.

The severity and effects of an electrical shock depend on a number of factors, such as the pathway through the body, the amount of current, the length of time of the exposure, and whether the skin is wet or dry. Water is a great conductor of electricity, allowing current to flow more easily in wet conditions and through wet skin. The effect of the shock may range from a slight tingle to severe burns to cardiac arrest. The chart below shows the general relationship between the degree of injury and amount of current for a 60-cycle hand-to-foot path of one second's duration of shock. While reading this chart, keep in mind that most electrical circuits can provide, under normal conditions, up to 20,000 milliamperes of current flow.

Current	Reaction
1 Milliampere	Perception level
5 Milliamperes	Slight shock felt; not painful but disturbing
6-30 Milliamperes	Painful shock; "let-go" range
50-150 Milliamperes	Extreme pain, respiratory arrest, severe muscular contraction
1000-4,300 Milliamperes	Ventricular fibrillation
10,000+ Milliamperes	Cardiac arrest, severe burns and probable death



In addition to the electrical shock hazards, sparks from electrical equipment can serve as an ignition source for flammable or explosive vapors or combustible materials.

Power Loss

Loss of electrical power can create hazardous situations. Flammable or toxic vapors may be released as a chemical warms when a refrigerator or freezer fails. Fume hoods may cease to operate, allowing vapors to be released into the laboratory. If magnetic or mechanical stirrers fail to operate, safe mixing of reagents may be compromised.

Preventing Electrical Hazards

There are various ways of protecting people from the hazards caused by electricity, including insulation, guarding, grounding, and electrical protective devices. Laboratory workers can significantly reduce electrical hazards by following some basic precautions:

- Inspect wiring of equipment before each use. Replace damaged or frayed electrical cords immediately.
- Use safe work practices every time electrical equipment is used.
- Know the location and how to operate shut-off switches and/or circuit breaker panels. Use these devices to shut off equipment in the event of a fire or electrocution.
- Limit the use of extension cords. Use only for temporary operations and then only for short periods of time. In all other cases, request installation of a new electrical outlet.
- Multi-plug adapters must have circuit breakers or fuses.
- Place exposed electrical conductors (such as those sometimes used with electrophoresis devices) behind shields.
- Minimize the potential for water or chemical spills on or near electrical equipment.

Insulation

All electrical cords should have sufficient insulation to prevent direct contact with wires. In a laboratory, it is particularly

important to check all cords before each use, since corrosive chemicals or solvents may erode the insulation.

Damaged cords should be repaired or taken out of service immediately, especially in wet environments such as cold rooms and near water baths.

Guarding
Live parts of electric equipment operating at 50 volts or more (i.e., electrophoresis devices) must be guarded against accidental contact. Plexiglas shields may be used to protect against exposed live parts.

Grounding
Only equipment with three-prong plugs should be used in the laboratory. The third prong provides a path to ground for internal electrical short circuits, thereby protecting the user from a potential electrical shock.

Circuit Protection Devices
Circuit protection devices are designed to automatically limit or shut off the flow of electricity in the event of a ground-fault, overload or short circuit in the wiring system. Ground-fault circuit interrupters, circuit breakers and fuses are three well-known examples of such devices.

Fuses and circuit breakers prevent over-heating of wires and components that might otherwise create fire hazards. They disconnect the circuit when it becomes overloaded. This overload protection is very useful for equipment that is left on for extended periods of time.

The ground-fault circuit interrupter, or GFCI, is designed to shut off electric power if a ground fault is detected, protecting the user from a potential electrical shock. The GFCI is particularly useful near sinks and wet locations. Since GFCIs can cause equipment to shut down unexpectedly, they may not be appropriate for certain apparatus.

Motors
In laboratories where volatile flammable materials are used, motor-driven electrical equipment should be equipped with non-sparking induction motors or air motors. These motors must meet National Electric Safety Code Class 1, Division 2, Group C-D explosion resistance specifications. Many stirrers, Variacs, outlet strips, ovens, heat tape, hot plates and heat guns do not conform to these code requirements.

Avoid series-wound motors, such as those generally found in some vacuum pumps, rotary evaporators and stirrers. Series- wound motors are also usually found in household appliances such as blenders, mixers, vacuum cleaners and power drills. These appliances should not be used unless flammable vapors are adequately controlled.

Safe Work Practices

The following practices may reduce risk of injury or fire when working with electrical equipment:

- Avoid contact with energized electrical circuits.
- Use guarding around exposed circuits and sources of live electricity.
- Disconnect the power source before servicing or repairing electrical equipment.
- When it is necessary to handle equipment that is plugged in, be sure hands are dry and, when possible, wear nonconductive gloves and shoes with insulated soles.
- If it is safe to do so, work with only one hand, keeping the other hand at your side or in your pocket, away from all conductive material. This precaution reduces the likelihood of accidents that result in current passing through the chest cavity.
- Minimize the use of electrical equipment in cold rooms or other areas where condensation is likely. If equipment must be used in such areas, mount the equipment on a wall or vertical panel.
- If water or a chemical is spilled onto equipment, shut off power at the main switch or circuit breaker and unplug the equipment.
- If an individual comes in contact with a live electrical conductor, do not touch the equipment, cord or person. Disconnect the power source from the circuit breaker. Call 911.

High Voltage or Current

Repairs of high voltage or high current equipment should be performed only by trained electricians.

Altering Building Wiring and Utilities

Any proposed modifications to existing electrical service in a laboratory or building must be approved by Facilities Management personnel.

Chapter 8. Laser Safety Program

West Virginia University Laser Safety Program

http://wecan.wvu.edu/sustainability/health_and_safety

Revised July 16, 2010

I. Statement, Purpose, and Scope

A. Statement: The University is committed to providing a safe and healthful workplace; this includes evaluating and taking action to prevent laser related exposures.

B. Purpose: To establish written procedures to evaluate laser exposures in compliance with OSHA Technical Manual Section III, Chapter 6.

C. Scope: This program covers all University employees working in areas where lasers are present.

II. Responsible Parties

A. Environmental Health Safety

1. Conduct an annual evaluation of the laser safety program.
2. Provide technical guidance to laser operators regarding hazard control.
3. Assist the Principal Investigator in assuring regulatory compliance and in evaluating and controlling hazards.
4. Recommend proper personal protective equipment (PPE) in consultation with the Principal Investigator (PI) and the Laser Safety Liaison.

B. Department

1. Dean/Director/Chairperson
   a. Ensure that all employees under their direction follow the applicable requirements and safe practices of this laser safety program including those specified in applicable standard operating procedures developed by each department.
   b. Appoint a Laser Safety Liaison.
   c. Procure appropriate PPE and signage.

2. Laser Safety Liaison
   a. Maintain compliance with the OSHA Technical Manual, Section III, Chapter 6, entitled "Laser Hazards".
   b. Maintain an inventory list of all lasers, classify or verify classification of lasers and laser systems used at WVU facilities.
   c. Carry out periodic safety inspections, and evaluate hazards of laser work areas.
   d. Assure the prescribed control measures are in effect, recommending or approving alternate control measures as necessary, periodically auditing the control measures in use.
   e. Approve standard operating procedures, alignment procedures, and other procedures that may be part of the requirement for administrative and procedural control measures.
   f. Recommend protective equipment, including eye wear, clothing, and barriers.
   g. Approve the wording on area signs and equipment labels.
   h. Shall approve laser installation and modification of facilities and laser equipment prior to use.
   i. Assure that adequate safety education and training is provided to laser area personnel as per the OSHA Technical Manual.
   j. Investigate any accident resulting from laser use.
   k. Provide copies to EHS of all inventories and inspections.
   l. Notify EHS of any incidents.
   m. Schedule eye examinations for employees utilizing lasers as needed.

3. Principal Investigator
   a. Knowledgeable of and utilize the OSHA Technical Manual for laser safety, hazard identification, training, etc.
   b. Develop standard operating procedures for the safe operation, alignment and maintenance of class II, III, and IV lasers under his/her control as per the OSHA Technical Manual.
   c. Validate that persons working in the area have received proper training in laser safety and other applicable safety classes.

d. Assure Laser Safety Liaison is aware of employees who need eye examinations.
e. Ensure the safe operation of lasers in the assigned area.
f. Ensure all individuals, including outside service contractors, understand the hazards associated with lasers and comply with all safety requirements.
g. Inform Liaison of installation or modification of laser prior to use.
h. Provide personal protective equipment and ensure that it is used properly.
i. Report any incident involving laser use to the Laser Safety Liaison.
j. Provide the Laser Safety Liaison an annual inventory of all lasers under their control.
k. Allow inspections of lasers and laser facilities upon request of the Laser Safety Liaison.
l. Notify the Laser Safety Liaison prior to any change in the laser West Virginia University or facility arrangement that affects the safety of personnel or property.

4. Users
   a. Comply with safety rules and regulations.
   b. Report any incident involving lasers to their supervisor.
   c. Attend laser safety training.
   d. Inform the Principle Investigator assigned to their area of any departure from established practices.
   e. Report any laser exposures to the Principal Investigator and seek medical help as needed.

5. Occupational Medicine
   a. Perform baseline eye examinations for individuals working with lasers.
   b. Notify EHS of all baseline examinations and post-incident evaluations.

III. Laser Safety-Related Medical Surveillance

It is recommended that ALL individuals working with Class III and Class IV lasers have a baseline eye exam prior to the use or operation. Contact EHS at 304-293-3792 for information on how to accomplish this.

IV. Laser Safety Practices

Information on Laser Safety Practices can be found in the OSHA Technical Manual http://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_6.html

Chapter 9. Vacuum Safety Guidelines

(with permission from Princeton University)

Working with materials or equipment at high or low pressures requires planning and special precautions. Procedures should be implemented to protect against explosion or implosion through appropriate equipment selection and the use of safety shields. Care should be taken to select apparatuses that can safely withstand designated pressure extremes.

High Pressure Vessels

- High-pressure operations should be performed only in pressure vessels appropriately selected for the operation, properly labeled and installed, and protected by pressure-relief and necessary control devices.
- Vessels must be strong enough to withstand the stresses encountered at the intended operating temperatures and pressures and must not corrode or otherwise react when in contact with the materials they contain.
- Systems designed for use at elevated temperatures should be equipped with a positive temperature controller. Manual temperature control using a simple variable autotransformer, such as a Variac, should be avoided. The use of a back-up temperature controller capable of shutting the system down is strongly recommended.
- All pressure equipment should be inspected and tested at intervals determined by the severity of the equipment's usage. Visual inspections should be accomplished before each use.

Vacuum Apparatus

Vacuum work can result in an implosion and the possible hazards of flying glass, splattering chemicals and fire. All vacuum operations must be set up and operated with careful consideration of the potential risks. Equipment at reduced pressure is especially prone to rapid pressure. Such conditions can force liquids through an apparatus, sometimes with undesirable consequences.

- Personal protective equipment, such as safety glasses or chemical goggles, face shields, and/or an explosion shield should be used to protect against the hazards of vacuum procedures, and the procedure should be carried out inside a hood.
- Do not allow water, solvents and corrosive gases to be drawn into vacuum systems. Protect pumps with cold traps and vent their exhaust into an exhaust hood.
- Assemble vacuum apparatus in a manner that avoids strain, particularly to the neck of the flask.
- Avoid putting pressure on a vacuum line to prevent stopcocks from popping out or glass apparatus from exploding.
- Place vacuum apparatus in such a way that the possibility of being accidentally hit is minimized. If necessary, place transparent plastic around it to prevent injury from flying glass in case of an explosion.
- When possible, avoid using mechanical vacuum pumps for distillation or concentration operations using large quantities of volatile materials. A water aspirator or steam aspirator is preferred. This is particularly important when large quantities of volatile materials are involved.

Vacuum Trapping

The vacuum trap:

- protects the pump and the piping from the potentially damaging effects of the material
- protects people who must work on the vacuum lines or system, and
- prevents vapors and related odors from being emitted back into the laboratory or system exhaust.

There have been incidents at Princeton University where improper trapping caused vapor to be emitted from the exhaust of the house vacuum system, resulting in either re-entry into the building or potential exposure to maintenance workers. Unfortunately, this type of incident is not the worst that can happen. In 2001, at the University of California-Davis, two plumbers were injured when a house vacuum line burst after one of the plumbers attempted to solder a fitting on the copper line. Results of analysis found evidence of copper perchlorate (an oxidizer) and acetate, which created an explosive mixture upon heating by the torch.

Proper Trapping Techniques

To prevent contamination, all lines leading from experimental apparatus to the vacuum source should be equipped with filtration or other trapping as appropriate.

- For particulates, use filtration capable of efficiently trapping the particles in the size range being generated.

- For most aqueous or non-volatile liquids, a filter flask at room temperature is adequate to prevent liquids from getting to the vacuum source.
- For solvents and other volatile liquids, use a cold trap of sufficient size and cold enough to condense vapors generated, followed by a filter flask capable of collecting fluid that could be aspirated out of the cold trap.
- For highly reactive, corrosive or toxic gases, use a sorbent canister or scrubbing device capable of trapping the gas.

Cold Traps
For most volatile liquids, a cold trap using a slush of dry ice and either isopropanol or ethanol is sufficient (to -78 deg. C). Avoid using acetone. Ethanol and isopropanol are cheaper and less likely to foam.

Liquid nitrogen may only be used with sealed or evacuated equipment, and then only with extreme caution. If the system is opened while the cooling bath is still in contact with the trap, oxygen may condense from the atmosphere and react vigorously with any organic material present.

Glass Vessels

Although glass vessels are frequently used in pressure and vacuum systems, they can explode or implode violently, either spontaneously from stress failure or from an accidental blow.

- Conduct pressure and vacuum operations in glass vessels behind adequate shielding.
- Ensure the glass vessel is designed for the intended operation.
- Carefully check glass vessels for star cracks, scratches or etching marks before each use. Cracks can increase the likelihood of breakage or may allow chemicals to leak into the vessel.
- Seal glass centrifuge tubes with rubber stoppers clamped in place. Wrap the vessel with friction tape and shield with a metal screen. Alternatively, wrap with friction tape and surround the vessel with multiple layers of loose cloth, then clamp behind a safety shield.
- Glass tubes with high-pressure sealers should be no more than 3/4 full.
- Sealed bottles and tubes of flammable materials should be wrapped in cloth, placed behind a safety shield, then cooled slowly, first with an ice bath, then with dry ice.
- Never rely on corks, rubber stoppers or plastic tubing as pressure-relief devices.
- Glass vacuum dessicators should be made of Pyrex or similar glass and wrapped partially with friction tape to guard against flying glass. Plastic dessicators are a good alternative to glass, but still require shielding.
- Never carry or move an evacuated dessicator.

Dewar Flasks

Dewar flasks are under vacuum to provide insulation and can collapse from thermal shock or slight mechanical shock.

- Shield flasks with friction tape or enclose in a wooden or metal container to reduce the risk of flying glass.
- Use metal flasks if there is a significant possibility of breakage.
- Styrofoam buckets offer a short-term alternative to dewar flasks.

Rotovaps

Rotovaps can implode under certain conditions. Since some Rotovaps contain components made of glass, this can be a serious hazard.

Working with hazardous chemicals at high or low pressures requires planning and special precautions. Procedures should be implemented to protect against explosion or implosion through appropriate equipment selection and the use of safety shields. Care should be taken to select glass apparatus that can safely withstand designated pressure extremes.

Chapter 10. WVU Biological Safety Program

The Biosafety Division of the WVU Department of Environmental Health and Safety oversees all work that involves samples of biological origin.

Section 1. WVU Institutional Biosafety Committee

The Institutional Biosafety Committee (IBC) at West Virginia University oversees all activities which pose a biohazard. Biosafety approval is required for the following activities:

- Activities involving infectious agents of plants, animals and humans
- The use of serum and/or tissue from humans or non-human primates
- Any work involving wild mammals or their tissue
- Creation of transgenic eucaryotes
- Transfection using adenovirus-derived vectors or other vectors capable of infecting human cells.

To register your research with the WVU IBC, ask questions regarding biological safety, or if you have questions regarding the approval of your submitted IBC protocol at West Virginia University you should contact the WVU Biosafety Officer at (304) 293-7157.

WVU Biosafety Website: http://ehs.wvu.edu/biosafety

Section 2. General Procedures

Individuals working with biohazards will:

- Follow the requirements of applicable research protocol, SOP, and this Laboratory Safety Manual.
- Institute biosafety measures consistent with U.S. Department of Health and Human Services, "Biosafety in Microbiological and Biomedical Laboratories", most current edition, Public Health Service, Centers for Disease Control and Prevention and National Institutes of Health, Washington, DC.
- Control access to laboratories and field research areas.
- Follow the applicable exposure control plan when the potential for exposure to bloodborne pathogens and other potentially infectious materials exists.
- Ensure that procured items are purchased from qualified suppliers and that items are inspected or certified upon receipt.
- Employees shall wash hands immediately after removing gloves or coming in contact with human or animal blood or other potentially infectious materials.
- Employees must not eat, drink, smoke, apply cosmetics, use cell phones, or handle contact lenses in areas of potential exposure. Equipment that may have been contaminated with human or animal blood or other infectious materials shall be examined and decontaminated, if feasible. If equipment cannot be decontaminated, it shall be labeled as a biohazard. Information regarding the biohazard shall be communicated to all handling, shipping, and service personnel.

Section 3. Engineering and Work Practice Controls

Drawing blood or collecting urine samples for private reasons (i.e., life insurance policies) is prohibited on WVU property. Engineering and work practice controls designed to eliminate or minimize worker exposure shall be implemented. Engineering controls that are used shall be examined, maintained, and replaced on a regular schedule to ensure their effectiveness. Examples of engineering controls include the use of a sharps disposal container and use of a container specially marked for contaminated first-aid materials. Hand-washing facilities shall be provided on each site. If hand-washing facilities are not available, antiseptic hand cleansers or towelettes must be used immediately, followed by soap and running water as soon as possible

Section 4. Personal Protective Equipment (PPE)

Use PPE that does not permit human or animal blood or other potentially infectious materials to reach employees' clothes or body under normal conditions and duration of use. Provide, maintain, and properly dispose PPE at each work area and place it in a regulated container for disposal. Gloves (i.e., latex and/or puncture-resistant gloves) must be worn when exposure to animal, human, or other potentially infectious materials is expected and when contaminated items or surfaces are being handled.

Do not reuse disposable gloves. Replace if torn or punctured or their ability to function as a barrier has been compromised. Wear surgical masks, in combination with eye protection (i.e., chemical splash goggles) when splashes may contaminate eyes, nose, or mouth.

Section 5. Housekeeping and Labeling

Clean and decontaminate all equipment and environmental surfaces after contact with animal, human, or other potentially infectious materials. Place regulated waste in containers that have lids that can be tightly closed, that are constructed to prevent leaks, and that are labeled with biohazard labels and sealed before moving. Dispose of all contaminated laundry as regulated waste or send to a laundry facility where personnel are experienced in handling infectious waste. Complete information regarding the nature of the waste and potential hazards shall be disclosed to the laundry facility.

Label all regulated waste with the "Biohazard" label. Label infectious waste containers with appropriate WVU labels for infectious wastes. Biohazard labels can be obtained by contacting the WVU Biosafety Office at 304- 293-7157.

Section 6. Biosafety Information and Bloodborne Pathogen Training

Annual training shall be provided for those working with biohazards by lab supervisors and/or university personnel from the Biosafety Office (304) 293-7157. The Bloodborne Pathogen training information can be found at: http://ehs.wvu.edu/biosafety/bl

The Bloodborne Pathogen Training shall include the following:

- An accessible copy of OSHA regulation 29 CFR 1910.1030 and explanation of its contents.
- A general explanation of the epidemiology and symptoms of bloodborne diseases.
- An explanation of the modes of transmission of bloodborne pathogens.
- An explanation of the Exposure Control Plan and the means by which an employee can obtain a copy of the written plan.
- An explanation of the required methods for recognizing tasks and other activities that may involve exposure to animal, human, and other potentially infectious materials.
- An explanation of the use and limitations of methods that prevent or reduce exposure, including appropriate engineering controls, work practices, and PPE.
- An opportunity for posing questions to and receiving answers from the person conducting the training session.

Section 7. Useful Biological Safety Web Sites

Biosafety in Microbiological and Biomedical Laboratories (BMBL): http://www.cdc.gov/biosafety/publications/bmbl5/

West Virginia University Institutional Biohazards Committee (IBC): http://ehs.wvu.edu/biosafety/institutional-biosafety-committee-ibc-qas

For information on Human Immune Deficiency Virus (HIV), Hepatitis B Virus (HBV), and Hepatitis C Virus (HCV): http://www.cdc.gov/hiv/pubs/facts.htm http://www.cdc.gov/ncidod/diseases/hepatitis/index.htm

National Institutes of Health "Guidelines for Research Involving Recombinant DNA Molecules": http://osp.od.nih.gov/office-biotechnology-activities/biosafety/nih-guidelines

Chapter 11. Radiation Safety Program

Section 1. WVU Radiation Safety Office

The WVU Radiation Safety Department, along with members of the Radiological Safety Committee and its subcommittees, are committed to the ongoing development and implementation of the current radiation safety program that includes WVU Campuses, the Robert C. Byrd Health Sciences Center, Jefferson Medical Center, WVU Hospitals Inc., and Blanchette Rockefeller Neurosciences Institute.

All research activities involving the use of radioactive materials, radiation producing devices, and the diagnostic and therapeutic use of radiation in humans, non-humans, and animals is overseen by the Radiation Safety Department and the committees. In managing this program, the Radiation Safety Department will provide guidance and enforcement to guarantee a safe working environment for all individuals working with radioactive materials or devices located within these facilities.

The WVU Radiation Safety Officer (RSO), with regard to US Nuclear Regulatory Commission (U.S. NRC) regulation, has been granted sufficient authority, organizational freedom and management prerogative by the institution to identify all radiation safety problems, initiate or provide corrective actions in order to stop unsafe operations, and suspend any operation that is found to cause an excessive radiation hazard as rapidly and safely as possible in carrying out his/her duties.

All responsibilities of the Radiation Safety Officer (RSO) are carried out under the direct supervision of the WVU Provost, President of WVU Hospitals, Vice President for Health Science Center, and the University's Chief Executive Official, who has federal licensing authorities. It is also the responsibility of the WVU Radiation Safety Officer (RSO) to provide timely reports to the U.S. NRC and the West Virginia Radiological Health Program (WV RHP) as appropriate and required by regulation.

The responsibilities of the Radiation Safety Officer and the Radiation Safety Department include the following:

- To furnish consulting services to any potential user of ionizing radiation and to advise the potential user on radiation safety procedures.
- To ensure that all license obligations and regulations of the federal and state government are met.
- To provide general surveillance of all health physics activities, including assisting all personnel in discharging their responsibilities.
- To supervise the procurement and receipt of all radioactive materials coming to the university and the hospital.
- To provide for individual and laboratory monitoring.
- To instruct university and hospital personnel in radiation safety.
- To administer a radioactive waste disposal program.
- To perform leak tests on sealed sources and provide radiation surveys after installation of radiation producing machines.
- To supervise decontamination in case of accidents.
- To provide a continuous program of environmental radiation hazard evaluation and hazard elimination.
- To provide advice and assistance in the acquisition of dosimeters and monitoring equipment.
- To provide maintenance and calibration of survey instruments in the Radiation Safety Department.
- To maintain all centralized records pertinent to the radiation safety program.
- To develop and refine radiation detection, shielding and health protection techniques.
- To be responsible for the overall day-to-day administration of the radiation safety program.
- To suspend any operation causing excessive radiation hazard as rapidly and safely as possible. (In carrying out this duty the Radiation Safety Officer will report directly to the President of the hospital or the Provost of the university or the Chair of the Radiological Safety Committee).
- To present periodic reports to the various committees on matters related to their functions.
- To keep each department chair informed of all Authorized Users in the department who are conducting projects approved by a radiation safety committee.
- To provide timely reports to the U.S. Nuclear Regulatory Commission and the West Virginia Department of Health as required by regulation.
- To maintain an inventory and accountability record of the radioactive material used at the university and the hospital to ensure compliance with license limits.

The WVU Radiation Safety Manual contains useful information about radiation safety at WVU and can be found at http://www.hsc.wvu.edu/rsafety/Radiation-Safety-Manual

WVU Radiation Safety Manual (RSM)

Table of Contents

Radiation Safety Hours

Normal business hours are Monday - Friday, 8:00 a.m. to 4:30 p.m. You can contact the Radiation Safety Department at (304) 293-3413 or by fax at (304) 293-4529. After hours, weekends, holidays, and in an emergency, you can page (304) 987-1586 for immediate assistance.

Section 2. Radiation Safety – Emergency Procedures

(from Chapter 13- WVU Radiation Safety Manual for WVU)

An accident may happen to even the most careful of workers, and any worker may be called upon to assist in the case of a spill, a contamination incident, or an emergency. Be prepared and know how to respond before an incident happens.

The following procedures provide an overview of who to notify and how to respond to several different types of incidents. Emergency Response Guidelines books which list incident contact phone numbers and procedures are posted near a telephone in every lab.

Who To Notify

Incident

An incident can be readily handled with laboratory or other University resources and may include a spill of radioactive materials, an incident of personal contamination or a possible exposure to an x-ray source.

During normal working hours, call The Radiation Safety Department (RSD) 304-293- 3413 Outside normal working hours, page Radiation Safety on call pager 304-987-1586

Fire, explosion or serious injury:

First, call Public Safety at 911 anytime.
Second, during normal working hours, call RSD at 304-293-3413.
Third, contact any Laboratory or Departmental Emergency contacts listed on the entry door.

Spill Occurs or Contamination is found

1. Notify other persons in the area of the spill.
2. Evacuate if spill is of a volatile material.
3. Immediately remove contaminated shoes or clothing.

4. Mark the spill area and limit access to avoid the inadvertent spread of contamination.
5. Flush contaminated skin thoroughly with water.
6. Remediate small spills and contaminated areas by:
    a. Put on protective gloves and lab coat. Use shoe covers if floor is contaminated.
    b. Drop absorbent paper on a liquid spill.
    c. Dampen a dry spill; take care not to spread the contamination
    d. Dispose absorbent papers into Radioactive Waste containers.
    e. Survey area either by GM survey meter and Gamma Well or Liquid Scintillation wipe test, depending on the isotope, to ensure that all contamination has been removed.
7. If the spill is too large to remediate on your own call RSD immediately for assistance.

For Skin and Body Contamination

1. Notify RSD immediately whenever any case of skin or body contamination occurs.
2. Note the original survey meter reading, the location of the contaminated area and the time of the contamination was discovered. RSD will use this information to calculate dose.
3. Wash skin using mild soap and warm water for 2-3 minutes. Do not abrade skin or use hot water.
4. Measure and record the count rate after the initial attempt at decontamination. Survey and repeat decontamination until the count rate cannot be reduced any further.
5. If the skin becomes irritated, discontinue decontamination.
6. When decontamination efforts are not immediately successful, often a substantial reduction in count rate is achieved during the next 24 hours with periodic washings with soap and water, combined with normal flaking of the skin.

Serious Injury with Radioactive Contamination

Serious injury and life-or-death situations always take priority over radiological concerns. In all cases of physical injury, even minor injuries, medical attention and hospitalization take precedence over contamination concerns. There are no radiation sources at the University that produce contamination and radiation exposure risks large enough to prevent first aid from being given.

1. Follow the Fire, Explosion & Serious Injury notification procedure. Public Safety responders are trained to provide first aid.
2. If possible, have someone meet emergency response personnel and escort them to the accident scene.
3. Remove contaminated items and clothing from the victim only if these actions will cause no further harm.
4. If time permits, attempt to provide an uncontaminated pathway for the emergency crew.
5. Have someone who can provide useful additional information accompany the victim to the emergency room.

Possible Overexposure to Sources of Radiation

The most likely scenario for a serious overexposure to radiation involves exposure to the primary beam of an x-ray diffractometer or to a high activity sealed source. In any case, notify RSD, who will provide additional instructions, based on the exposure conditions.

Section 3. Useful Radiation Safety Web Sites

WVU Radiation Safety Office Web Site: http://www.hsc.wvu.edu/rsafety/

Nuclear Regulatory Commission: http://www.nrc.gov/

U.S. Environmental Protection Agency-Radiation: http://www.epa.gov/radiation/

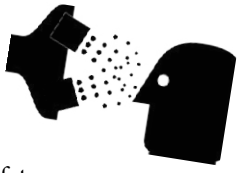
Chapter 12. Emergency Preparedness

Section 1. Fire Alarm Policy

When a fire alarm sounds in the facility, you must evacuate the laboratory immediately via the nearest exit. Extinguish all flames and turn off all equipment, as appropriate, before exiting. Faculty and teaching assistants must ensure the orderly and expeditious evacuation of the students from the classrooms and laboratories. Personnel who violate this fire alarm policy will be subject to citations and/or arrest by the responding university and city officials.

Section 2. Emergency Safety Equipment

1. A written emergency action plan should be developed and communicated to all personnel in the unit. The plan should include procedures for evacuation, ventilation failure, first-aid, and incident reporting.
2. Fire extinguishers will be made available in the laboratory and will be tested on a regular basis by Facilities Management personnel. If you activate a fire extinguisher for any reason, immediately report the activity to the Chemical Hygiene Officer so that the fire extinguisher will be replaced in a timely manner.
3. Eye wash stations will be made available and inspected on a regular basis by trained personnel.



4. Safety showers will be made available and tested routinely by trained personnel.
5. Fire blankets will be made available in the laboratory, as required. Fire blankets are used to wrap a burn victim to douse the flames. They are also useful to cover a shock victim and for warmth and to provide a privacy shield when treating a victim under a safety shower in the event of a chemical spill.
6. Access to fire alarms and telephones will be made available for emergency use.
7. Maintain clear pathways to fire extinguishers, eyewash stations, fire blankets, first-aid kits, and safety showers.

Section 3. Chemical Spill Policy

Laboratory personnel should be familiar with the chemical, physical, and toxicological properties of each hazardous substance in the laboratory. Consult the label and the Safety Data Sheet prior to the initial use of each hazardous substance. Personal protective equipment should be used that is appropriate to the degree of hazard of the chemical in use. Always use the minimal amount of the chemical and use caution when transporting the chemical. In the event of an accidental chemical release or spill, personnel should refer to the following general guidelines. Consult the Chemical Hygiene Officer if you should have any questions regarding the following guidelines.

Low flammability and low toxicity materials that are not volatile (e.g., inorganic acids and caustic bases)

1. Decontaminate any victims with the nearest safety shower, eyewash, or other appropriate action as described in the Safety Data Sheet.
2. Immediately notify the Chemical Hygiene Officer.
3. Wear personal protective equipment that is appropriate to the degree of hazard of the spilled substance.
4. Using chemical spill kits that contain an inert absorbent, clean up the affected area if this action can be accomplished without risk of additional injury or contamination to personnel. If the spill is located on the laboratory floor, be aware that some absorbents can create a slipping hazard.
5. Dispose of contaminated materials according to departmental policy.
6. Complete an incident report and submit it to the Chemical Hygiene Officer.

Flammable solvents of low toxicity (e.g., diethyl ether and tetrahydrofuran)

1. Decontaminate any victims with the nearest safety shower, eyewash, or other appropriate action as described in the Safety Data Sheet.
2. Alert all other workers in the laboratory and the general vicinity of the spill.
3. Extinguish all flames and turn off any spark-producing equipment. If necessary, turn off the power to the laboratory at the circuit breaker. However, the ventilation system must remain operational.
4. Immediately notify Chemical Hygiene Officer.
5. Wear personal protective equipment that is appropriate to the degree of hazard of the spilled substance.
6. Using spill pillows or spill absorbent and non-sparking tools, soak up the solvent as quickly as possible. Be sure to soak up chemicals that have seeped under equipment and other objects in the laboratory. If the spill is located on the

laboratory floor, be aware that some absorbents can create a slipping hazard.
7. Dispose of contaminated materials according to departmental policy.
8. Complete an incident report and submit it to the Chemical Hygiene Officer.

Highly toxic materials (e.g., dimethylmercury and hydrofluoric acid)

1. Alert all other workers in the laboratory and the general vicinity of the spill and immediately evacuate the area.
2. Decontaminate any victims with a safety shower or eyewash in a safe location. Take other appropriate decontamination action as described in the Safety Data Sheet.
3. Immediately notify the Chemical Hygiene Officer.
4. Do not attempt to clean up the spill. EHS personnel will evaluate the hazards that are involved with the spill and will take the appropriate actions.
5. Only EHS personnel and appropriate outside industrial hygienists are authorized to decontaminate the area and dispose of the contaminated waste.
6. Complete an incident report and submit it to the Chemical Hygiene Officer.

Section 4. WVU First Aid Kit Requirements (WVU Department of EHS)

This information pertains to the content, placement, and usage of first aid kits in all West Virginia University buildings and facilities. References to activating EMS by dialing 911 may have different applicability throughout the state. Each campus or office is responsible to determine their local emergency response agency and identify the appropriate contact information. Some important information must be noted in order to properly maintain a first aid kit in any West Virginia University facility.

- Any department or administrative unit of West Virginia University may maintain a first aid kit.
- It is not necessary to be First Aid/CPR certified to use first aid kits.
- Units that do require First Aid/CPR responders must comply with the OSHA Bloodborne Pathogen standard (CFR 1910.1030).
- The locations of first aid kits shall be clearly marked so that those who need to locate them may do so quickly and easily.
- All employees should be informed regarding the availability and location of any first aid kits and supplies.
- It should be noted that departments or administrative units at West Virginia University shall not provide or maintain any form of medication (oral, topical, inhaled, prescription or non-prescription) in first aid kits for use by any individual.
- First aid kits are strictly intended to allow persons to treat themselves and/or others for minor medical incidents, not to replace the professional EMS services.
- Any medical emergency which involves loss of consciousness, profuse bleeding, possible broken bones, head or neck injuries, serious burns, cardiovascular distress, or any other serious injury or illness should immediately be referred to the EMS system by dialing 911.
- The contents of each first aid kit should be inventoried at least quarterly (every 3 months) and restocked in a timely fashion.

Contents of First Aid Kits

First aid kits may be created based on individual organizational needs. Supplies may be purchased through normal West Virginia University purchasing procedures. Many vendors provide pre-packaged first aid kits which may be tailored to meet individual needs. If pre-packaged kits contain any oral or topical substance, these substances shall be removed from the kits and appropriately destroyed/disposed.

Appropriate supplies and equipment which may be purchased and maintained in University-funded first aid kits may include, but are not limited to:

- Adhesive bandages (Band-aids)
- Bandage scissors
- Blanket
- Cotton
- Gauze pads (4” x 4”), (3” x 3”)
- Ice packs (chemical) (or use Ziploc bags if ice is available)
- Medical gloves
- 1” Medical tape

- Moist towelettes
- Roller gauze (1”-3” available)
- Triangular bandages
- Elastic bandages (Ace wrap)
- Gauze bandages (self-adhering)

As part of the EMS system, early first aid can play a critical role in the reduction of death and disability. Any person or persons administering first aid should work cooperatively with the ambulance service EMT and EMT- Paramedics if such services are required as a result of a given emergency. Those involved in providing such care should identify themselves to the responding ambulance service and briefly describe the situation and the aid given.

Exceptions

This information is not intended to cover situations in which West Virginia University employs or uses personnel with specific education, certification and/or licensure to deliver emergency care. Quick responders such as EMT, EMT-Paramedics, Registered Nurses and other health care professionals should have available all supplies and equipment which they have been authorized to use by virtue of their specific training or medical protocols.

Section 5. Accident Procedures

In the event of an accident/incident, immediately notify the Chemical Hygiene Officer. Following the incident, the employee must complete a Supervisor’s Injury/Illness Report (included in Appendix D) and submit it to the Chemical Hygiene Officer. Provide a copy of the appropriate SDS to the attending physician, as needed.

Cuts: If the injured person has experienced a minor cut, flush the wound with tepid running water to remove any possible chemical contaminants. If there is a cut on a gloved hand, remove the glove after thoroughly washing the affected area to avoid contamination of the cut with chemicals. Apply a bandage and advise the victim that he or she should report any signs of infection to a physician. If there is a possibility that the wound is contaminated by broken glass or chemicals, the victim should seek immediate medical attention.

If the injured person has experienced a more serious injury (if sutures will be necessary) call 911 and apply sterile gauze pads to the wound. If necessary, apply direct pressure to the wound to stop the bleeding. Apply additional pads if the blood soaks through the first sterile pad. If bleeding continues, encourage the victim to lie down and elevate the wound area to a position above the victim’s heart. If you are unable to stop the bleeding, remain calm and carefully explain the situation to the dispatcher at 911. The dispatcher will advise you on further action.

Thermal Burns: Do not apply ointments or ice to the wound. For first-degree wounds, flush with copious amounts of tepid running water. Apply a dressing and bandage loosely.

For second degree (with open blisters) and third degree burns, do not flush with water. Apply a dry dressing and bandage loosely. Immediately seek medical attention.

HF Exposure: Hydrofluoric acid (HF) is an extremely corrosive liquid that can cause severe injury via skin and eye contact, inhalation, and ingestion. HF readily penetrates the skin and causes decalcification of the bones. Laboratory workers should be familiar with first-aid procedures for HF exposure before beginning work with HF. Calcium gluconate gel (2.5% w/w) must be readily accessible in work areas where any potential HF exposure exists. In the event of any contact with HF, first-aid must be started within seconds. In the event of an HF exposure on skin, immediately flush the exposed area with tepid water, remove contaminated clothing, and call 911. Wearing nitrile gloves, apply the calcium gluconate gel after 5 minutes of flushing with water. If the calcium gluconate gel is unavailable, continue flushing the exposed areas with water until medical assistance arrives. If HF is splashed in the eyes, immediately call 911. Flush the eyes for 15 minutes, holding the eyelids apart. If ingested, call 911 immediately. If the vapor is inhaled, move the victim to fresh air and call 911. All persons who are exposed to HF must be evaluated by a medical professional.

Chemical Burns: Immediately flush the area with tepid running water for 15 minutes. Place the victim in the safety shower, if necessary, before removing any jewelry, contaminated clothing, and shoes. Do not apply ointments, baking soda, ice, or gauze coverings to the wound.

Seek immediate medical attention.

Eye Contact: Flush eyes with tepid water for 15 minutes and seek immediate medical attention.

Ingestion: **DO NOT WASTE TIME.** Call 911. Do not encourage vomiting except under the advice of a physician. **Call the Poison Control Center immediately and consult the SDS for the appropriate action.**

POISON CONTROL CENTER: 1-800-222-1222

Save all chemical containers and a small amount of vomitus, if possible, for analysis. Stay with the victim until emergency medical assistance arrives.

Unconsciousness: Call 911. If it is safe for you to enter the area, place the victim on his or her back and cover with a blanket. Do not attempt to remove the victim from the area unless there exists an immediate danger. Clear the area of any chemical spills or broken glassware. If the victim begins to vomit, turn the head so that the stomach contents are not aspirated into the lungs.

Convulsions: Call 911. If it is safe for you to enter the area, remove anything that might cause harm to the victim. Clear the area of any chemical spills or broken glassware. If the victim begins to vomit, turn the head so that the stomach contents are not aspirated into the lungs. Try to protect the victim from further danger with as little interference as possible.

First Aid for Cold Burns: Tissue contact with cryogenic liquids produces damage similar to that associated with thermal burns and causes severe deep freezing with extensive destruction of tissue. Flush affected areas with large volumes of tepid water (41-46 °C [105-115°F]) to reduce freezing. If it is not in the area involved, loosen any clothing which may restrict circulation. Do not apply heat. Cover the affected area with a sterile protective dressing or with clean sheets if the area is large, and protect the area from further injury. Seek medical attention promptly. Note that frozen tissues are painless and appear waxy with a pallid yellow color. Tissues become painful and edematous upon thawing and the pale color turns to pink or red as circulation of blood is restored. Tissues which have been frozen show severe, widespread cellular injury and are highly susceptible toinfections and additional trauma. Therefore, rapid rewarming of tissues in the field is not recommended if transportation to a medical facility will be delayed.

Chapter 13. Glossary of Terms and Safety References

Glossary of Terms

Section 1. Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
ATSDR	Agency for Toxic Substances and Disease Registry
BEI	Biological Exposure Indexes
CAA	Clean Air Act
CAS	Chemical Abstracts Service
CDC	Centers for Disease Control and Prevention
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CGA	Compressed Gas Association
CHEMTREC	Chemical Transportation Emergency Center
CHO	Chemical Hygiene Officer
CHP	Chemical Hygiene Plan
CMA	Chemical Manufacturer's Association
CPSC	Consumer Product Safety Commission
CWA	Clean Water Act
DOE	Department of Energy
DOL	Department of Labor
DOT	Department of Transportation
EPA	Environmental Protection Agency
FDA	Food and Drug Administration
FR	Federal Register
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	High Efficiency Particulate Air
HMIS	Hazardous Materials Identification System
IARC	International Agency for Research on Cancer
IDLH	Immediately Dangerous to Life and Health
LSM	Laboratory Safety Manual
NAS	National Academy of Sciences
NEC	National Electrical Code
NFPA	National Fire Protection Association
NIEHS	National Institute of Environmental Health Sciences
NIH	National Institutes of Health
NIOSH	National Institute for Occupational Safety and Health
NSF	National Science Foundation
NTP	National Toxicology Program
OEL	Occupational Exposure Limit
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
PPE	Personal Protective Equipment
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act
SCBA	Self-Contained Breathing Apparatus
SDS	Safety Data Sheets
SOP	Standard Operating Procedures
TLV	Threshold Limit Value
TWA	Time Weighted Average
VOC	Volatile Organic Compounds
WHO	World Health Organization

Section 2. Definitions

Acute Exposure—Short durations of exposure to high concentrations of hazardous materials in the work place.

Allergen—A chemical substance that induces an immediate or delayed adverse reaction by the immune system.

Asphyxiant—A substance that can cause suffocation.

Carcinogen—A substance that causes the development of cancerous growths in humans or is considered capable of causing cancer in humans. A substance is considered a carcinogen if:

1) It has been evaluated by the International Agency for Research on Cancer (IARC) and has been found to be a carcinogen or potential carcinogen;
2) It is listed in the National Toxicology Program's (NTP) Annual Report on Carcinogens as a carcinogen or potential carcinogen;
3) It is an OSHA-regulated carcinogen;
4) One study has been published which positively identifies the substance as a carcinogen.

Caustic Material—A material that has a pH greater than 12 and has a corrosive or irritating effect on living tissue at the point of contact.

Chemical Abstracts Service (CAS) Registration Number—A unique number that is assigned to a chemical as a means to identify the material.

Chemical Hygiene Officer—An employee who is qualified, through training, education, and experience, to oversee the implementation of and subsequent reviews of the Chemical Hygiene Plan, per OSHA 29 CFR 1910.1450, Occupational Exposure to Hazardous Chemicals in Laboratories.

Chemical Hygiene Plan—A written plan that is designed to protect laboratory workers from occupational exposure to hazardous chemicals, per OSHA 29 CFR 1910.1450, Occupational Exposure to Hazardous Chemicals in Laboratories.

Chronic Exposure—Continuous exposure over a long period of time to low concentrations of hazardous materials in the work place.

Chronic Toxicity—Adverse health effects that can be a result of long-term exposure to hazardous materials.

Combustible Material—A substance (solid, liquid, or gas) that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur.

Corrosive Material—A substance that has a pH less than 2 or greater than 12 which can cause visible destruction of or irreversible alteration on physical contact with living tissue.

Embryotoxin—A material that is harmful to a developing embryo at a concentration that does not have adverse effects on the pregnant female.

Explosive Material—A material that will exhibit a rapid chemical change when subjected to a suitable ignition source (i.e., detonation, heat, friction, or impact).

Flammable—A term commonly used to describe a gas, solid, vapor, or liquid that easily ignites and rapidly burns.

Flash Point—The lowest temperature at which a flammable liquid produces sufficient vapor to form a readily ignitable mixture with air, either at its surface or in a container.

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 persons.

Hazard Warning—A label on a chemical container that includes text and/or symbols to convey the hazards of the material.

High Efficiency Particulate Air (HEPA) filter—An air filter that has a 99.97% removal efficiency for 0.03 micron particles.

Immediately Dangerous to Life and Health (IDLH)—The maximum concentration of a hazardous substance from which a worker can escape within 30 minutes without irreversible health effects. IDLH is used to determine respirator selection.

Incompatible Materials—Materials which, when mixed, could result in the formation of toxic gases or hazardous conditions (i.e., an explosion).

Irritant—A substance that produces an inflammatory effect on contact with living tissue.

Lachrymator—A substance that has an irritating or burning effect on skin, eyes, and respiratory tract.

LD — The single dose (lethal dose) of a substance that will cause the death of 50% of a population of animals. Exposure 50 to the substance is via all routes except inhalation.

Mutagen—A material that produces genetic mutations in chromosomal DNA.

Oxidizing Agent—A substance that may react violently upon contact with reducing materials.

Nonflammable—A material that is not easily ignited; a DOT hazard class for compressed gases that are not classed as flammable gases.

Permissible Exposure Limit (PEL)—The maximum acceptable concentration of a chemical in the work place air. Commonly

used exposure limits include TLV-TWA (Threshold Limit Value-Time Weighted Average), STEL (Short-Term Exposure Limit), and C (Ceiling Value).

Personal Protective Equipment (PPE)—Protective equipment (i.e., gloves, chemical splash goggles, laboratory coat or apron, respirators) that is worn by laboratory workers to protect them from direct exposure to hazardous materials.

Physical Hazard—A substance that is a hazard of physical origin (i.e., a burn); a material that is flammable, explosive, water reactive, pyrophoric, or unstable; a combustible liquid, a compressed gas, an organic peroxide, or an oxidizer.

Poison—A substance that may injure or kill an organism, even in relatively low doses.

Pyrophoric Material—Any liquid or solid which will ignite spontaneously in air below 54EC (130EF).

Reactive Material—An explosive material, organic peroxide, pressure-generating material, or water-reactive material that vigorously polymerizes, decomposes, condenses, or becomes self-reactive when subjected to pressure, shock, or temperature changes.

Safety Data Sheet—A document which contains relevant information about a material, as referenced by OSHA 29 CFR, Part 1910.1200.

Select Carcinogen—Defined in OSHA 29 CFR 1910.1450, Occupational Exposure to Hazardous Chemicals in Laboratories, as a substance that:

1) Is regulated by OSHA as a carcinogen;
2) Is listed by the NTP as "known to be carcinogen";
3) Is listed on IARC lists as Group 1, "carcinogenic to humans"; or
4) Is included on the IARC lists as Group 2A or 2B, "reasonably anticipated to be carcinogen", because it causes statistically significant tumor incidence in animals according to the criteria that are listed in Section 2, Paragraph b.

Stench—Material that emits an extremely offensive odor.

Teratogen—A substance that causes growth abnormalities in embryos.

Threshold Limit Value (TLV) —The ACGIH term that is used to express the maximum airborne concentration of a substance to which most workers can be exposed during a normal eight-hour work day or normal 40-hour work week with no adverse health effects.

TLV-Ceiling Limit—The exposure concentration of an airborne substance that must not be exceeded at any time.

TLV-Short Term Exposure Limit (STEL)—-The maximum concentration of an airborne substance for a continuous exposure period of 15 minutes, with the following guidelines:

1) There will be a maximum of four 15-minute periods per day.
2) There will be at least 60 minutes between exposure periods.
3) The daily TLV-TWA will not be exceeded.

TLV-Time Weighted Average—The ACGIH term that is used to express the maximum allowable time weighted average concentration of an airborne substance for a normal eight-hour work day or 40-hour work week.

Toxic Material—A poisonous substance which has the ability to cause adverse health effects upon exposure.

Section 3. Safety References

1. ANSI Z87.1-2010; American National Standard, *Occupational and Educational Personal Eye and Face Protection Devices*; American Society of Safety Engineers: Des Plaines, IL, 2010.
2. ANSI Z358.1-2009; *Standard for Emergency Eyewash and Shower Equipment*; American National Standards Institute: New York, NY, 2009.
3. National Fire Protection Association, NFPA 30: *Flammable and Combustible Liquids Code;* Quincy, MA, 2003 edition.
4. National Fire Protection Association, NFPA 45: *Standard on Fire Protection for Laboratories Using Chemicals*; Quincy, MA, 2011 edition.
5. National Fire Protection Association, NFPA 704: *Standard System for the Identification of the Hazards of Materials for Emergency Response*; Quincy, MA, 2007 edition.
6. Occupational Safety and Health Administration, *Occupational Exposure to Hazardous Chemicals in Laboratories*; 29 CFR; Part 1910.1450, 1990. http://www.osha.gov
7. P*rudent Practices in the Laboratory, Handling and Management of Chemical Hazards*; National Research Council; National Academy Press: Washington, D.C., 2011. http://www.nap.edu
8. *Safety in Academic Chemistry Laboratories*; American Chemical Society; Washington, D.C., 2003. http://portal.acs.org/portal/PublicWebSite/about/governance/committees/chemicalsafety/publications/WPCP_012294

Appendix A. Visiting Scholar Guidelines

Revised 10/2013

WEST VIRGINIA UNIVERSITY
ACADEMIC VISITOR/VISITING SCHOLAR GUIDELINES

I. PURPOSE

As a major research institution, West Virginia University ("WVU") often hosts visitors to its campus to collaborate on research topics of mutual interest or to engage in other scholarly pursuits. In some cases, students who are under the age of eighteen may wish to come to campus to volunteer or engage in some type of independent academic exercise. These visitors are referred to as Visiting Scholars or Academic Visitors ("Visitors"). A Visitor usually does not have official authority to operate or access WVU facilities. Department heads, deans, the Office of the Provost, and, in some cases, the Office of International Students and Scholars ("OISS") and the Office of Sponsored Programs ("OSP"), must be aware of and approve the presence and activities of Visitors.

II. SCOPE

These Guidelines apply to all Visitors, whether paid or unpaid, who will engage in research, observation, teaching, lecturing, volunteering, and other academic pursuits for a temporary period of time at WVU. In addition, these Guidelines apply to host faculty, department heads, deans, the Office of the Provost, OISS, OSP and any and all other units or persons involved in the activities of Visitors. These Guidelines do not govern the presence of groups of students under the age of eighteen who come to campus for "field trips" or other group activities that are sponsored by a particular University department, unit, or student organization.

III. GUIDELINES

A. All Visitors

1. Visitors are defined as individuals who are not WVU students, faculty, or staff who come to campus to conduct research and/or scholarly activities, including, but not limited to, performing research at a University facility, collaborating with other faculty or researchers in a specific field, participating as a visiting lecturer, or volunteering in an academic setting. Visitors may be granted access to University facilities and issued an official identification card or library card when the appropriate approval process is completed.
2. Host faculty members or departments must be willing to sponsor the Visitors and must secure approval from the University administration for Visitors to access University facilities and utilize University resources. Each college should devise its own practices for the sponsorship and tracking of Visitors commensurate with these Guidelines. For Visiting Scholars, practices should include, at a minimum, an appointment letter or other written document outlining the specifications of the Scholar's visit. The practices should also define the offices or persons who, based on the individual college's chosen practice, must be notified of the presence of Visitors, which might include the appropriate department head or director, the dean, the Office of the Provost, the OISS and the OSP, if necessary. In the event that the purpose or duration of a Visitor's visit changes, the host faculty member or college shall reflect the change in writing and ensure that the appropriate parties are notified of the change, per the practices of the specific college. As a guide, template offer-letters for Visiting Scholars are available.
3. All Visitors should review WVU's policies, rules, guidelines, procedures, and other information available on the University's website: http://bog.wvu.edu/policies. All Visitors are "members of the University community," as defined in Board of Governors' policy, and are expected to abide by applicable University standards.
4. If a Visitor's activity at WVU involves projects of a proprietary or confidential nature, the Visitor may be required to sign a Non-disclosure Agreement at the request of an appropriate WVU official.
5. All Visitors are required to have health and accident insurance. A Visitor who does not have appropriate health insurance coverage will not be eligible to remain on campus as a Visitor.
6. WVU does not assume responsibility or liability, in whole or in part, for any sickness, disease, injuries (including death), losses, damages, acts of God, force majeure, public health risks, criminal activity, terrorism, accident, damage to property, failure or negligence of any nature howsoever caused in connection with the Visitor's presence on, or transportation to and from, WVU's campus, or events, or locations related to Visitor's affiliation with WVU.

B. Visitors who are Nonresident Aliens

1. Departments that sponsor a J-1 exchange Visitor have certain responsibilities. Such responsibilities have a federal regulatory basis and apply to all J-1 Visitors regardless of whether the visitor will be employed by WVU or not. For specific information on the responsibilities of sponsoring departments, please consult the J-1 Sponsoring Unit Responsibilities form, which is incorporated herein by reference, and located at the OISS website at http://oiss.wvu.edu/.
2. Nonresident aliens who require J-1 Exchange Visitor's visas will not be granted access to University facilities unless they have completed a J-1 mandatory orientation with OISS and have had their arrival validated through the federal Student and Exchange Visitor Information System ("SEVIS").
3. For Visitors who require J-1 Exchange Visitor's visas, it is the responsibility of the hosting faculty to ensure the Visitor's activities are conducted in strict compliance with those activities identified and authorized in the SEVIS. J-1 Exchange Visitors may participate in occasional (single event rather than an ongoing activity) lectures and consultations not defined and authorized in SEVIS, if authorized to do so by the host faculty, relevant department, and OISS.
4. Pursuant to 22 C.F.R. § 62.10(a)(2), sponsors of a J-1 Exchange Visitor must screen and select prospective Visitors to ensure that they possess sufficient proficiency in the English language to participate in the program.
5. For Visitors who are not U.S. citizens or Permanent Residents, it is the responsibility of the hosting faculty or department to work with the OSP to determine whether export control laws and regulations will be implicated by the Visitor's work and to ensure compliance.
6. For Visitors who are not U.S. citizens or Permanent Residents, it is the responsibility of the hosting faculty or department to consult visa-related information provided by OISS at http://oiss.wvu.edu/scholars.
7. In the event that any payments and/or reimbursements are made to Visitors, they must be in compliance with their visa status, if applicable, and may be subject to taxation. It is the responsibility of the Visitor to understand the payments and/or reimbursements that are permitted and to pay any and all applicable taxes.
8. Visitors who require J-1 Exchange Visitor's visas are required to have health and accident insurance for themselves and any accompanying dependents while in the United States that is in compliance with regulations set forth by the U.S. Department of State. Insurance should be purchased prior to the beginning of the Scholar's work at WVU. Visitors who wish to use insurance from their home countries must provide verification that their coverage meets Department of State requirements. Proof of insurance must be provided to OISS. Information regarding insurance and related requirements will be sent to the Scholar by OISS along with visa materials.

C. Visitors Under the Age of Eighteen

1. Persons under the age of eighteen who come to WVU to volunteer or gain experience in an academic setting must provide written parental permission prior to coming to campus. A template parental permission form is available.
2. Visitors under the age of eighteen must be accompanied by the faculty host or other member of the relevant academic department while in any academic facility, including, but not limited to, classrooms or laboratories.
3. Host faculty and other members of the relevant department should be aware of any other University policies that may be implicated by the presence of persons under the age of eighteen on campus.

See Parental Permission and Release form on following page.

WEST VIRGINIA UNIVERSITY PARENTAL PERMISSION AND RELEASE FOR ACADEMIC VISITORS UNDER EIGHTEEN YEARS OLD

My minor child (a person under the age of 18), [print name], desires to participate as an Academic Visitor ("Visitor") in the [location] at [insert specific building] at West Virginia University ("WVU") with [insert host faculty] from [date] to [date].

1. Purpose

This Visitor opportunity is an academic experience. I understand that there is neither compensation nor benefits nor academic credit for this Visitor position. I understand that it does not create an employee, agent, or representative relationship with WVU.

2. Risks and Responsibilities

I understand that there are inherent risks to life, health, and property in a [insert location], including, but not limited to, [insert risks]. I understand these risks and agree to permit my child to volunteer in the [insert location] with full knowledge and acceptance of them.

3. Medical Insurance and Authorization

I hereby represent and warrant that my child is and will be covered by a policy of comprehensive health and accident insurance, which provides coverage for injuries and illnesses. I agree to report to WVU at the time of my execution and delivery of this form any physical or mental condition my child has that may require special medical attention or accommodation. I consent to any medical treatment that my child may require as a result of her/his participation in the [insert location]. I accept full responsibility for the costs of any medical care my child might receive during or as a consequence of participation as Visitor.

4. Compliance and Termination

The Visitor will abide by the rules, regulations, and policies of WVU as well as applicable local, state, and federal law. A violation of rules, regulations, policies, or law could result in termination of the visiting experience.

5. Release

To the extent allowable by law, I hereby WAIVE any claim my child or I may have at any time based on my child's participation as a Visitor. Specifically, I hereby RELEASE, DISCHARGE, and AGREE NOT TO SUE the State of West Virginia; West Virginia University, including any component of the University, and its Board of Governors, officers, employees, students and agents; medical personnel, whether provided by WVU or not; and the heirs, predecessors, successors, and assigns of all of the persons and organizations listed here. I fully release all of these persons and organizations from any liability whatsoever. My waiver of rights includes giving up any claim that I may have, and any claim that any other person may have based on my child's participation, including, but not limited to, parents, spouses, children and other relatives; my estate, personal representative or guardian; and insurers. My waiver releases all of the persons and organizations listed here from all liability, claims, demands, causes of actions, losses or damages, whether known or unknown, for bodily or personal injury or death, or damage to or loss of property, or any other injury, damage or loss of any kind, resulting from, arising out of, or in any way related to my child's participation, including any claim based on actual or alleged negligence, gross negligence, intentional, or reckless behavior.

I understand and hereby acknowledge that my child's participation as a Visitor is wholly voluntary. Further, I have read this form in its entirety and I understand it fully. By signing it, I agree to all the terms of this document. I understand that my child may not volunteer without my permission and that all of the releases, authorizations, and statements made in this document apply to me and my child, and I consent to my child's full participation as an Academic Visitor at WVU.

Parent/Guardian Name (printed): _____

Parent/Guardian Signature: _____ Date: _____

On behalf of (minor child): _____

Host Faculty Signature: _____ Date: _____

Department Chair/Dean Signature: _____ Date: _____

Appendix B. Laboratory Close-out Guidelines

West Virginia University
Eberly College of Arts and Sciences

Laboratory Close-out Guidelines

The Principal Investigator (PI) is responsible for the safe operation of his/her laboratory room(s). The PI is also responsible for taking the appropriate steps to close out the laboratory space in the event that he/she chooses to retire or to leave WVU. It is essential that all laboratory close-outs are performed in a timely manner and according to established guidelines and policies for the various types of hazards in the laboratory. The department chairperson will enforce the laboratory close-out policies.

The following guidelines are designed to assist the PI in the successful completion of the laboratory close-out process.

Chemical Hazards

All chemical containers in the laboratory must be clearly and properly labeled and must be removed from the laboratory via disposal by the Department of Environmental Health and Safety (EHS), transfer to another institution, or transfer to another PI in the department. Every effort should be made to notify other investigators in the department of the availability of usable chemicals or solvents. Contact WVU EHS to pick up all unneeded chemicals by completing an online waste disposal request. Never dispose of chemicals by placing them in waste baskets or pouring them down the sinks.

Identification and disposal of unknown substances can be expensive and time consuming. If you find unlabeled (unknown) chemicals in your laboratory, segregate them for identification by the waste vendor and notify WVU EHS by completing an online waste disposal request.

Check beneath hoods, in shared labs, in freezers and refrigerators, in acid cabinets and flammable liquid cabinets, and in cold rooms for chemicals and hazardous materials that belong to you and properly dispose of these materials.

All chemicals that will be shipped must be labeled and packaged according to federal regulations. If you plan to ship hazardous materials to another institution, you must contact the certified DOT IATA shipper in your department to ensure that all Department of Transportation (DOT) shipping requirements are followed.

The laboratory space should be clean and chemical-free when vacated. All surfaces, including bench tops, cabinets, shelves, and chemical fume hoods must be thoroughly cleaned.

Controlled Substances

All controlled substances that are regulated by the United States Drug Enforcement Agency (DEA) must be removed from the laboratory and must be handled according to DEA regulations.

Biological Hazards

Contact the WVU Biosafety Officer (293-7157) if you have biohazardous materials/waste in your laboratory. All biological materials must be removed from the laboratory and work areas. Equipment must be thoroughly cleaned and decontaminated. Place all sharps (needles, razor blades, scalpels) in an approved sharps disposal container. Properly dispose of all animals, animal carcasses, or tissue samples as required by applicable regulations.

Radiological Material Hazards

If you have radioactive materials in your laboratory, contact the WVU Radiation Safety Office (293-3413) to discuss the proper disposal of the materials and the decontamination of your laboratory.

Gas Cylinders/Lecture Bottles

All gas cylinders and lecture bottles must be properly labeled and must be returned to the supplier before you leave. Remove the regulators and replace the caps on the cylinders.

Laboratory Equipment

Usable laboratory equipment that has been thoroughly cleaned may remain in place. All broken equipment should be sent out as surplus. All refrigerators and freezers in the laboratory must be emptied, cleaned, defrosted, and decontaminated.

Barbara L. Foster, *College Safety Officer*
May 2014

Appendix C. OSHA Laboratory Standard, Appendix A

(Revised 2013)

DEPARTMENT OF LABOR
Occupational Safety and Health Administration
29 CFR Part 1910
Occupational Exposure to Hazardous Chemicals in Laboratories (Non-Mandatory Appendix); Technical Amendment

AGENCY: Occupational Safety and Health Administration (OSHA), Labor.

ACTION: Technical amendment.

SUMMARY: This document updates a non-mandatory appendix in OSHA's Occupational Exposure to Hazardous Chemicals in Laboratories Standard. The non-mandatory appendix is being updated to include the contents of the latest National Academy of Sciences publication entitled, "Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards," 2011 edition. All revisions being made are minor and non-substantive.

DATES: The effective date of this technical amendment to the standard is January 22, 2013.

FOR FURTHER INFORMATION CONTACT:

Press inquiries: Frank Meilinger, Director, Office of Communications, OSHA, U.S. Department of Labor, Room N–3647, 200 Constitution Avenue NW., Washington, DC 20210; telephone: (202) 693–1999.

General and technical information: Andrew Levinson, OSHA Directorate of Standards and Guidance, Office of Biological Hazards, Room N–3718, U.S. Department of Labor, 200 Constitution Avenue NW., Washington, DC 20210; telephone: (202) 693–1950.

SUPPLEMENTARY INFORMATION:

Background

When the OSHA Laboratory Standard was published in 1990, the nonmandatory Appendix A was based on the 1981 edition of "Prudent Practices for Handling Hazardous Chemicals in Laboratories" and the 1983 edition of "Prudent Practices for Disposal of Chemicals from Laboratories," both published by National Academy Press. Since then, there have been many changes in the culture of safety in laboratories. The National Academies of Science (NAS) recognized these changes and has revised and updated its earlier "Prudent Practices," reflected in the 2011 edition of "Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards" (National Academies Press). The 2011 edition of "Prudent Practices" is being used by OSHA as the basis for nonmandatory Appendix A because of its wide distribution and acceptance and because of its preparation by recognized authorities in the laboratory community.

OSHA has reviewed the 2011 edition and collaborated with the NAS to revise non-mandatory Appendix A. This new revision addresses current laboratory practices, security, and emergency response, as well as promoting safe handling of highly toxic and explosive chemicals and their waste products.

Inapplicability of Public Notice and Delayed Effective Date Requirements

Section 553 of the Administrative Procedure Act (APA), 5 U.S.C. 553(b)(3)(B), provides that, when an Agency for good cause finds that notice and public procedure are impracticable, unnecessary or contrary to the public interest, the Agency may issue a final rule without providing notice and an opportunity for public comment. OSHA has determined that there is good cause, pursuant to 5 U.S.C. 553(b)(3)(B), Section 6(b) of the Occupational Safety and Health Act of 1970 (29 U.S.C. 655(b)), and 29 CFR 1911.5, for making this technical amendment final without prior proposal and opportunity for comment because the amendment does not modify or revoke existing rights or obligations, and does not establish new rights or obligations. Its revisions are non-mandatory and disseminated for informational purposes only. For the same reasons, the Agency finds good cause under 5 U.S.C. 553(d)(3) to make the amendments effective upon publication.

List of Subjects in 29 CFR Part 1910

Occupational safety and health, Laboratories.

Authority and Signature

David Michaels, Ph.D., MPH, Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, 200 Constitution Avenue NW., Washington, DC 20210, authorized the preparation of this document.

David Michaels,

Assistant Secretary of Labor for Occupational Safety and Health.

Accordingly, OSHA is amending 29 CFR part 1910 by making the following technical amendment:

PART 1910—OCCUPATIONAL SAFETY AND HEALTH STANDARDS

Subpart Z—[Amended]

✶1. The authority citation for Part 1910 Subpart Z continues to read as follows:

Authority: Sections 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 12–71 (36 FR 8754), 8–76 (41 FR 25059), 9–83 (48 FR 35736), 1–90 (55 FR 9033), 6–96 (62 FR 111), 3–2000 (65 FR 50017), or 5–2007 (72 FR 31159), 4–2010 (75 FR 55355) or 1–2012 (77 FR 3912), as applicable; and 29 CFR part 1911.

All of subpart Z issued under section 6(b) of the Occupational Safety and Health Act of 1970, except those substances that have exposure limits listed in Tables Z–1, Z–2, and Z–3 of 29 CFR 1910.1000. The latter were issued under section 6(a) (29 U.S.C. 655(a)).

Section 1910.1000, Tables Z–1, Z–2 and Z– 3 also issued under 5 U.S.C. 553, but not under 29 CFR part 1911 except for the arsenic (organic compounds), benzene, cotton dust, and chromium (VI) listings.

Section 1910.1001 also issued under section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 3704) and 5 U.S.C. 553.

Section 1910.1002 also issued under 5 U.S.C. 553, but not under 29 U.S.C. 655 or 29 CFR part 1911.

Sections 1910.1018, 1910.1029, and 1910.1200 also issued under 29 U.S.C. 653.

Section 1910.1030 also issued under Pub. L. 106–430, 114 Stat. 1901.

Section 1910.1201 also issued under 49 U.S.C. 1801–1819 and 5 U.S.C. 533.

✶2. Amend § 1910.1450 by revising Appendix A to read as follows:

§ 1910.1450 Occupational exposure to hazardous chemicals in laboratories.

* * * * *

APPENDIX A TO § 1910.1450—NATIONAL RESEARCH COUNCIL RECOMMENDATIONS CONCERNING CHEMICAL HYGIENE IN LABORATORIES (NON-MANDATORY)

To assist employers in developing an appropriate laboratory Chemical

Hygiene Plan (CHP), the following non-mandatory recommendations were based on the National Research Council's (NRC) 2011 edition of "Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards." This reference, henceforth referred to as "Prudent Practices," is available from the National Academies Press, 500 Fifth Street NW., Washington DC 20001 (*www.nap.edu*). "Prudent Practices" is cited because of its wide distribution and acceptance and because of its preparation by recognized authorities in the laboratory community through the sponsorship of the NRC. However, these recommendations do not modify any requirements of the OSHA Laboratory standard. This appendix presents pertinent recommendations from "Prudent Practices," organized into a form convenient for quick reference during operation of a laboratory and during development and application of a CHP. For a detailed explanation and justification for each recommendation, consult "Prudent Practices."

"Prudent Practices" deals with both general laboratory safety and many types of chemical hazards, while the Laboratory standard is concerned primarily with chemical health hazards as a result of chemical exposures. The recommendations from "Prudent Practices" have been paraphrased, combined, or otherwise reorganized in order to adapt them for this purpose. However, their sense has not been changed.

Section F contains information from the U.S. Chemical Safety Board's (CSB) Fiscal Year 2011 Annual Performance and Accountability report and Section F contains recommendations extracted from the CSB's 2011 case study, "Texas Tech University Laboratory Explosion," available from: *http://www.csb.gov/.*

Culture of Safety

With the promulgation of the Occupational Safety and Health Administration (OSHA) Laboratory standard (29 CFR 1910.1450), a culture of safety consciousness, accountability, organization, and education has developed in industrial, governmental, and academic laboratories. Safety and training programs have been implemented to promote the safe handling of chemicals from ordering to disposal, and to train laboratory personnel in safe practices. Laboratory personnel must realize that the welfare and safety of each individual depends on clearly defined attitudes of teamwork and personal responsibility. Learning to participate in this culture of habitual risk assessment, experiment planning, and consideration of worst-case possibilities—for oneself and one's fellow workers—is as much part of a scientific education as learning the theoretical background of experiments or the step-by-step protocols for doing them in a professional manner. A crucial component of chemical education for all personnel is to nurture basic attitudes and habits of prudent behavior so that safety is a valued and inseparable part of all laboratory activities throughout their career.

Over the years, special techniques have been developed for handling chemicals safely. Local, state, and federal regulations hold institutions that sponsor chemical laboratories accountable for providing safe working environments. Beyond regulation, employers and scientists also hold themselves personally responsible for their own safety, the safety of their colleagues and the safety of the general public. A sound safety organization that is respected by all requires the participation and support of laboratory administrators, workers, and students. A successful health and safety program requires a daily commitment from everyone in the organization. To be most effective, safety and health must be balanced with, and incorporated into, laboratory processes. A strong safety and health culture is the result of positive workplace attitudes—from the chief executive officer to the newest hire; involvement and buy-in of all members of the workforce; mutual, meaningful, and measurable safety and health improvement goals; and policies and procedures that serve as reference tools, rather than obscure rules.

In order to perform their work in a prudentmanner, laboratory personnel must consider the health, physical, and environmental hazards of the chemicals they plan to use in an experiment. However, the ability to accurately identify and assess laboratory hazards must be taught and encouraged through training and ongoing organizational support. This training must be at the core of every good health and safety program. For management to lead, personnel to assess worksite hazards, and hazards to be eliminated or controlled, everyone involved must be trained.

A. General Principles

1. Minimize All Chemical Exposures and Risks

Because few laboratory chemicals are without hazards, general precautions for handling all laboratory chemicals should be adopted. In addition to these general guidelines, specific guidelines for chemicals that are used frequently or are particularly hazardous should be adopted.

Laboratory personnel should conduct their work under conditions that minimize the risks from both known and unknown hazardous substances. Before beginning any laboratory work, the hazards and risks associated with an experiment or activity should be determined and the necessary safety precautions implemented. Every laboratory should develop facility-specific policies and procedures for the highest-risk materials and procedures used in their laboratory. To identify these, consideration should be given to past accidents, process conditions, chemicals used in large volumes, and particularly hazardous chemicals.

Perform Risk Assessments for Hazardous Chemicals and Procedures Prior to Laboratory Work:

(a) Identify chemicals to be used, amounts required, and circumstances of use in the experiment. Consider any special employee or laboratory conditions that could create or increase a hazard. Consult sources of safety and health information and experienced scientists to ensure that those conducting the risk assessment have sufficient expertise.

(b) Evaluate the hazards posed by the chemicals and the experimental conditions. The evaluation should cover toxic, physical, reactive, flammable, explosive, radiation, and biological hazards, as well as any other potential hazards posed by the chemicals.

(c) For a variety of physical and chemical reasons, reaction scale-ups pose special risks, which merit additional prior review and precautions.

(d) Select appropriate controls to minimize risk, including use of engineering controls, administrative controls, and personal protective equipment (PPE) to protect workers from hazards. The controls must ensure that OSHA's Permissible Exposure contingencies and be aware of the institutional procedures in the event of emergencies and accidents.

One sample approach to risk assessment is to answer these five questions:

(a) What are the hazards?

(b) What is the worst thing that could happen?

(c) What can be done to prevent this from happening?

(d) What can be done to protect from these hazards?

(e) What should be done if something goes wrong?

2. Avoid Underestimation of Risk

Even for substances of no known

significant hazard, exposure should be minimized; when working with substances that present special hazards, special precautions should be taken. Reference should be made to the safety data sheet (SDS) that is provided for each chemical. Unless otherwise known, one should assume that any mixture will be more toxic than its most toxic component and that all substances of unknown toxicity are toxic.

Determine the physical and health hazards associated with chemicals before working with them. This determination may involve consulting literature references, laboratory chemical safety summaries (LCSSs), SDSs, or other reference materials. Consider how the chemicals will be processed and determine whether the changing states or forms will change the nature of the hazard. Review your plan, operating limits, chemical evaluations and detailed risk assessment with other chemists, especially those with experience with similar materials and protocols.

Before working with chemicals, know your facility's policies and procedures for how to handle an accidental spill or fire. Emergency telephone numbers should be posted in a prominent area. Know the location of all safety equipment and the nearest fire alarm and telephone.

3. Adhere to the Hierarchy of Controls

The hierarchy of controls prioritizes intervention strategies based on the premise that the best way to control a hazard is to systematically remove it from the workplace, rather than relying on employees to reduce their exposure. The types of measures that may be used to protect employees (listed from most effective to least effective) are: engineering controls, administrative controls, work practices, and PPE. Engineering controls, such as chemical hoods, physically separate the employee from the hazard. Administrative controls, such as employee scheduling, are established by management to help minimize the employees' exposure time to hazardous chemicals. Work practice controls are tasks that are performed in a designated way to minimize or eliminate hazards. Personal protective equipment and apparel are additional protection provided under special circumstances and when exposure is unavoidable.

Face and eye protection is necessary to prevent ingestion and skin absorption of hazardous chemicals. At a minimum, safety glasses, with side shields, should be used for all laboratory work. Chemical splash goggles are more appropriate than regular safety glasses to protect against hazards such as projectiles, as well as when working with glassware under reduced or elevated pressures (e.g., sealed tube reactions), when handling potentially explosive compounds (particularly during distillations), and when using glassware in high-temperature operations. Do not allow laboratory chemicals to come in contact with skin. Select gloves carefully to ensure that they are impervious to the chemicals being used and are of correct thickness to allow reasonable dexterity while also ensuring adequate barrier protection.

Lab coats and gloves should be worn when working with hazardous materials in a laboratory. Wear closed-toe shoes and long pants or other clothing that covers the legs when in a laboratory where hazardous chemicals are used. Additional protective clothing should be used when there is significant potential for skin-contact exposure to chemicals. The protective characteristics of this clothing must be matched to the hazard. Never wear gloves or laboratory coats outside the laboratory or into areas where food is stored and consumed.

4. Provide Laboratory Ventilation

The best way to prevent exposure to airborne substances is to prevent their escape into the working atmosphere by the use of hoods and other ventilation devices. To determine the best choice for laboratory ventilation using engineering controls for personal protection, employers are referred to Table 9.3 of the 2011 edition of "Prudent Practices." Laboratory chemical hoods are the most important components used to protect laboratory personnel from exposure to hazardous chemicals.

(a) Toxic or corrosive chemicals that require vented storage should be stored in vented cabinets instead of in a chemical hood.

(b) Chemical waste should not be disposed of by evaporation in a chemical hood.

(c) Keep chemical hood areas clean and free of debris at all times.

(d) Solid objects and materials, such as paper, should be prevented from entering the exhaust ducts as they can reduce the air flow.

(e) Chemical hoods should be maintained, monitored and routinely tested for proper performance.

A laboratory ventilation system should include the following characteristics and practices:

(a) Heating and cooling should be adequate or the comfort of workers and operation of equipment. Before modification of any building HVAC, the impact on laboratory or hood ventilation should be considered, as well as how laboratory ventilation changes may affect the building HVAC.

(b) A negative pressure differential should exist between the amount of air exhausted from the laboratory and the amount supplied to the laboratory to prevent uncontrolled chemical vapors from leaving the laboratory.

(c) Local exhaust ventilation devices should be appropriate to the materials an operations in the laboratory.

(d) The air in chemical laboratories shouldbe continuously replaced so that concentrations of odoriferous or toxic substances do not increase during the workday.

(e) Laboratory air should not be recirculated but exhausted directly outdoors.

(f) Air pressure should be negative with respect to the rest of the building. Local capture equipment and systems should be designed only by an experienced engineer or industrial hygienist.

(g) Ventilation systems should be inspected and maintained on a regular basis. There should be no areas where air remains static or areas that have unusually high airflow velocities.

Before work begins, laboratory workers should be provided with proper training that includes how to use the ventilation equipment, how to ensure that it is functioning properly, the consequences of improper use, what to do in the event of a system failure or power outage, special considerations, and the importance of signage and postings.

5. Institute a Chemical Hygiene Program

A comprehensive chemical hygiene program is required. It should be designed to minimize exposures, injuries, illnesses and incidents. There should be a regular, continuing effort that includes program oversight, safe facilities, chemical hygiene planning, training, emergency preparedness and chemical security. The chemical hygiene program must be reviewed annually and updated as necessary whenever new processes, chemicals, or equipment is implemented. Its recommendations should be followed in all laboratories.

6. Observe the PELs and TLVs

OSHA's Permissible Exposure Limits (PELs) must not be exceeded. The American Conference of Governmental Industrial Hygienists' Threshold Limit Values (TLVs) should also not be exceeded.

B. Responsibilities

Persons responsible for chemical

hygiene include, but are not limited to, the following:

1. Chemical Hygiene Officer

(a) Establishes, maintains, and revises the chemical hygiene plan (CHP).

(b) Creates and revises safety rules and regulations.

(c) Monitors procurement, use, storage, and disposal of chemicals.

(d) Conducts regular inspections of the laboratories, preparations rooms, and chemical storage rooms, and submits detailed laboratory inspection reports to administration.

(e) Maintains inspection, personnel training, and inventory records.

(f) Assists laboratory supervisors in developing and maintaining adequate facilities.

(g) Seeks ways to improve the chemical hygiene program.

2. Department Chairperson or Director

(a) Assumes responsibility for personnel engaged in the laboratory use of hazardous chemicals.

(b) Provides the chemical hygiene officer (CHO) with the support necessary to implement and maintain the CHP.

(c) After receipt of laboratory inspection report from the CHO, meets with laboratory supervisors to discuss cited violations and to ensure timely actions to protect trained laboratory personnel and facilities and to ensure that the department remains in compliance with all applicable federal, state, university, local and departmental codes and regulations.

(d) Provides budgetary arrangements to ensure the health and safety of the departmental personnel, visitors, and students.

3. Departmental Safety Committee reviews accident reports and makes appropriate recommendations to the department chairperson regarding proposed changes in the laboratory procedures.

4. Laboratory Supervisor or Principal Investigator has overall responsibility for chemical hygiene in the laboratory, including responsibility to:

(a) Ensure that laboratory personnel comply with the departmental CHP and do not operate equipment or handle hazardous chemicals without proper training and authorization.

(b) Always wear personal protective equipment (PPE) that is compatible to the degree of hazard of the chemical.

(c) Follow all pertinent safety rules when working in the laboratory to set an example.

(d) Review laboratory procedures for potential safety problems before assigning to other laboratory personnel.

(e) Ensure that visitors follow the laboratory rules and assumes responsibility for laboratory visitors.

(f) Ensure that PPE is available and properly used by each laboratory employee and visitor.

(g) Maintain and implement safe laboratory practices.

(h) Provide regular, formal chemical hygiene and housekeeping inspections, including routine inspections of emergency equipment;

(i) Monitor the facilities and the chemical fume hoods to ensure that they are maintained and function properly. Contact the appropriate person, as designated by the department chairperson, to report problems with the facilities or the chemical fume hoods.

5. Laboratory Personnel

(a) Read, understand, and follow all safety rules and regulations that apply to the work area;

(b) Plan and conduct each operation in accordance with the institutional chemical hygiene procedures;

(c) Promote good housekeeping practices in the laboratory or work area.

(d) Notify the supervisor of any hazardous conditions or unsafe work practices in the work area.

(e) Use PPE as appropriate for each procedure that involves hazardous chemicals.

C. The Laboratory Facility

General Laboratory Design Considerations

Wet chemical spaces and those with a higher degree of hazard should be separated from other spaces by a wall or protective barrier wherever possible. If the areas cannot be separated, then workers in lower hazard spaces may require additional protection from the hazards in connected spaces.

1. Laboratory Layout and Furnishing

(a) Work surfaces should be chemically resistant, smooth, and easy to clean.

(b) Hand washing sinks for hazardous materials may require elbow, foot, or electronic controls for safe operation.

(c) Wet laboratory areas should have chemically resistant, impermeable, slipresistant flooring.

(d) Walls should be finished with a material that is easy to clean and maintain.

(e) Doors should have view panels to prevent accidents and should open in the direction of egress.

(f) Operable windows should not be present in laboratories, particularly if there are chemical hoods or other local ventilation systems present.

2. Safety Equipment and Utilities

(a) An adequate number and placement of safety showers, eyewash units, and fire extinguishers should be provided for the laboratory.

(b) Use of water sprinkler systems is resisted by some laboratories because of the presence of electrical equipment or waterreactive materials, but it is still generally safer to have sprinkler systems installed. A fire large enough to trigger the sprinkler system would have the potential to cause far more destruction than the local water damage.

D. Chemical Hygiene Plan (CHP)

The OSHA Laboratory standard defines a CHP as “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.” (29 CFR 1910.1450(b)). The Laboratory Standard requires a CHP: “Where hazardous chemicals as defined by this standard are used in the workplace, the employer shall develop and carry out the provisions of a written Chemical Hygiene Plan.” (29 CFR 1910.1450(e)(1)). The CHP is the foundation of the laboratory safety program and must be reviewed and updated, as needed, and at least on an annual basis to reflect changes in policies and personnel. A CHP should be facility specific and can assist in promoting a culture of safety to protect workers from exposure to hazardous materials.

1. The Laboratory’s CHP must be readily available to workers and capable of protecting workers from health hazards and minimizing exposure. Include the following topics in the CHP:

(a) Individual chemical hygiene responsibilities;

(b) Standard operating procedures;

(c) Personal protective equipment, engineering controls and apparel;

(d) Laboratory equipment;

(e) Safety equipment;

(f) Chemical management;

(g) Housekeeping;

(h) Emergency procedures for accidents and spills;

(i) Chemical waste;

(j) Training;

(k) Safety rules and regulations;

(l) Laboratory design and ventilation;

(m) Exposure monitoring;

(n) Compressed gas safety;

(o) Medical consultation and examination.

It should be noted that the nature of laboratory work may necessitate addressing biological safety, radiation safety and security issues.

2. Chemical Procurement, Distribution, and Storage

Prudent chemical management includes the following processes:

Chemical Procurement:

(a) Information on proper handling, storage, and disposal should be known to those who will be involved before a substance is received.

(b) Only containers with adequate identifying labels should be accepted.

(c) Ideally, a central location should be used for receiving all chemical shipments.

(d) Shipments with breakage or leakage should be refused or opened in a chemical hood.

(e) Only the minimum amount of the chemical needed to perform the planned work should be ordered.

(f) Purchases of high risk chemicals should be reviewed and approved by the CHO.

(g) Proper protective equipment and handling and storage procedures should be in place before receiving a shipment.

Chemical Storage:

(a) Chemicals should be separated and stored according to hazard category and compatibility.

(b) SDS and label information should be followed for storage requirements.

(c) Maintain existing labels on incoming containers of chemicals and other materials.

(d) Labels on containers used for storing hazardous chemicals must include the chemical identification and appropriate hazard warnings.

(e) The contents of all other chemical containers and transfer vessels, including, but not limited to, beakers, flasks, reaction vessels, and process equipment, should be properly identified.

(f) Chemical shipments should be dated upon receipt and stock rotated.

(g) Peroxide formers should be dated upon receipt, again dated upon opening, and stored away from heat and light with tightfitting, nonmetal lids.

(h) Open shelves used for chemical storage should be secured to the wall and contain 3⁄4-inch lips. Secondary containment devices should be used as necessary.

(i) Consult the SDS and keep incompatibles separate during transport, storage, use, and disposal.

(j) Oxidizers, reducing agents, and fuels should be stored separately to prevent contact in the event of an accident.

(k) Chemicals should not be stored in the chemical hood, on the floor, in areas of egress, on the benchtop, or in areas near heat or in direct sunlight.

(l) Laboratory-grade, flammable-rated refrigerators and freezers should be used to store sealed chemical containers of flammable liquids that require cool storage. Do not store food or beverages in the laboratory refrigerator.

(m) Highly hazardous chemicals should be stored in a well-ventilated and secure area designated for that purpose.

(n) Flammable chemicals should be stored in a spark-free environment and in approved flammable-liquid containers and storage cabinets. Grounding and bonding should be used to prevent static charge buildups when dispensing solvents.

(o) Chemical storage and handling rooms should be controlled-access areas. They should have proper ventilation, appropriate signage, diked floors, and fire suppression systems.

Chemical Handling:

(a) As described above, a risk assessment should be conducted prior to beginning work with any hazardous chemical for the first time.

(b) All SDS and label information should be read before using a chemical for the first time.

(c) Trained laboratory workers should ensure that proper engineering controls (ventilation) and PPE are in place.

Chemical Inventory:

(a) Prudent management of chemicals in any laboratory is greatly facilitated by keeping an accurate inventory of the chemicals stored.

(b) Unneeded items should be discarded or returned to the storeroom.

Transporting Chemicals:

(a) Secondary containment devices should be used when transporting chemicals.

(b) When transporting chemicals outside of the laboratory or between stockrooms and laboratories, the transport container should be break-resistant.

(c) High-traffic areas should be avoided.

Transferring Chemicals:

(a) Use adequate ventilation (such as a fume hood) when transferring even a small amount of a particularly hazardous substance (PHS).

(b) While drum storage is not appropriate for laboratories, chemical stockrooms may purchase drum quantities of solvents used in high volumes. Ground and bond the drum and receiving vessel when transferring flammable liquids from a drum to prevent static charge buildup.

(c) If chemicals from commercial sources are repackaged into transfer vessels, the new containers should be labeled with all essential information on the original container.

Shipping Chemicals: Outgoing chemical shipments must meet all applicable Department of Transportation (DOT) regulations and should be authorized and handled by the institutional shipper.

3. Waste Management

A waste management plan should be in place before work begins on any laboratory activity. The plan should utilize the following hierarchy of practices:

(a) Reduce waste sources. The best approach to minimize waste generation is by reducing the scale of operations, reducing its formation during operations, and, if possible, substituting less hazardous chemicals for a particular operation.

(b) Reuse surplus materials. Only the amount of material necessary for an experiment should be purchased, and, if possible, materials should be reused.

(c) Recycle waste. If waste cannot be prevented or minimized, the organization should consider recycling chemicals that can be safely recovered or used as fuel.

(d) Dispose of waste properly. Sink disposal may not be appropriate. Proper waste disposal methods include incineration, treatment, and land disposal. The organization's environmental health and safety (EHS) office should be consulted in determining which methods are appropriate for different types of waste.

Collection and Storage of Waste:

(a) Chemical waste should be accumulated at or near the point of generation, under the control of laboratory workers.

(b) Each waste type should be stored in a compatible container pending transfer or disposal. Waste containers should be clearly labeled and kept sealed when not in use.

(c) Incompatible waste types should be kept separate to ensure that heat generation, gas evolution, or another reaction does not occur.

(d) Waste containers should be segregated by how they will be managed. Waste containers should be stored in a designated location that does not interfere with normal laboratory operations. Ventilated storage and secondary containment may be appropriate for certain waste types.

(e) Waste containers should be clearly labeled and kept sealed when not in use. Labels should include the accumulation

start date and hazard warnings as appropriate.

(f) Non-explosive electrical systems, grounding and bonding between floors and containers, and non-sparking conductive floors and containers should be used in the central waste accumulation area to minimize fire and explosion hazards. Fire suppression systems, specialized ventilation systems, and dikes should be installed in the central waste accumulation area. Waste management workers should be trained in proper waste handling procedures as well as contingency planning and emergency response. Trained laboratory workers most familiar with the waste should be actively involved in waste management decisions to ensure that the waste is managed safely and efficiently. Engineering controls should be implemented as necessary, and personal protective equipment should be worn by workers involved in waste management.

4. Inspection Program

Maintenance and regular inspection of laboratory equipment are essential parts of the laboratory safety program. Management should participate in the design of a laboratory inspection program to ensure that the facility is safe and healthy, workers are adequately trained, and proper procedures are being followed.

Types of inspections: The program should include an appropriate combination of routine inspections, self-audits, program audits, peer inspections, EHS inspections, and inspections by external entities.

Elements of an inspection:

(a) Inspectors should bring a checklist to ensure that all issues are covered and a camera to document issues that require correction.

(b) Conversations with workers should occur during the inspection, as they can provide valuable information and allow inspectors an opportunity to show workers how to fix problems.

(c) Issues resolved during the inspection should be noted.

(d) An inspection report containing all findings and recommendations should be prepared for management and other appropriate workers.

(e) Management should follow-up on the inspection to ensure that all corrections are implemented.

5. Medical Consultation and Examination

The employer must provide all employees who work with hazardous chemicals an opportunity to receive medical attention, including any follow-up examinations that the examining physician determines to be necessary, whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory. If an employee encounters a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure, the affected employee must be provided an opportunity for a medical consultation by a licensed physician. All medical examinations and consultations must be performed by or under the direct supervision of a licensed physician and must be provided without cost to the employee, without loss of pay and at a reasonable time and place. The identity of the hazardous chemical, a description of the incident, and any signs and symptoms that the employee may experience must be relayed to the physician.

6. Records

All accident, fatality, illness, injury, and medical records and exposure monitoring records must be retained by the institution in accordance with the requirements of state and federal regulations (see 29 CFR part 1904 and § 1910.1450(j)). Any exposure monitoring results must be provided to affected laboratory staff within 15 working days after receipt of the results (29 CFR 1910.1450(d)(4)).

7. Signs

Prominent signs of the following types should be posted:

(a) Emergency telephone numbers of emergency personnel/facilities, supervisors, and laboratory workers;

(b) Location signs for safety showers, eyewash stations, other safety and first aid equipment, and exits; and

(c) Warnings at areas or equipment where special or unusual hazards exist.

8. Spills and Accidents

Before beginning an experiment, know your facility's policies and procedures for how to handle an accidental release of a hazardous substance, a spill or a fire. Emergency response planning and training are especially important when working with highly toxic compounds. Emergency telephone numbers should be posted in a prominent area. Know the location of all safety equipment and the nearest fire alarm and telephone. Know who to notify in the event of an emergency. Be prepared to provide basic emergency treatment. Keep your co-workers informed of your activities so they can respond appropriately. Safety equipment, including spill control kits, safety shields, fire safety equipment, PPE, safety showers and eyewash units, and emergency equipment should be available in wellmarked highly visible locations in all chemical laboratories. The laboratory supervisor or CHO is responsible for ensuring that all personnel are aware of the locations of fire extinguishers and are trained in their use. After an extinguisher has been used, designated personnel must promptly recharge or replace it (29 CFR 1910.157(c)(4)). The laboratory supervisor or CHO is also responsible for ensuring proper training and providing supplementary equipment as needed.

Special care must be used when handling solutions of chemicals in syringes with needles. Do not recap needles, especially when they have been in contact with chemicals. Remove the needle and discard it immediately after use in the appropriate sharps containers. Blunt-tip needles are available from a number of commercial sources and should be used unless a sharp needle is required to puncture rubber septa or for subcutaneous injection.

For unattended operations, laboratory lights should be left on, and signs should be posted to identify the nature of the experiment and the hazardous substances in use. Arrangements should be made, if possible, for other workers to periodically inspect the operation. Information should be clearly posted indicating who to contact in the event of an emergency. Depending on the nature of the hazard, special rules, precautions, and alert systems may be necessary.

9. Training and Information

Personnel training at all levels within the organization, is essential. Responsibility and accountability throughout the organization are key elements in a strong safety and health program. The employer is required to provide employees with information and training to ensure that they are apprised of the hazards of chemicals present in their work area (29 CFR 1910.1450(f)). This information must be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations. The frequency of refresher information and training should be determined by the employer. At a minimum, laboratory personnel should be trained on their facility's specific CHP, methods and observations that may be used to detect the presence or release of a hazardous chemical (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance

or odor of hazardous chemicals when being released), the physical and health hazards of chemicals in the work area and means to protect themselves from these hazards. Trained laboratory personnel must know shut-off procedures in case of an emergency. All SDSs must be made available to the employees.

E. General Procedures for Working With Chemicals

The risk of laboratory injuries can be reduced through adequate training, improved engineering, good housekeeping, safe work practice and personal behavior.

1. General Rules for Laboratory Work With Chemicals

(a) Assigned work schedules should be followed unless a deviation is authorized by the laboratory supervisor.

(b) Unauthorized experiments should not be performed.

(c) Plan safety procedures before beginning any operation.

(d) Follow standard operating procedures at all times.

(e) Always read the SDS and label before using a chemical.

(f) Wear appropriate PPE at all times.

(g) To protect your skin from splashes, spills and drips, always wear long pants and closed-toe shoes.

(h) Use appropriate ventilation when working with hazardous chemicals.

(i) Pipetting should never be done by mouth.

(j) Hands should be washed with soap and water immediately after working with any laboratory chemicals, even if gloves have been worn.

(k) Eating, drinking, smoking, gum chewing, applying cosmetics, and taking medicine in laboratories where hazardous chemicals are used or stored should be strictly prohibited.

(l) Food, beverages, cups, and other drinking and eating utensils should not be stored in areas where hazardous chemicals are handled or stored.

(m) Laboratory refrigerators, ice chests, cold rooms, and ovens should not be used for food storage or preparation.

(n) Contact the laboratory supervisor, Principal Investigator, CHO or EHS office with all safety questions or concerns.

(o) Know the location and proper use of safety equipment.

(p) Maintain situational awareness.

(q) Make others aware of special hazards associated with your work.

(r) Notify supervisors of chemical sensitivities or allergies.

(s) Report all injuries, accidents, incidents, and near misses.

(t) Unauthorized persons should not be allowed in the laboratory.

(u) Report unsafe conditions to the laboratory supervisor or CHO.

(v) Properly dispose of chemical wastes.

Working Alone in the Laboratory

Working alone in a laboratory is dangerous and should be strictly avoided. There have been many tragic accidents that illustrate this danger. Accidents are unexpected by definition, which is why coworkers should always be present. Workers should coordinate schedules to avoid working alone.

Housekeeping

Housekeeping can help reduce or eliminate a number of laboratory hazards. Proper housekeeping includes appropriate labeling and storage of chemicals, safe and regular cleaning of the facility, and proper arrangement of laboratory equipment.

2. Nanoparticles and Nanomaterials

Nanoparticles and nanomaterials have different reactivities and interactions with biological systems than bulk materials, and understanding and exploiting these differences is an active area of research. However, these differences also mean that the risks and hazards associated with exposure to engineered nanomaterials are not well known. Because this is an area of ongoing research, consult trusted sources for the most up to date information available. Note that the higher reactivity of many nanoscale materials suggests that they should be treated as potential sources of ignition, accelerants, and fuel that could result in fire or explosion. Easily dispersed dry nanomaterials may pose the greatest health hazard because of the risk of inhalation. Operations involving these nanomaterials deserve more attention and more stringent controls than those where the nanomaterials are embedded in solid or suspended in liquid matrixes.

Consideration should be given to all possible routes of exposure to nanomaterials including inhalation, ingestion, injection, and dermal contact (including eye and mucous membranes). Avoid handling nanomaterials in the open air in a freeparticle state. Whenever possible, handle and store dispersible nanomaterials, whether suspended in liquids or in a dry particle form, in closed (tightly-sealed) containers. Unless cutting or grinding occurs, nanomaterials that are not in a free form (encapsulated in a solid or a nanocomposite) typically will not require engineering controls. If a synthesis is being performed to create nanomaterials, it is not enough to only consider the final material in the risk assessment, but consider the hazardous properties of the precursor materials as well.

To minimize laboratory personnel exposure, conduct any work that could generate engineered nanoparticles in an enclosure that operates at a negative pressure differential compared to the laboratory personnel breathing zone. Limited data exist regarding the efficacy of PPE and ventilation systems against exposure to nanoparticles.

However, until further information is available, it is prudent to follow standard chemical hygiene practices. Conduct a hazard evaluation to determine PPE appropriate for the level of hazard according to the requirements set forth in OSHA's Personal Protective Equipment standard (29 CFR 1910.132).

3. Highly Toxic and Explosive/Reactive Chemicals/Materials

The use of highly toxic and explosive/reactive chemicals and materials has been an area of growing concern. The frequency of academic laboratory incidents in the U.S. is an area of significant concern for the Chemical Safety Board (CSB). The CSB issued a case study on an explosion at Texas Tech University in Lubbock, Texas, which severely injured a graduate student handling a high-energy metal compound. Since 2001, the CSB has gathered preliminary information on 120 different university laboratory incidents that resulted in 87 evacuations, 96 injuries, and three deaths.

It is recommended that each facility keep a detailed inventory of highly toxic chemicals and explosive/reactive materials. There should be a record of the date of receipt, amount, location, and responsible individual for all acquisitions, syntheses, and disposal of these chemicals. A physical inventory should be performed annually to verify active inventory records. There should be a procedure in place to report security breaches, inventory discrepancies, losses, diversions, or suspected thefts.

Procedures for disposal of highly toxic materials should be established before any experiments begin, possibly even before the chemicals are ordered. The procedures should address methods for decontamination of any laboratory equipment that comes into contact with highly toxic chemicals. All waste should be accumulated in clearly labeled impervious containers that are stored in unbreakable secondary containment.

Highly reactive and explosive materials that may be used in the laboratory require

appropriate procedures and training. An explosion can occur when a material undergoes a rapid reaction that results in a violent release of energy. Such reactions can happen spontaneously and can produce pressures, gases, and fumes that are hazardous. Some reagents pose a risk on contact with the atmosphere. It is prudent laboratory practice to use a safer alternative whenever possible.

If at all possible, substitutes for highly acute, chronic, explosive, or reactive chemicals should be considered prior to beginning work and used whenever possible.

4. Compressed Gas

Compressed gases expose laboratory personnel to both chemical and physical hazards. It is essential that these are monitored for leaks and have the proper labeling. By monitoring compressed gas inventories and disposing of or returning gases for which there is no immediate need, the laboratory can substantially reduce these risks. Leaking gas cylinders can cause serious hazards that may require an immediate evacuation of the area and activation of the emergency response system. Only appropriately trained hazmat responders may respond to stop a leaking gas cylinder under this situation.

F. Safety Recommendations—Physical Hazards

Physical hazards in the laboratory include combustible liquids, compressed gases, reactives, explosives and flammable chemicals, as well as high pressure/energy procedures, sharp objects and moving equipment. Injuries can result from bodily contact with rotating or moving objects, including mechanical equipment, parts, and devices. Personnel should not wear loosefitting clothing, jewelry, or unrestrained long hair around machinery with moving parts.

The Chemical Safety Board has identified the following key lessons for laboratories that address both physical and other hazards:

(1) Ensure that research-specific hazards are evaluated and then controlled by developing specific written protocols and training.

(2) Expand existing laboratory safety plans to ensure that all safety hazards, including physical hazards of chemicals, are addressed.

(3) Ensure that the organization's EHS office reports directly to an identified individual/office with organizational authority to implement safety improvements.

(4) Develop a verification program that ensures that the safety provisions of the CHP are communicated, followed, and enforced at all levels within the organization.

(5) Document and communicate all laboratory near-misses and previous incidents to track safety, provide opportunities for education and improvement to drive safety changes at the university.

(6) Manage the hazards unique to laboratory chemical research in the academic environment. Utilize available practice guidance that identifies and describes methodologies to assess and control hazards.

(7) Written safety protocols and training are necessary to manage laboratory risk.

G. Emergency Planning

In addition to laboratory safety issues, laboratory personnel should be familiar with established facility policies and procedures regarding emergency situations. Topics may include, but are not limited to:

(1) Evacuation procedures—when it is appropriate and alternate routes;

(2) Emergency shutdown procedures—equipment shutdown and materials that should be stored safely;

(3) Communications during an emergency—what to expect, how to report, where to call or look for information;

(4) How and when to use a fire extinguisher;

(5) Security issues—preventing tailgating and unauthorized access;

(6) Protocol for absences due to travel restrictions or illness;

(7) Safe practices for power outage;

(8) Shelter in place—when it is appropriate;

(9) Handling suspicious mail or phone calls;

(10) Laboratory-specific protocols relating to emergency planning and response;

(11) Handling violent behavior in the workplace; and

(12) First-aid and CPR training, including automated external defibrillator training if available.

It is prudent that laboratory personnel are also trained in how to respond to short-term, long-term and large-scale emergencies. Laboratory security can play a role in reducing the likelihood of some emergencies and assisting in preparation and response for others. Every institution, department, and individual laboratory should consider having an emergency preparedness plan. The level of detail of the plan will vary depending on the function of the group and institutional planning efforts already in place.

Emergency planning is a dynamic process. As personnel, operations, and events change, plans will need to be updated and modified. To determine the type and level of emergency planning needed, laboratory personnel need to perform a vulnerability assessment. Periodic drills to assist in training and evaluation of the emergency plan are recommended as part of the training program.

H. Emergency Procedures

(1) Fire alarm policy. Most organizations use fire alarms whenever a building needs to be evacuated—for any reason. When a fire alarm sounds in the facility, evacuate immediately after extinguishing all equipment flames. Check on and assist others who may require help evacuating.

(2) Emergency safety equipment. The following safety elements should be met:

a. A written emergency action plan has been provided to workers;

b. Fire extinguishers, eyewash units, and safety showers are available and tested on a regular basis; and

c. Fire blankets, first-aid equipment, fire alarms, and telephones are available and accessible.

(3) Chemical spills. Workers should contact the CHO or EHS office for instructions before cleaning up a chemical spill. All SDS and label instructions should be followed, and appropriate PPE should be worn during spill cleanup.

(4) Accident procedures. In the event of an accident, immediately notify appropriate personnel and local emergency responders. Provide an SDS of any chemical involved to the attending physician. Complete an accident report and submit it to the appropriate office or individual within 24 hours.

(5) Employee safety training program. New workers should attend safety training before they begin any activities. Additional training should be provided when they advance in their duties or are required to perform a task for the first time. Training documents should be recorded and maintained. Training should include hands-on instruction of how to use safety equipment appropriately.

(6) Conduct drills. Practice building evacuations, including the use of alternate routes. Practice shelter-in-place, including plans for extended stays. Walk the fastest route from your work area to the nearest fire alarm, emergency eye wash and emergency shower. Learn how each is activated. In the excitement of an actual

emergency, people rely on what they learned from drills, practice and training.

(7) Contingency plans. All laboratories should have long-term contingency plans in place (e.g., for pandemics). Scheduling, workload, utilities and alternate work sites may need to be considered.

I. Laboratory Security

Laboratory security has evolved in the past decade, reducing the likelihood of some emergencies and assisting in preparation and response for others. Most security measures are based on the laboratory's vulnerability. Risks to laboratory security include, but are not limited to:

(1) Theft or diversion of chemicals, biologicals, and radioactive or proprietary materials, mission-critical or high-value equipment;

(2) Threats from activist groups;

(3) Intentional release of, or exposure to, hazardous materials;

(4) Sabotage or vandalism of chemicals or high-value equipment;

(5) Loss or release of sensitive information; and

(6) Rogue work or unauthorized laboratory experimentation. Security systems in the laboratory are used to detect and respond to a security breach, or a potential security breach, as well as to delay criminal activity by imposing multiple layered barriers of increasing stringency. A good laboratory security system will increase overall safety for laboratory personnel and the public, improve emergency preparedness by assisting with preplanning, and lower the organization's liability by incorporating more rigorous planning, staffing, training, and command systems and implementing emergency communications protocols, drills, background checks, card access systems, video surveillance, and other measures. The security plan should clearly delineate response to security issues, including the coordination of institution and laboratory personnel with both internal and external responders.

* * * * *

[FR Doc. 2013–00788 Filed 1–18–13; 8:45 am]

BILLING CODE 4510–26–P

Appendix D. US Environmental Protection Agency P-Listed Wastes

P023	107-20-0	Acetaldehyde, chloro-
P002	591-08-2	Acetamide, N-(aminothioxomethyl)-
P057	640-19-7	Acetamide, 2-fluoro-
P058	62-74-8	Acetic acid, fluoro-, sodium salt
P002	591-08-2	1-Acetyl-2-thiourea
P003	107-02-8	Acrolein
P070	116-06-3	Aldicarb
P203	1646-88-4	Aldicarb sulfone.
P004	309-00-2	Aldrin
P005	107-18-6	Allyl alcohol
P006	20859-73-8	Aluminum phosphide (R,T)
P007	2763-96-4	5-(Aminomethyl)-3-isoxazolol
P008	504-24-5	4-Aminopyridine
P009	131-74-8	Ammonium picrate (R)
P119	7803-55-6	Ammonium vanadate
P099	506-61-6	Argentate(1-), bis(cyano-C)-, potassium
P010	7778-39-4	Arsenic acid H3AsO4
P012	1327-53-3	Arsenic oxide As2O3
P011	1303-28-2	Arsenic oxide As2O5
P011	1303-28-2	Arsenic pentoxide
P012	1327-53-3	Arsenic trioxide
P038	692-42-2	Arsine, diethyl-
P036	696-28-6	Arsonous dichloride, phenyl-
P054	151-56-4	Aziridine
P067	75-55-8	Aziridine, 2-methyl-
P013	542-62-1	Barium cyanide
P024	106-47-8	Benzenamine, 4-chloro-
P077	100-01-6	Benzenamine, 4-nitro-
P028	100-44-7	Benzene, (chloromethyl)-1,2-Benzenediol, 4-[1-hydroxy-2-(methylamino)
P042	51-43-4	ethyl]-, (R)-
P046	122-09-8	Benzeneethanamine, alpha,alpha-dimethyl-
P014	108-98-5	Benzenethiol 7-Benzofuranol, 2, 3-dihydro-2, 2-dimethyl-
P127	1563-66-2	methylcarbamate. Benzoic acid, 2-hydroxy-, compd. with (3aS-cis)- 1, 2, 3, 3a, 8, 8a-hexahdro-1, 3a, 8-trimethylp
P188	57-64-7	yrrolo[2,3-b]indol-5-yl methylcarbamate ester (1:1)
P001	fn1 81-81-2	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenylbutyl)-, & salts, when present at concentrations greater than 0.3%
P028	100-44-7	Benzyl chloride
P015	7440-41-7	Beryllium powder
P017	598-31-2	Bromoacetone
P018	357-57-3	Brucine
P045	39196-18-4	2-Butanone, 3,3-dimethyl-1-(methylthio)- O-[methylamino)carbonyl] oxime
P021	592-01-8	Calcium cyanide
P021	592-01-8	Calcium cyanide Ca(CN)2
P189	55285-14-8	Carbamic acid, [(dibutylamino)- thio]methyl-, 2, 3-dihydro-2,2-dimethyl- 7-benzofuranyl ester.
P191	644-64-4	Carbamic acid, dimethyl-, 1-[(dimethyl- amino) carbonyl]- 5-methyl-1H- pyrazol-3-yl ester.
P192	119-38-0	Carbamic acid, dimethyl-, 3-methyl-1- (1-methylethyl)-1H- pyrazol-5-yl ester.
P190	1129-41-5	Carbamic acid, methyl-, 3-methylphenyl ester.
P127	1563-66-2	Carbofuran.
P022	75-15-0	Carbon disulfide
P095	75-44-5	Carbonic dichloride
P189	55285-14-8	Carbosulfan.

P023	107-20-0	Chloroacetaldehyde
P024	106-47-8	p-Chloroaniline
P026	5344-82-1	1-(o-Chlorophenyl)thiourea
P027	542-76-7	3-Chloropropionitrile
P029	544-92-3	Copper cyanide
P029	544-92-3	Copper cyanide Cu(CN)
P202	64-00-6	m-Cumenyl methylcarbamate.
P030		Cyanides (soluble cyanide salts), not otherwise specified
P031	460-19-5	Cyanogen
P033	506-77-4	Cyanogen chloride
P033	506-77-4	Cyanogen chloride (CN)Cl
P034	131-89-5	2-Cyclohexyl-4,6-dinitrophenol
P016	542-88-1	Dichloromethyl ether
P036	696-28-6	Dichlorophenylarsine
P037	60-57-1	Dieldrin
P038	692-42-2	Diethylarsine
P041	311-45-5	Diethyl-p-nitrophenyl phosphate
P040	297-97-2	O,O-Diethyl O-pyrazinyl phosphorothioate
P043	55-91-4	Diisopropylfluorophosphate (DFP)
P004	309-00-2	1,4,5,8-Dimethanonaphthalene, 1,2,3,4, 10,10- hexa- chloro-1, 4, 4a, 5, 8, 8a, -hexahydro-, (1alpha, 4 alpha, 4 abeta, 5 alpha,8 alpha, 8 abeta)-
P060	465-7 3-6	1, 4, 5, 8-Dimethanonaphthalene, 1, 2, 3, 4, 10, 10-hexa-chloro-1, 4, 4a, 5,8, 8a-hexahydro-,(alpha, 4 alpha,4ab eta,5beta,8beta,8abeta)-
P037	60-57-1	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9- hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta, 2aalpha, 3beta,6beta,6aalpha,7beta, 7aalpha)-
P051	fn1 72- 20-8	2,7:3,6-Dimethanonaphth [2,3-b]oxirene, 3,4,5,6,9,9- hexachloro-1a,2,2a,3,6,6a,7,7a- octahydro-, (1aalpha,2beta, 2abeta,3alpha,6alpha,6a beta,7beta, 7aalpha)-, & metabolites
P044	60-51-5	Dimethoate
P046	122-09-8	alpha,alpha-Dimethylphenethylamine
P191	644-64-4	Dimetilan.
P047	fn1 534- 52-1	4,6-Dinitro-o-cresol, & salts
P048	51-28-5	2,4-Dinitrophenol
P020	88-85-7	Dinoseb
P085	152-16-9	Diphosphoramide, octamethyl-
P111	107-49-3	Diphosphoric acid, tetraethyl ester
P039	298-04-4	Disulfoton
P049	541-53-7	Dithiobiuret
P185	26419-73-8	1,3-Dithiolane-2-carboxaldehyde, 2,4-dimethyl-, O- [(methylamino)- carbonyl]oxime.
P050	115-29-7	Endosulfan
P088	145-73-3	Endothall
P051	72-20-8	Endrin
P051	72-20-8	Endrin, & metabolites
P042	51-43-4	Epinephrine
P031	460-19-5	Ethane dinitrile
P194	23135-22-0	Ethanimidothioc acid, 2-(dimethylamino)-N- [[(methylamino) carbonyl]oxy]-2 -oxo-, methyl ester.
P066	16752-77-5	Ethanimidothioic acid, N-[[(methylamino) carbonyl] oxy]-, methyl ester
P101	107-12-0	Ethyl cyanide
P054	151-56-4	Ethyleneimine
P097	52-85-7	Famphur
P056	7782-41-4	Fluorine
P057	640-19-7	Fluoroacetamide
P058	62-74-8	Fluoroacetic acid, sodium salt
P198	23422-53-9	Formetanate hydrochloride.
P197	17702-57-7	Formparanate.
P065	628-86-4	Fulminic acid, mercury(2+) salt (R,T)
P059	76-44-8	Heptachlor
P062	757-58-4	Hexaethyl tetraphosphate

P116	79-19-6	Hydrazinecarbothioamide
P068	60-34-4	Hydrazine, methyl-
P063	74-90-8	Hydrocyanic acid
P063	74-90-8	Hydrogen cyanide
P096	7803-51-2	Hydrogen phosphide
P060	465-73-6	Isodrin
P192	119-38-0	Isolan.
P202	64-00-6 3-	Isopropylphenyl N-methylcarbamate.
P007	2763-96-4	3(2H)-Isox azolone, 5-(aminomethyl)-
P196	15339-36-3	Manganese, bis(dimethylcarbamodithioato-S,S')-,
P196	15339-36-3	Manganese dimethyldithiocarbamate.
P092	62-38-4	Mercury, (acetato-O)phenyl-
P065	628-86-4	Mercury fulminate (R,T)
1P192	23422-53-9	Methanimidamide, N,N-dimethyl-N'-[3- [[(methylamino)-carbonyl]oxy]phenyl]-, monohydrochloride.
P197	17702-57-7	Methanimidamide, N,N-dimethyl-N'-[2-methyl-4- [[(methylamino)carbonyl]oxy]p henyl]-
P082	62-75-9	Methanamine, N-methyl-N-nitroso-
P064	624-83-9	Methane, isocyanato-
P016	542-88-1	Methane, oxybis[chloro-
P112	509-14-8	Methane, tetranitro- (R)
P118	75-70-7	Methanethiol, trichloro-
P050	115-29-7	6,9-Methano-2,4,3-benzodioxathiepin , 6,7,8,9,10,10- hexachloro- 1,5,5a,6,9,9a-hexahydro-, 3-oxide
P059	76-44-8 4,7-	Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro- 3a,4,7,7a-tetrahydro-
P199	2032-65-7	Methiocarb.
P066	16752-77-5	Methomyl
P068	60-34-4	Methyl hydrazine
P064	624-83-9	Methyl isocyanate
P069	75-86-5	2-Methyllactonitrile
P071	298-00-0	Methyl parathion
P190	1129-41-5	Metolcarb.
P128	315-18-4	Mexacarbate.
P072	86-88-4	alpha-Naphthylth iourea
P073	13463-39-3	Nickel carbonyl
P073	13463-39-3	Nickel carbonyl Ni(CO)4, (T-4)-
P074	557-19-7	Nickel cyanide
P074	557-19-7	Nickel cynaide Ni(CN)2
P075	fn1 54-11-5	Nicotine, & salts
P076	10102-43-9	Nitric oxide
P077	100-01-6	p-Nitroaniline
P078	10102-44-0	Nitrogen dioxide
P076	10102-43-9	Nitrogen oxide NO
P078	10102-44-0	Nitrogen oxide NO2
P081	55-63-0	Nitroglycerine (R)
P082	62-75-9	N-Nitrosodimethylamine
P084	4549-40-0	N- Nitrosomethylvinylamine
P085	152-16-9	Octamethylpyrophosphor amide
P087	20816-12-0	Osmium oxide OsO4, (T-4)-
P087	20816-12-0	Osmium tetroxide
P088	145-73-3	7-Oxabicyclo[2.2.1]heptane-2,3-dicar boxylic acid
P194	23135-22-0	Oxamyl.
P089	56-38-2	Parathion
P034	131-89-5	Phenol, 2-cyclohexyl-4,6-dinitro-
P048	51-28-5	Phenol, 2,4-dinitro-
P047	fn1 534- 52-1	Phenol, 2-methyl-4,6-dinitro-, & salts
P020	88-85-7 P	henol, 2-(1-methylpropyl)-4,6-dinitro-
P009	131-74-8	Phenol, 2,4,6-trinitro-, ammonium salt (R)
P128	315-18-4	Phenol, 4-(dimethylamino)-3,5-dimethyl-, methylcarbamate (ester).

P199	2032-65-7	Phenol, (3,5-dimethyl-4-(methylthio)-, methylcarbamate
P202	64-00-6	Phenol, 3-(1-methylethyl)-, methyl carbamate.
P201	2631-37-0	Phenol, 3-methyl-5-(1-methylethyl)-, methyl carbamate.
P092	62-38-4	Phenylmercury acetate
P093	103-85-5	Phenylthiourea
P094	298-02-2	Phorate
P095	75-44-5	Phosgene
P096	7803-51-2	Phosphine
P041	311-45-5	Phosphoric acid, diethyl 4-nitrophenyl ester
P039	298-04-4	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester
P094	298-02-2	Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl] ester
P044	60-51-5	Phosphorodithioic acid, O,O-dimethyl S-[2- (methylamino)- 2-oxoethyl] ester
P043	55-91-4	Phosphorofluoridic acid, bis(1-methylethyl) ester
P089	56-38-2	Phosphorothioic aci O,O-dimethyl ester
P040	297-97-2	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester
P097	52-85-7	Phosporothioic acid, O-[4-[(dimethylamino) sulfonyl]phenyl]0,0-dimethyl ester
P071	298-00-0	Phosphorothioic acid, O,O,-dimethyl O-(4- nitrophenyl) ester
P204	57-47-6	Physostigmine.
P188	57-64-7	Physostigmine salicylate.
P110	78-00-2	Plumbane, tetraethyl-
P098	151-50-8	Potassium cyanide
P098	151-50-8	Potassium cyanide K(CN)
P099	506-61-6	Potassium silver cyanide
P201	2631-37-0	Promecarb
P070	116-06-3	Propanal, 2-methyl-2-(methylthio)-, O-[(methylamino)carbonyl]oxime
P203	1646-88-4	Propanal, 2-methyl-2-(methyl-sulfonyl)-, O- [(methylamino)carbonyl] oxime.
P101	107-12-0	Propanenitrile
P027	542-76-7	Propanenitrile, 3-chloro-
P069	75-86-5	Propanenitrile, 2-hydroxy-2-methyl-
P081	55-63-0	1,2,3-Propanetriol, trinitrate (R)
P017	598-31-2	2-Propanone, 1-bromo-
P102	107-19-7	Propargyl alcohol
P003	107-02-8	2-Propenal
P005	107-18-6	2-Propen-1-ol
P067	75-55-8	1,2-Propylenimine
P102	107-19-7	2-Propyn-1-ol
P008	504-24-5	4-Pyridinamine
P075	fn1 54-11-5	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, (S)-, & salts
P204	57-47-6	Pyrrolo[2,3-b]indol-5-ol, 1,2,3,3a,8,8a- hexahydro-1,3a,8-trimethyl-, methylcarbamate (ester), (3aS- cis)-
P114	12039-52-0	Selenious acid, dithallium(1+) salt
P103	630-10-4	Selenourea
P104	506-64-9	Silver cyanide
P104	506-64-9	Silver cyanide Ag(CN)
P105	26628-22-8	Sodium azide
P106	143-33-9	Sodium cyanide
P106	143-33-9	Sodium cyanide Na(CN)
P108	fn1 57-24-9	Strychnidin-10-one, & salts
P018	357-57-3	Strychnidin-10-one, 2,3-dimethoxy-
P108	fn1 57-24-9	Strychnine, & salts
P115	7446-18-6	Sulfuric acid, dithallium(1+) salt
P109	3689-24-5	Tetraethyldithiopyrophosphate
P110	78-00-2	Tetraethyl lead
P111	107-49-3	Tetraethyl pyrophosphate
P112	509-14-8	Tetranitromethane (R)
P062	757-58-4	Tetraphosphoric acid, hexaethyl ester
P113	1314-32-5	Thallic oxide

P113	1314-32-5	Thallium oxide Tl2O3
P114	12039-52-0	Thallium(I) selenite
P115	7446-18-6	Thallium(I) sulfate
P109	3689-24-5	Thiodiphosphoric acid, tetraethyl ester
P045	39196-18-4	Thiofanox
P049	541-53-7	Thioimidodi carbonic diamide [(H2N)C(S)]2NH
P014	108-98-5	Thiophenol
P116	79-19-6 T	hiosemicarbazide
P026	5344-82-1	Thiourea, (2-chlorophenyl)-
P072	86-88-4	Thiourea, 1-naphthalenyl-
P093	103-85-5	Thiourea, phenyl-
P185	26419-73-8	Tirpate.
P123	8001-35-2	Toxaphene
P118	75-70-7	Trichlorome thanethiol
P119	7803-55-6	Vanadic acid, ammonium salt
P120	1314-62-1	Vanadium oxide V2O5
P120	1314-62-1	Vanadium pentoxide
P084	4549-40-0	Vinylamine, N-methyl-N-nitroso-
P001	81-81-2	Warfarin, & salts, when present at concentrations greater than 0.3%
P205	137-30-4	Zinc, bis(dimethylcarbamodithioato-S,S)-
P121	557-21-1	Zinc cyanide
P121	557-21-1	Zinc cyanide Zn(CN)2
P122	1314-84-7	Zinc phosphide Z[3]P[2], when present at concentrations greater than 10% (R,T)
P205	137-30-4	Ziram.

Appendix E. Employee Injury/Incident Report

WVU EMPLOYEE INJURY/INCIDENT REPORT (Case #_____)

Contact within 24 hours: Environmental Health and Safety (EHS) (304-293-3792). You can call in the injury @ 304.293. HURT (for Med Mgmt)) and report the high-lighted information.

Supervisors complete **both pages** and immediately fax to EHS (304)293-7257 and Med Mgmt (304)293-2644

For EH&S use only
OSHA Recordable
Yes___ No___

Reclassified _____

Privacy Case_____
WVU Occupational Medicine
Health Care Evaluation
Recommended_____
Describe on page 2 reason
for Evaluation

Serious Injury_____
Fatality_____
Near miss_____

SECTION ONE

1. Name of Injured: _____ **2. WVU ID No.** (700 xx xxxx):_____
(Last, Suffix) (First) (Middle) Click here to look up WVU ID

3. Gender:____Female ____Male **4. Date of Birth** ____/____ /____ or Age_____

5. Date of Incident____/____ /____

6. Time of Incident: ____:__AM ____:__PM during work___ entering work___ leaving work___ lunch/break___

7. Campus: Main___ Potomac___ WVUIT___ **8. Department**_____

9. Job Title_____

10. Employment Category: (Check one) Faculty___ Staff___ Student___ Employee___ Research Corp___

11. Status: Full-time___ Part-time___ Temporary___

12. Length of Employment: ___years **13. Time in occupation when incident occurred:** ___years

14. Describe Exactly what happened, Include timeline of event and OBJECT or SUBSTANCE that caused harm:
An example would be: slipped on wet floor, exposure to cleaning chemicals, cut with carpet knife. (For informational purposes, please submit detailed information on the appropriate Incident Description Statement Form(s).)

15. Location of Incident include building and room number, state if outdoors: i.e Engineering Sciences Bldg, Room G38)

16. Describe the INJURY or ILLNESS and Specific BODY PART(S) affected:
(An example would be: cut on palm of left hand or sprained lower back)

SECTION TWO

17. Was the victim wearing Personal Protective Equipment? (please specify)

18. Was the employee seen by a physician? ___Yes ___No **19. Name of Physician** _____

20. Location of Treatment_____

21. Was employee in Emergency room? ___Yes ___No

22. Was employee hospitalized overnight as a patient? ___Yes ___No

23. Type of Treatment received: (check type)

_____Set Fracture/broken bone ____Treat Infection _____Stitches/Sutures _____Tetanus Shot _____Surgery
_____Prescription ____Physical Therapy (more than once) _____Remove foreign Object from eye
_____Hearing Loss Other (explain)_____

SECTION THREE

24. Total lost work days after the day of incident ___ **25. Total days of restricted activity** ___

26. If employee has not returned to work check here ___ *(Please complete Employee Return-To-Work Notice)*

27. Was Worker Compensation Filed? Yes___ No___

Employee's Signature_____ Phone Number_____ Date_____

Supervisor's Signature_____ Phone Number_____ Date_____

Reviewer's Name_____Signature_____ Date_____

(EHS use only) Healthcare Needlestick injuries only: Sharps Injury:___ Body Fluids Exposure___

WVU EMPLOYEE INJURY/INCIDENT REPORT (Case #_____)

INCIDENT DESCRIPTION STATEMENT FORM

Supervisor, Injured Employee, and Witness complete a separate Statement Form

Please check appropriate box

☐ Supervisor ☐ Employee ☐ Witness

Name of Injured Employee: _____

Date of Injury: _____

Description of Incident: Describe in detail exactly what happened, Include: task(s) and procedure(s) being performed, timeline of events, and OBJECT and/or SUBSTANCE that may have been involved.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Name (Printed):_____

Signature: _____ Date: _____

Supervisors complete form and immediately fax to EHS (304) 293-7257
or mail Environmental Health and Safety Injury/Illness Prevention Program,
PO Box 6551, Morgantown, WV 26506

Appendix F. National Chemistry Week and Community Activity Safety Guidelines

These guidelines are based on the premise that all presenters care very much about the safety of their audiences and participants during demonstration shows and hands-on activities. Although these guidelines are primarily for the presenters of chemistry outreach programs, the responsibility for presenting safe chemistry programs falls on a much larger group of individuals. Local section leaders, community activity coordinators, volunteers, and even participants and their parents share the responsibility of ensuring safe environments for these programs and activities. The information presented in these guidelines will help in the selection and presentation of programs and activities to keep community activities safe.

For the purpose of these guidelines, a chemical is defined as any material used during the course of a demonstration or a hands-on activity. Material Safety Data Sheets (MSDS) should be available for all chemicals used in demonstrations and hands-on activities. Because these activities involve "doing science," presenters and participants will be required to do what scientists do—wear appropriate personal protective equipment that includes, at a minimum, chemical splash (cover) goggles that conform to the American National Standard Institute (ANSI) Z87.1 standard, types G or H.

The guidelines presented here are divided into four sections, two for types of facilities and two for types of activities.
1. Guidelines for Presentations and Activities at Scientifically Equipped Facilities
2. Guidelines for Presentations and Activities at Non-scientifically Equipped Facilities
3. Guidelines for Hands-On Activities
4. Guidelines for Chemical Demonstrations (ACS Division of Chemical Education)

Follow all guidelines appropriate for both site and type of activity. For example, a hands-on activity at a shopping mall would need to follow both the guidelines from Section 2 and those from Section 3, always using the more stringent rules of the two guidelines. If you observe any activity that puts the audience at risk, we encourage you to take action. If the situation is deemed immediately hazardous, take appropriate measures to stop the activity. If such action is taken, report the circumstances of the activity to the community activities coordinator and the local section executive committee. If you have concerns about other issues related to safety, address them to the presenter in a timely manner.

(Information regarding ACS liability insurance can be found at acs.org)

Presentations and Activities at Scientifically Equipped Facilities

Scientifically equipped facilities include:

- science facilities at colleges, universities, secondary schools, and science museums;
- research and manufacturing facilities; and
- any other type of facility that has laboratories.

It is assumed that these facilities generally have:

- extensive emergency equipment, including fire extinguishers;
- chemical supplies;
- adequate ventilation and air circulation;
- disposal procedures for chemical waste; and
- rules concerning personal safety of visitors and employees during community activities.

1. Secure pre-approval for use of the facilities.

Secure pre-approval of all hands-on activities and demonstrations from the laboratory safety director or other management official. Make facility security/safety officers aware of the planned activity.

2. Prepare supplies in an appropriate area.

Carry out demonstration and activity preparations in an area designed for working with chemicals. Put controls in place to ensure that the types and quantities of chemicals brought into the area are appropriate and kept to a minimum. Make certain that all chemicals are appropriately labeled including appropriate safety hazard warnings. Make MSDS available for all chemicals in the activity area.

3. Pretest demonstrations and activities.

Pretest programs, if possible, in the area in which they are to be performed. The pre-testing will help identify potential safety hazards.

4. Carefully review activities that produce loud noises.

Consider moving these activities outside. If they are carried out inside, be certain to notify management and security. In all cases, alert the audience to expect a loud noise and to cover (protect) their ears.

5. Identify issues related to chemical waste.

Establish in advance the types of chemical waste that will be produced and the procedure for waste disposal. Be certain to follow the federal, state, and local regulations for waste disposal.

6. For demonstrations, provide adequate shielding for the audience and the demonstrator.

The safety of the audience is paramount. It must not be assumed that the members of the audience are protected by distance. Protection could be achieved by shielding the audience and by the demonstrator wearing chemical splash (cover) goggles (ANSI Z87.1) types G or H. Alternately, chemical splash (cover) goggles could be worn by all participants (demonstrator and audience). Have a goggle sanitation plan for goggles used by multiple persons. One possible method of sanitation is to immerse the goggles in diluted household laundry bleach (1 part bleach to 9 parts water), followed by thorough rinsing and drying. Know the location of the nearest eye wash fountain and safety shower and ensure in advance that the eyewash and safety shower are working properly. Discuss safety precautions with the audience as well as the locations of the nearest restrooms.

7. If the activity is hands-on, provide adequate personal protective equipment for the participants, the leader(s), and any assistants.

The safety of all persons involved is paramount. All participants, helpers, and presenters must wear eye protection in the form of chemical splash (cover) goggles (ANSI Z87.1) types G or H. Prepare and execute a goggle sanitation plan for goggles used by multiple persons. One possible method of sanitation is to immerse the goggles in diluted household laundry bleach (1 part bleach to 9 parts water), followed by thorough rinsing and drying. If the activity is likely to be messy, consider providing disposable laboratory aprons and gloves. If aprons are to be reused, be certain to label the front of the apron. Never reuse disposable gloves. Prior to the activity, discuss safety precautions with the audience as well as the locations of the nearest restrooms.

8. Perform programs in areas with adequate ventilation.

Make certain the facility being used for the activity or demonstration has adequate ventilation for the chemicals being used.

9. Make plans in advance for adequate crowd control.

Make advance plans and provide personnel to ensure that the audience size is maintained at a predetermined level for the activities. This includes control over the entrances to limit the number of persons admitted to the area. Make certain that the number of volunteers is appropriate for the activities and for the expected size of the audience. For hands-on activities, it is very important to control the number of persons having access to the area of the activity.

10. Plan exit routes.

Make certain that there is easy access to and exit from the area of the demonstration or activity. Include an explanation of exit procedures and have adequate personnel to supervise evacuation in case of an emergency. Be aware of all on-site fire regulations regarding audience size and emergency evacuations.

11. Do not allow consumption of food or drink in the demonstration/activity area.

12. Have spill kits available that are appropriate for the chemicals to be used.

13. Ensure that fire protection is readily available in the immediate area.

14. Distribute handouts complete with safety recommendations.

If the description of the activity is distributed, make sure that the procedure is well tested and details all safety related concerns. All ACS materials have undergone safety review and contain appropriate guidelines.

Presentations and Activities at Non-scientifically Equipped Facilities

Non-scientifically equipped facilities include:

- elementary schools
- exhibit halls
- hospitals
- museums
- libraries
- senior citizen centers
- shopping malls
- sports facilities
- theaters

These facilities generally lack:

- extensive emergency equipment, including fire extinguishers;
- chemical supplies;
- adequate ventilation and air circulation;
- disposal procedures for chemical waste; and
- rules concerning personal safety of visitors and employees during community activities.

1. Secure approval in writing for use of the facility from its management.

Make management fully aware of the specific demonstrations and activities that are planned, any inherent hazards, and the precautions being taken to mitigate those hazards. Make facility security/safety officers aware of the planned activity.

2. Inspect the facility to ensure its adequacy.

Make no assumptions about the facility that will be used. Prepare a checklist of items necessary for the activities to be carried out, including basics such as water and electricity. Keep in mind that non-scientific facilities have inadequate ventilation and air exchange compared with scientific facilities. Make certain an appropriate fire extinguisher is available in the immediate area even if you must supply one.

3. Be aware of audience size limitations set by local fire regulations. Fire regulations may also determine what materials can be brought into the facility.

4. Use care in selecting the demonstrations/activities to be done in this type of facility.

For example, avoid reactions that produce loud noises, flames, smoke, and fumes.

5. Pretest demonstrations and activities.

Because it may not be possible to pre-test the demonstrations and activities in the facility to be used, pre-test them with an age-appropriate helper in a similar area. During the pre-testing process, identify and correct potential safety problems. Pre-testing will also ensure that the planned activity produces the expected results.

6. Minimize on-site reagent preparation.

For example, pre-weigh samples in bottles to which water may be added on-site to prepare solutions. This eliminates the need to bring large quantities of solution to the facility.

7. Consider the time length of demonstrations and activities.

In a facility that has a large turnover of people, consider the use of brief demonstrations and activities. This is important for crowd control.

8. Do not take flammables or combustibles [as defined by the National Fire Protection Association (NFPA); www.nfpa.org] into a non-scientifically equipped facility.

9. Do not use flames of any type.

Caution must also be exercised when using hotplates. Never use a hotplate to heat flammable materials.

10. Carefully review activities that produce loud noises.

Consider moving these activities outside. If they are carried out inside, be certain to notify management and security. In all cases, alert the audience to expect a loud noise and to cover their ears.

11. Use plastic, non-breakable containers and supplies.

Keep use of glass to a minimum. Use glass only when necessary and with appropriate safety precautions.

12. Consider issues related to the transport of chemicals and removal of waste.

The transport of chemicals to the event site and removal of waste afterwards present potential problems, including legal problems, to those in charge of the programs.

A. To minimize the potential problems associated with the transport of chemicals to the facility, give careful consideration to the planned activities and demonstrations. You should strongly consider developing demonstrations and activities that use chemicals that may be purchased at local stores such as hardware, grocery, and discount stores. Be aware that there could be potential problems associated with transporting these chemicals to the facility, although some of these chemicals (e.g., drain cleaner, muriatic acid) would not be appropriate for use in community activities. Make certain that all chemicals are appropriately labeled. Include any hazard and handling information. When practical, make MSDS available for all materials used.

B. If possible, develop demonstrations and activities that "neutralize" the wastes that are produced. Depending on the nature of the liquid wastes, it may be possible to dispose of some or all of the wastes on-site through the sanitary sewage system, provided permission to do so has been obtained from local sewer/sanitation authorities. This must not be done unless you have previously secured management approval. If the waste is transported off-site, it is important to observe all federal, state, and local regulations governing such transport.

C. Label all waste and dispose of it in accordance with EPA or equivalent local regulations.
D. Follow the rule "if you take it in, you must take it out" as much as possible and always for any hazardous and potentially hazardous substances.

13. For demonstrations, provide adequate shielding for the audience and the demonstrator.

The safety of the audience is paramount. The audience must be kept a minimum distance from demonstrations; a minimum of five feet is recommended. It must not be assumed that the members of the audience are protected by distance. Protection could be achieved by shielding the audience and by the demonstrator wearing chemical splash (cover) goggles (ANSI Z87.1) types G or H. Alternately, chemical splash (cover) goggles could be worn by all participants (demonstrator and audience). Have a goggle sanitation plan for goggles used by multiple persons. One possible method of sanitation is to immerse the goggles in diluted household laundry bleach (1 part bleach to 9 parts water), followed by thorough rinsing and drying. Know the location of the nearest eye wash fountain and safety shower and ensure in advance that the eyewash and safety shower are working properly. Discuss safety precautions with the audience as well as the locations of the nearest restrooms.

14. If the activity is hands-on, provide adequate personal protective equipment for the participants, the leader(s), and any assistants.

The safety of all persons involved is paramount. All participants, helpers, and presenters must wear eye protection in the form of chemical splash (cover) goggles (ANSI Z87.1) types G or H. Prepare and execute a goggle sanitation plan for goggles used by multiple persons. One possible method of sanitation is to immerse the goggles in diluted household laundry bleach (1 part bleach to 9 parts water), followed by thorough rinsing and drying. If the activity is likely to be messy, consider providing disposable laboratory aprons and gloves. If aprons are to be reused, be certain to label the front of the apron. Never reuse disposable gloves. There should be a discussion with the audience of the safety precautions being taken as well as the locations of the nearest restrooms.

15. Make plans in advance for adequate crowd control.

Make advance plans and provide personnel to ensure that the audience size is maintained at a predetermined level for the activities. This includes control over the entrances to limit the number of persons admitted to the area. Make certain that the number of volunteers is appropriate for the activities and for the expected size of the audience. For hands-on activities, it is very important to control the number of persons having access to the area of the activity.

16. Plan exit routes.

Make certain that there is easy access to and exit from the area of the demonstration or activity. Include an explanation of exit procedures and have adequate personnel to supervise evacuation in case of an emergency.
Be aware of all on-site fire regulations regarding audience size and emergency evacuations.

17. Do not allow consumption of food or drink in the demonstration/activity areas.

18. Have spill kits available that are appropriate for the chemicals to be used.

19. Distribute handouts complete with safety recommendations.

If the description of the activity is distributed, make sure that the procedure is well tested and details all safety related concerns. All ACS materials have undergone safety review and contain appropriate guidelines.

Guidelines for Hands-on Activities

When hands-on activities are planned, regardless of the location, certain precautions must be taken to protect the participants and those directing and assisting with the activity. The protection is necessary regardless of the nature of the activity, even if the "safest of chemicals" are being used. These guidelines must be used in conjunction with one of the two facility guidelines.

1. Pretest all planned activities to ensure that they work and to identify and eliminate any safety problems.

2. Select chemicals that carry a minimum of risk for use in hands-on activities.

Keep in mind common allergies such as those to different varieties of nuts, latex, and sulfites.

3. Explain the procedures clearly to ensure that all participants understand and agree to follow the procedures before beginning the activity.

4. Make provisions to ensure that adequate experienced help is available to carefully oversee the experimenters carrying out the hands-on activities.

5. Supervise participants.

Do not allow unsupervised activity. Do not allow any extension of the planned activity unless approved by the presenters. Prior to starting any activity, discuss safety precautions with the audience as well as the locations of the nearest restrooms.

6. All participants, helpers, and presenters must wear appropriate personal protective equipment.

The safety of all persons involved is paramount. All participants, helpers, and presenters must wear eye protection in the form of chemical splash (cover) goggles (ANSI Z87.1) types G or H. Have a goggle sanitation plan for goggles used by multiple persons. One possible method of sanitation is to immerse the goggles in diluted household laundry bleach (1 part bleach to 9 parts water), followed by thorough rinsing and drying. If the activity is likely to be messy, consider providing disposable laboratory aprons and gloves. If aprons are to be reused, be certain to label the front of the apron. Never reuse disposable gloves.

7. Make all participants aware of all safety precautions.
Do not allow anyone to participate in any activity if they have missed procedural and safety instructions.

8. Exercise caution with flames.
Never use alcohol burners in any type of activity. It is inappropriate to use a flame in a non-scientific facility. If burners are used in a laboratory setting, make certain that the experimenters are old enough to understand the use and dangers involved. Be careful of loose-fitting clothing, and make certain that long hair is tied back or otherwise prevented from hanging down when using burners. Caution must also be exercised when using hotplates. Never use a hotplate to heat flammable materials.

9. Carefully control activities using the sense of smell.
Prepare in advance any activity that involves smelling any substances. Allow only safe, commercially available substances to be smelled. Additionally, these should be at minimal concentrations even if dilution is required. Teach participants about the dangers of smelling chemicals and instruct them in the proper technique—wafting a small amount of vapor from the container to the nose rather than placing the nose directly over the container. Use professional discretion in selecting substances for these types of activities being particularly aware of chemical sensitivities (allergies).

10. Do not perform activities that involve tasting.
This guideline is consistent with the earlier guideline that prohibits the consumption of food or drink in the demonstration areas. In keeping with standard, safe chemical practice, chemists do not taste substances used in their activities.

11. Instruct all participants to wash their hands immediately upon completion of the activity and before leaving the facility in which the activity takes place.

Guidelines for Chemical Demonstrations

When demonstrations are planned, regardless of the location, certain precautions must be taken to protect the presenters, participants, and audience. Protection is necessary regardless of the nature of the activity, even if the "safest of chemicals" are being used. It is recommended that highly hazardous, highly flammable, or carcinogenic substances, such as benzene, carbon tetrachloride, carbon disulfide, and formaldehyde, not be used in any demonstration activity. These guidelines must be used in conjunction with one of the two facility guidelines.

Minimum Safety Guidelines for Chemical Demonstrations ACS Division of Chemical Education

Chemical Demonstrators Must:

1. Know the properties of the chemicals and the chemical reactions involved in all demonstrations presented.
2. Comply with all local rules and regulations.
3. Wear appropriate eye protection for all chemical demonstrations.
4. Warn members of the audience to cover their ears whenever a loud noise is anticipated.
5. Plan the demonstration so that harmful quantities of noxious gases (e.g., N02, S02, H2S) do not enter the local air supply.
6. Provide safety shield protection wherever there is the slightest possibility that a container, its fragments or its contents could be propelled with sufficient force to cause personal injury.
7. Arrange to have a fire extinguisher at hand whenever the slightest possibility for fire exists.
8. Not taste or encourage spectators to taste any nonfood substance.
9. Not use demonstrations in which parts of the human body are placed in danger (such as placing dry ice in the mouth or dipping hands into liquid nitrogen).
10. Not use open containers of volatile, toxic substances (e.g., benzene, CCl4, CS2, formaldehyde) without adequate ventilation as provided by fume hoods.
11. Provide written procedure, hazard, and disposal information for each demonstration whenever the audience is encouraged to repeat the demonstration.
12. Arrange for appropriate waste containers for and subsequent disposal of materials harmful to the environment.

Appendix G. Sign-off Sheet

Eberly College of Arts and Sciences

Laboratory Safety Manual

2019

I have read and I understand the safety information contained in the Eberly College Laboratory Safety Manual. I will follow the safety procedures and precautions and incorporate them into my standard operating procedures when working in the laboratory.

_____	_____
PRINTED NAME	DATE
_____	_____
SIGNATURE	DATE
_____	_____
OFFICE TELEPHONE NUMBER	CELL PHONE NUMBER
_____	_____
EMERGENCY CONTACT NAME	EMERGENCY CONTACT TELEPHONE NUMBER

Complete this form and submit it to your Chemical Hygiene Officer.

Michael McKinstry, Department of Biology
Barbara Foster, C. Eugene Bennett Department of Chemistry
Casper Venter, Department of Forensic and Investigative Science
Dr. Graham Andrews, Department of Geology and Geography
Dr. D.J. Pisano, Department of Physics and Astronomy