Eberly College of Arts and Sciences
Department of Biology
Chemical Hygiene Plan

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Table of Contents

1. Introduction

The Department of Biology Chemical Hygiene Plan (CHP) was developed to meet the requirements of OSHA 29 CFR 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories*. This regulation, known as the OSHA Lab Standard, was created to minimize employee exposure to hazardous chemicals in the laboratory. By OSHA definition, a hazardous chemical is any chemical which is a physical or health hazard. This standard does not apply to laboratory chemicals which provide no potential threat upon employee exposure (i.e., dip-and-read tests). A laboratory is defined as a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis. A laboratory worker is defined as an individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments. This Chemical Hygiene Plan 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 in the laboratory.

2. Responsibilities

2.1. ***Departmental Chairperson*** – The Chair of the Biology Department has the following responsibilities:

Oversees the implementation of and compliance with the Department's Chemical Hygiene Plan.

Ex officio member of Departmental Safety Committee

Attempts to secure the funds needed for safety-related purchases and projects.

Appoints faculty members, a graduate student member, and other appropriate representatives to serve on the Departmental Safety Committee.

2.2. ***Chemical Hygiene Officer*** (CHO) – The CHO for the department has the following responsibilities:

Establish and maintain a departmental chemical hygiene plan (CHP) that promotes a safe and healthy environment in which to teach, learn, and conduct research.

Ensures that an annual inventory update of <u>purchased or produced</u> chemicals (specifying owner, amount of material, building, room number, and location of the material within the room) is completed by July 1 of each year.

Ensures that a chemical spill response plan and emergency action plan for the department have been written and disseminated.

Promotes CHP compliance of employees.

Ex officio member of Departmental Safety Committee

Conducts regular inspections of the laboratories and prep rooms.

Keeps current of legal requirements concerning regulated substances by reading material provided by the safety program coordinator for the college.

Seeks ways to improve the chemical hygiene program.

Ensures that employees can receive appropriate training and information regarding the chemical hazards in their work area. The frequency of refresher information and training shall be determined by the CHO.

The CHO will notify affected employees in writing of any monitoring results provided by the Department of Environmental Health and Safety, either individually or by posting results in an appropriate location accessible to employees.

Attends mandatory CHO training that is conducted by the Eberly College Safety Program Coordinator and/or the institution.

Encourages laboratory employees to attend specialized training provided by the institution (i.e., first-aid training, fire extinguisher training, and gas cylinder training).

2.3. ***Chair, Departmental Safety Committee*** – The Chair of the Departmental Safety Committee has the following responsibilities:

Maintains inspection, personnel training, and inventory records.

Ensures that departmental Material Safety Data Sheets (MSDS) are accessible to all laboratory workers. Maintains the departmental collection of MSDS and makes sure it is updated at least once per year.

Keeps current of legal requirements concerning regulated substances by reading material provided by the safety program coordinator for the college.

Assists with regular inspections of the laboratories and prep rooms.

Ensures that employees are informed that they can contact Environmental Health & Safety about the university's medical monitoring program when a chemical exposure has taken place or is suspect based on signs and symptoms (see section 4.13).

2.4. ***Departmental Safety Committee*** – The Departmental Safety Committee has the following responsibilities:

Annually reviews and revises, as needed, the Chemical Hygiene Plan for the department. All changes are to be approved by the CHO, Departmental Chair, and the Eberly College Safety Program Coordinator.

Reviews accident reports and makes appropriate recommendations to the CHO and the Departmental Chair regarding proposed changes in the laboratory procedures.

Assists with regular inspections of the laboratories and prep rooms.

Keeps current of legal requirements concerning regulated substances by reading material provided by the safety program coordinator for the college.

2.5. ***Laboratory Supervisors*** – Faculty and staff supervisors for research and teaching laboratories have the following responsibilities:

Identify workers who, in the course of their work, may be exposed to hazardous chemicals.

Training and information shall be provided at the time of an employee's initial assignment to a work area and prior to assignments involving new exposure situations.

Ensure the implementation, in their lab, of all procedures found in the CHP.

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.

Report to the physical plant and CHO when ventilation systems and other protective equipment are not functioning properly.

When a new material is ordered, the Laboratory Supervisor will encourage employees to follow the guidelines contained in the MSDS datasheet for that material and ensure that the facilities meet established requirements.

Ensures that access to eyewash stations and safety showers is not restricted in any way.

Determines the required control measures and personal protection equipment (PPE) needed for each operation and ensures that the required PPE is available, used, and in working order.

Encourages workers to seek appropriate training when required.

Ensures that the CHO, Departmental Chair, Eberly College Safety Program Coordinator, and the Department of Environmental Health and Safety are notified of incidents.

Ensures that all chemical waste produced in their laboratory is disposed of properly.

2.6. ***Laboratory Workers*** – All workers using chemicals in research and teaching laboratories have the following responsibilities:

Read, understand, and follow all safety rules and regulations that apply to the work area.

Maintain qualifications by meeting laboratory chemical safety training requirements.

Read the Material Safety Data Sheets (MSDS) for the chemicals they use.

Treat unknown chemicals as hazardous substances.

Keep the quantity of chemicals stored in the laboratory to a level that is consistent with the work in progress.

Follow appropriate protocols and use appropriate PPE when working with chemicals.

Plan and conduct each use of hazardous chemicals in accordance with the CHP.

Identify all ignition sources and follow safe operating procedures when working with flammable chemicals.

Immediately report any job-related illness or injury to the supervisor.

3. Facilities

3.1. ***Fire Alarm Policy -*** When a fire alarm sounds, 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 are responsible for 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.

3.2. ***Design –*** 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. Hood face velocity should be 80-120 linear feet per minute. In addition, all lab personnel:

Should know the location of the nearest safety showers, eyewash stations, fire blankets, and fire extinguishers.

Should only conduct laboratory projects appropriate to the facilities available.

Should **not** make any modifications to the laboratory facility without consulting with the WVU Department of Environmental Health and Safety.

Should **not** use hazardous chemicals for any procedure if there is a possibility that the ventilation system cannot handle any gas or vapor emissions that may be produced.

4. General Protocols & Procedures

4.1. ***Fundamentals*** **-** To minimize exposure to hazardous chemicals, all lab workers and students should:

Read the label and the Material Safety Data Sheet before using a chemical for the first time in the laboratory. Follow all directions that pertain to chemical handling, storage, transport, and disposal.

Take precautions when handling all laboratory chemicals to avoid skin and eye contact and do not directly smell chemicals. Never taste any chemical.

Assume that all chemicals of unknown toxicity are toxic.

Perform work in fume hoods to prevent exposure to airborne substances.

Observe the Permissible Exposure Limits (PEL) of OSHA and the Threshold Limit Values (TLV) of the American Conference of Governmental Industrial Hygienists (ACGIH). These limits and threshold values can be found on the appropriate MSDS sheet.

4.2. ***Housekeeping*** **–** The following housekeeping practices should be observed in each laboratory:

Access to exits, emergency equipment, and utilities must never be blocked. Coats, bags, and other personal items must not be stored on the bench-tops or in the aisle ways.

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 and any other special warnings (e.g. the hazard class).

Promptly wipe up all liquid spills and ice on the floor.

Keep work areas clean and uncluttered. Bench-tops and hoods should remain clear of broken glass, spilled chemicals, paper litter, etc.

Chemical hazards should be not be placed within two inches of the edge of the bench tops.

Hallways and stairways should not be used as chemical storage areas.

Do not conduct unattended experiments without the authorization and prior approval of the Laboratory Supervisor.

Do not store chemicals on the floor.

Do not block the sink drains. Place rubber matting in the bottom of the sinks to prevent breakage of glassware.

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.

Clean up work areas at the end of the operation or day.

Properly dispose of broken glass and sharps (i.e., needles and razor blades) – do not throw sharp material into the trash can. If broken glassware is contaminated with a hazardous substance, the glassware must be treated as a hazardous substance.

When not being used, drawers and cabinets must be kept closed.

Properly dispose of all waste chemicals.

Formal housekeeping and chemical hygiene inspections will be conducted on a regular basis by the Eberly College Safety Program Coordinator, the CHO, and/or the Departmental Safety Committee.

4.3. ***Personal Protective Equipment*** (PPE) -

Emergency equipment must be available and compatible with the degree of potential chemical hazard.

Always review new procedures and refer to the MSDS to determine the degree of PPE that is required for each chemical that will be used in the laboratory.

Wear safety goggles at all times (and over eyeglasses) when working with corrosive chemicals and when a splash hazard exists. These goggles should conform to ANSI Z87.1a-1991, *Practice for Occupational and Educational Eye and Face Protection*.

Safety glasses with UV-absorbing lenses should be worn when working with radiation of wavelengths shorter than 250 nm.

Lab coats or aprons must be worn at all times when working with chemicals in the laboratory.

Gloves that are appropriate to the degree of hazard of the chemical (according to the MSDS) must be worn at all times.

> Refer to the “Glove Compatibility Guide for Chemicals” on the University of Nebraska-Lincoln Environmental Health and Safety Web site for information on choosing the appropriate glove for use with hazardous materials: http://ehs.unl.edu/Documents/ChemSafe.cfm.

Inspect gloves for defects before wearing. Remove gloves before handling pens, notebooks, doorknobs, radios, computer keyboards, and telephones. Remove gloves before exiting the laboratory.

Respirators should be used only by trained employees.

> Respirator use must be in compliance with *OSHA 29 CFR 1910.134* and ANSI Z88.2-1992, *Practices for Respiratory Protection*.

Ear protection must be worn when needed to comply with *OSHA 29 CFR 1926.52.*

All photographs that are taken in a laboratory setting in the Life Sciences Building must depict laboratory workers who are wearing proper personal protective equipment (i.e., goggles, gloves, and laboratory coat). Notify the Eberly College Safety Program Coordinator, the Chemical Hygiene Officer and/or the Department Chairperson when photographs of laboratory workers are scheduled to be taken for publication purposes.

4.4. ***Emergency Safety Equipment***

A written emergency action plan should be developed and made available to all personnel in the department. The plan should include procedures for evacuation, ventilation failure, first-aid, and incident reporting.

Fire extinguishers will be made available in the laboratory and will be tested on a regular basis by the Office of Environmental Health and Safety.

Eye wash stations and safety showers should be located within 10 seconds of the chemical or physical hazard and inspected on a regular basis by the Office of Environmental Health and Safety.

Fire blankets will available in laboratories, 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 modesty when treating a victim under a safety shower in the event of a chemical spill.

Access to fire alarms and telephones will be made available for emergency use.

Maintain clear pathways to fire extinguishers, eye wash stations, fire blankets, first-aid kits, and safety showers.

4.5. ***Chemical Spills***

Guidelines for chemical spills based on hazard class are found in section 6.2.1.

In the event of a chemical spill, consult the label and the MSDS, and refer to the departmental Emergency Action Plan.

If the spill is flammable, toxic, or volatile, warn all laboratory occupants, immediately extinguish all flames, and turn off all spark-producing equipment.

If appropriate, according to the departmental spill policy, promptly clean up spills according to the directions on the MSDS.

- Use appropriate protective equipment and clothing.
- Properly dispose of chemical waste.

All spills should be reported immediately to the CHO and the Department Chairperson.

4.6. ***Signs and Labels***

Emergency signs shall be posted on all laboratory and prep room doors by the Office of Environmental Health and Safety. The signs must contain the names and telephone numbers of all emergency contact personnel.

Label all secondary containers, including waste receptacles, with the contents and appropriate warnings (e.g. the hazard class).

Have designated location(s) for safety shower, eye wash, fire extinguisher, first-aid station, fire blanket, and emergency telephone.

Post warning signs for areas of special or unusual hazards.

4.7. ***Chemical Procurement***

Before purchasing hazardous chemicals the lab supervisor should consider the following:

- the availability of PPE and level of training that is required for the safe handling of the chemical
- the existence of proper storage facilities
- special handling precautions
- adequate laboratory ventilation
- containment issues in the event of a chemical spill, fire, or flood
- the amount of the chemical ordered should be the minimum amount required for the project
- the chemical must be able to be disposed in the institution's waste stream

All chemical substances should be opened by trained laboratory personnel in a laboratory or prep room with proper ventilation.

4.8. ***Chemical Storage***

All chemicals should be properly labeled and dated upon receipt. Properly label all secondary containers with the chemical name, hazard class, and any special warnings.

Refer to the manufacturer's label for a "use before" date on the bottle.

Store chemicals by compatibility, not alphabetically. Read the MSDS and heed the precautions regarding the storage requirements of incompatible materials. For additional information on chemical compatibilities, refer to the University of Nebraska-Lincoln Web sites:

http://ehs.unl.edu/ChemicalInfo/compchrt.html
http://ehs.unl.edu/ChemicalInfo/comptabl.html

Do not expose chemicals to direct sunlight or heat.

Long-term storage of chemicals on bench-tops, on the floor, or inside hoods is not permissible unless the hood is clearly marked "For Chemical Storage Only". Use storage trays and other secondary containment devices to minimize the spillage of material in the event of a container leak or break. Use secondary containment for perchlorate solutions stored in containers that are made of non-organic materials. Use secondary containment for hydrofluoric acid solutions that are stored in containers made of non-glass material. Do not store hydrofluoric acid solutions with hazardous liquids contained in glass. Do not store perchlorate solutions with hazardous liquids contained in organic material (plastic).

Safety storage cabinets may be used for long-term storage of limited amounts of chemicals.

Toxic chemicals should be segregated in a well-identified area with adequate local exhaust ventilation. Chemicals that are highly toxic should be placed in unbreakable secondary containers.

Non-volatile chemicals that are non-toxic may be stored in open shelves within the laboratory.

Shelving should be secured to the wall and should ideally contain lips to prevent accidents.

Do not store liquid chemicals on shelves over five feet in height.

Chemicals and flammable liquids requiring cool storage should be placed in sealed and appropriately labeled containers in explosion-proof refrigerators if they are available. Periodically defrost refrigerators to ensure maximum efficiency.

Do not store or consume food and beverages in the laboratory.

Label all refrigerators that contain radioactive materials with the appropriate symbols and warnings. Conduct regular inspections of the refrigerators to ensure that they are not contaminated.

Rooms specifically designated for chemical storage and handling, such as prep rooms, storerooms, waste collection rooms, and chemical laboratories are controlled-access areas.

4.9. ***Transportation of Chemicals***

If chemicals are to be hand-carried, the chemicals should be placed in a safety container or rubber bucket.

If possible, do not allow other passengers to ride on an elevator while it is being used to transport chemicals.

Avoid transporting chemicals in crowded areas.

Chemicals should be transported on carts with attached side rails to contain the bottles. Liquid chemicals should be transported on carts that have trays of single piece construction at least two inches deep to contain any spill that may occur. Liquid bottles should be separated or insulated by plastic foam or cardboard that is placed between the bottles. Liquids should never be transported in basket type carts or in carts whose shelves would allow leakage of spilled liquid. Do not over fill carts. Gas cylinders require special carts. Do not carry carts over obstructions or up or down stairs.

Always ground the drum and receiving vessel when transferring flammable liquids from a drum to prevent a static charge buildup.

All chemicals that are transported to field sites must be handled in a prudent manner, packaged appropriately, properly labeled, and transported back to the Life Sciences Building for disposal via the university chemical waste disposal system. Under no circumstances should any chemicals that originated at the Department of Biology be left at the field site or disposed of at the field site.

Prior to the planned field event, faculty 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.

4.10. ***Waste Disposal***

Waste chemicals must be stored in separate screw cap containers and must be labeled in compliance with institutional regulations. Halogenated materials must be grouped separately from non-halogenated materials.

Waste containers should be the minimum size that is required and should contain one to two inches of head space prior to collection.

Chemical disposal should follow procedures contained in the appropriate MSDS sheets.

Contact the Office of Environmental Health and Safety to obtain the hazardous waste procedures and forms.

Hazardous waste will be collected on a regular basis by institutional personnel.

4.11. ***Laboratory Equipment***

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 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.

Centrifuges should be positioned securely on 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.

When using Dewar flasks; shield or wrap them with tape to contain implosions.

Use laboratory equipment for the intended purpose only.

Periodically clean and examine all laboratory equipment.

Do not block walkways or aisles with extension cords. Periodically inspect extension cords for visible defects.

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.

When using UV lamps, wear UV-absorbing eye protection, as described in the operating procedures for the instrument. Cover exposed skin. Do not touch mercury arc lamps as the oil on our skin can lead to early lamp failure.

4.12. ***Environmental Monitoring***

Employee exposure monitoring shall be provided upon request.

Regular monitoring for airborne substances may be appropriate when testing a new ventilation system or when redesigning laboratory hoods.

Regular monitoring may be appropriate if a hazardous substance is stored in the laboratory or if the substance is used more than twice a week.

4.13. ***Medical Monitoring Program***

WVU has an Employee Medical Monitoring Program. 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.

4.14. ***Record Maintenance***

Accident records will be written and submitted to the CHO, chair of the departmental safety committee, and the chair of the Biology Department.

Inventory of High Hazard substances (e.g., select carcinogens, reproductive toxins, and substances that have a high degree of acute or chronic toxicity) will be maintained by the CHO.

Medical records are to be retained by the appropriate university office.

EHS and the CHO will retain copies of all personnel training records.

EHS and the Department of Biology will retain a copy of the annually-updated departmental chemical inventory.

The CHO will maintain the departmental CHP and each lab supervisor will update the Material Safety Data Sheets (MSDS) for their lab on at least an annual basis.

4.15. ***Avoidance of Routine Exposure***

Review all proposed laboratory procedures to determine the potential health and safety hazards before beginning work in the laboratory. Refer to the MSDS for guidance on chemical storage, handling, and disposal. Avoid underestimation of risk when handling hazardous materials.

Minimize all chemical exposure. Avoid ingestion, injection, inhalation, eye contact, and skin contact with hazardous materials. Do not directly smell chemicals. Never taste any chemical. When instructed to smell a chemical, gently waft the vapors toward your nose. Do not directly inhale the vapors.

Observe the PEL (Permissible Exposure Limit) and TLV (Threshold Limit Value) of each hazardous material in the laboratory. These limits are listed in the MSDS.

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.

Vent apparatuses which may discharge chemicals (vacuum pumps, distillation columns, etc) into local exhaust or hoods.

Inspect gloves and glove boxes before use.

Do not allow release of toxic substances into cold rooms since these rooms recirculate the air.

Always wash exposed areas of skin after chemical usage and before exiting the laboratory.

Never wear gloves or lab coats outside of the laboratory or into areas where food is stored and consumed.

Eating, smoking, using smokeless tobacco products, drinking, chewing gum, or applying cosmetics in areas where laboratory chemicals are present is prohibited.

Food, beverages, and cosmetics are not to be stored in chemical storage areas or refrigerators.

Do not use glassware or utensils used for laboratory work for any other purpose (e.g., do not drink from beakers).

Laboratory workers should wash laboratory apparel separately from personal clothing.

Keep chemical containers closed when not in use.

4.16. ***Safety Rules***

Unauthorized experiments are strictly forbidden. Employees are not permitted to deviate from the assigned work schedule without prior authorization from the laboratory supervisor.

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.

Read the MSDS and the container label before using a hazardous chemical for the first time in the laboratory.

Report all injuries, accidents, incidents, and near-misses to the CHO and to the Laboratory Supervisor.

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.

Appropriate personal protective equipment must be worn at all times in the laboratory.

Appropriate eye protection (safety glasses, goggles, and/or a face shield) must be worn by all persons (including visitors) where chemicals are used or stored.

Wear appropriate gloves when handling toxic materials. Inspect all gloves for holes and defects before using.

The use of contact lenses in the laboratory is strongly discouraged. If an employee must wear contact lenses when working with hazardous substances, then safety glasses must be

worn.

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.

Notify your supervisor if you experience any sensitivities to any chemicals.

When heating a test tube or other apparatus, never point the apparatus toward yourself or your laboratory colleagues.

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 glassware has cooled before you touch it.

Dilute concentrated acids and bases by slowly pouring the acid or base into the water with stirring.

Excessive noise and practical jokes are prohibited.

Avoid working alone in the laboratory.

Do not pipette any substance by mouth in the laboratory; use a pipette aid.

Properly dispose of all chemical wastes. Do not pour chemicals down the drains.

Report unsafe conditions to the Laboratory Supervisor and CHO.

Children and other unauthorized persons are not permitted in the laboratory.

4.17. ***Personal Apparel***

Wear clothing that provides protection from chemical spills in the laboratory. When working with chemicals, shorts and short skirts are inappropriate apparel. You should wear clothing that sufficiently covers your upper and lower body.

Wear shoes at all times in the laboratory. Do not wear perforated, open-toed, open-backed, or high-heeled shoes or sandals.

For your protection, jewelry (i.e., rings, bracelets, necklaces, and watches) should not be worn when working with chemicals 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 (e.g., when mercury comes into contact with gold).

Hair longer than shoulder length and loose sleeves must be confined.

4.18. ***Unattended Operations***

Obtain permission from the supervisor prior to conduct any unattended operations.

Leave lights on and post a sign on the door to inform others (e.g., janitorial workers) that an unattended operation is in progress.

Return periodically to check on the unattended operation.

Provide for the containment of toxic substances in the event of equipment or utility failure.

Make sure that water hoses are securely fastened to faucets and apparatus to avoid floods.

The laboratory doors should be posted with emergency contact names and telephone numbers.

4.19. ***Use of Hoods***

When using the hood, the sash opening should be kept at a minimum to maximize 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 substance.

Use the hood when working with any flammable liquid or gas.

Keep hoods closed when not in use.

Do not store chemicals or equipment in a hood where work is performed.

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 do not obstruct the view of the hood with posters, decals, or other items.

4.20. ***Accident Procedures***

After each incident, the employee must complete an incident report and submit it to the CHO. Provide a copy of the appropriate MSDS to the attending physician, as needed.

Cuts: For a minor cut, flush the wound with tepid running water to remove any chemical contaminants. If there is 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 9-911 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 9-911. 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 moist 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.

Hydrofluoric Acid (HF) Exposure: Hydrofluoric acid is extremely corrosive and 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 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 9-911. 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 flush for 15 minutes, holding the eyelids apart, and call 9-911. If ingested, call 9-911 immediately. If the vapor is inhaled, move the victim to fresh air and call 9-911.

Chemical Burns: Immediately flush the area with tepid running water for 15 minutes. Remove any jewelry, contaminated clothing, and shoes. Place the victim in the safety shower, if necessary. **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: CALL 9-911 IMMEDIATELY. Do not encourage vomiting except under the advice of a physician. **Call the Poison Control Center immediately and consult the MSDS for the appropriate action.**

POISON CONTROL CENTER: 9-1-800-222-1222

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 9-911. 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 spill 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 9-911. 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.

5. Guidelines for Handling Hazardous Chemicals

5.1. ***Allergens*** - An allergen is a chemical substance that induces an immediate or delayed adverse reaction by the immune system. *Examples include isocyanates, latex gloves, and diazomethane*

- Read and follow all instructions on the MSDS with regard to handling, storage, and waste disposal of the chemical.
- Wear suitable gloves to prevent hand contact with allergens or substances of unknown allergic activity.
- Use all appropriate protective apparel to prevent skin contact

5.2 ***Embryo Toxins*** - Reproductive toxins are defined as chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis; OSHA 29 CFR 1910.1450). *Examples include formamide, lead compounds, and organomercurials*

- Read and follow all instructions on the MSDS with regard to handling, storage, and waste disposal of the chemical.
- Women of childbearing age should:
    - Handle embryo toxins only in a proper fume hood.
    - Use all appropriate protective apparel and appropriate gloves to prevent skin contact.
    - Review each laboratory operation with a supervisor annually or when a procedure changes.
    - Store allergens and embryo toxins in a well-ventilated area in an unbreakable secondary container.

5.3. ***Chemicals of Moderate Chronic or High Acute Toxicity*** - *Examples include hydrogen cyanide and hydrofluoric acid*

Supplement the above rules with the following practices:

- Minimize exposure to these toxic substances by using all reasonable precautions. Always use a laboratory hood. Wear appropriate personal protection and always thoroughly wash hands and arms after working with these chemicals.
- Be knowledgeable of the appropriate first-aid measures in the event of an exposure.
- Store these chemicals in unbreakable secondary containers in designated areas.
- Ensure that at least two persons are present at all times during the use of highly toxic substances.
- In the event of a spill or contamination, thoroughly decontaminate the area, including clothing and shoes. Report the spill immediately to the CHO.
- Store waste material in a closed, well-labeled container until it is properly disposed.

5.4. ***Chemicals of High Chronic Toxicity including Select Carcinogens*** - *Examples include dimethylmercury, nickel carbonyl, and benzo-a-pyrene*

Supplement the above rules with the following practices:

- All work with these toxic materials must be conducted in a properly labeled designated area. Follow specified contamination-decontamination procedures.
- Decontaminate vacuum pumps and glassware in a hood before removing from the designated area. Decontaminate the designated area before normal work is resumed.
- The Laboratory Supervisor should consult with the College Safety Program Coordinator to devise procedures which minimize the formation and dispersal of contaminated aerosols.
- When exiting a designated area, remove any protective clothing, place in an appropriately labeled container for disposal, and wash hands, forearms, face, and neck.
- To sweep toxic dusts, always use a wet mop for housekeeping or a vacuum equipped with a HEPA filter.
- Consult the CHO to arrange for medical surveillance if using a cancer-causing substance in amounts that may result in personnel exposure.
- The Laboratory Supervisor must maintain detailed records of all amounts of these substances stored and used. The records must include the names of the users along with the dates used.
- Store the chemical in an unbreakable secondary container in a well-ventilated, limited access area. Properly label the secondary container.
- Written emergency action plans should be available in the event of an accident or spill.
- Negative pressure glove boxes must have a ventilation rate of at least two volume changes per hour. Positive pressure glove boxes must be thoroughly checked for leaks. Trap or filter the exit gases from all glove boxes through a HEPA filter and then release the gases into the hood.
- Ensure that containers of contaminated wastes are transferred from the designated area in appropriately labeled secondary containers.

6. Specific Procedures for Some Types of Hazardous Materials & Conditions

6.1. ***Flammable and Combustible Chemicals*** - Solid materials that readily sustain combustion and liquids with a flashpoint below 100EF are considered to be flammable chemicals. Liquids with a flashpoint between 100EF and 200EF are classed as combustible.

Appropriate fire extinguishers should be present in the work area and personnel should be trained in the proper use of each type of fire extinguisher. Employees should be familiar with the fire alarm system and the emergency exits in both the laboratory and the general facility. Properly ground the dispensing drum and the receiving vessel to avoid sparks when transferring flammable liquids. Heat flammable liquids with a heating mantle, hot water bath, or steam bath; not with an open flame or hot plate. In the event of a spill, immediately clean up all flammable and combustible materials.

No smoking or any source of open flame is allowed where flammable/combustible chemicals are stored and used. Flammable liquids should not be stored in domestic refrigerators. To avoid possible explosions, store flammable liquids in an explosion-proof refrigerator. Approved storage cabinets should be used to store flammable liquids in glass containers. Do not store flammable liquids with oxidizing agents (i.e., perchloric acid or nitric acid). As a general rule, use metal safety cans to store flammable liquids. Do not store safety cans in areas that are subject to extreme changes in temperature or pressure. Do not work with flammable liquids near sources of ignition in the laboratory (i.e., ovens, open flames, motors).

6.2. ***Corrosive Chemicals*** - A corrosive substance has a pH less than 2 or greater than 12 or can cause visible destruction of or irreversible alteration in living tissue at the point of contact. Classes of corrosives include strong acids, strong bases, strong dehydrating agents, and strong oxidizing agents.

Work with corrosives should be done in a fume hood. Personal protective equipment such as gloves, lab aprons, chemical splash goggles, and face shields should be used and, if there is a significant possibility of inhalation, appropriate cartridge respiratory equipment should be used. The laboratory must be equipped with a safety shower and eye wash station that are located within 10 seconds of the hazard.

Corrosive materials should be handled with caution. Read the precautionary information on the label and the MSDS. When using corrosives, one should order the smallest amount of material that will be needed for the experimental work. Corrosives should be purchased in plastic containers to minimize the dangers of splashing if dropped. Properly store corrosives according to hazard class. Store corrosives in cabinets or on low shelves, not in the fume hood or on the bench top.

Safety carriers must always be used to transport containers of dangerous chemicals, even if the chemical container has a protective plastic coating. To avoid major chemical spills, workers should use the minimal amount of the chemical that is needed and use all due 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 CHO if you should have any questions regarding the following guidelines.

6.2.1. **Chemical Release or Spill 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 Material Safety Data Sheet.

2. Immediately notify the Department Chairperson and CHO.

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 CHO.

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 Material 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 the Department Chairperson and CHO.

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 CHO.

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 Material Safety Data Sheet. Seek immediate medical attention.

3. Immediately notify the Department Chairperson and CHO.

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 CHO.

6.3. *Explosive Chemicals*

Ethers

Low molecular weight ethers present a fire hazard and require special storage and disposal considerations. Additionally, ethers can form organic peroxides upon exposure to air, resulting in explosions. Check the MSDS for all chemicals to determine if peroxide formation is possible. Obtain ethers in metal cans, not glass bottles. Date the ethers upon arrival, again upon opening, and consult the MSDS for the expiration date. Store ether in a cool location away from direct sunlight and heat. Ether may be stored in an explosion-proof refrigerator.

Picric Acid

Explosive when dry, picric acid should contain at least 10% water and should be kept out of contact with metals. Always wipe the bottle neck and lid with a moist paper towel before capping to prevent crystal formation. Do not allow picric acid to become dry and do not handle dry picric acid. Call the CHO for assistance with dry picric acid. Do not attempt to open any container of dry picric acid.

Sodium Azide

Sodium azide (as with all chemicals) should never be discharged down the drain in the laboratory. The discharge can react with metals in the plumbing system to form accumulations of lead, copper, and silver azide, extremely shock-sensitive compounds when dry. Treat drains that have been contaminated with sodium azide with a strong caustic, such as sodium hydroxide.

6.4. *Toxic Chemicals*

Mercury

Read the MSDS and use all appropriate precautions when handling, storing, and disposing of mercury. Metallic mercury and mercury compounds are extremely toxic. Store mercury in airtight, plastic containers away from direct sunlight or heat. Whenever possible, use secondary containment devices to reduce the chance of a mercury spill.

Trained personnel must clean up mercury spills.

Cyanides

Read the MSDS and use all appropriate precautions when handling, storing, and disposing of cyanides. Do not allow cyanide solutions to be mixed with acids. Hydrogen cyanide, a lethal vapor, is produced when acids react with cyanides.

Sulfides

Do not allow sulfides to become mixed with acids. Hydrogen sulfide is a lethal vapor.

6.5. ***Cryogenics*** - Cryogenic materials are low temperature materials (-73EC or -100EF). Because they are all extremely cold, cryogenic liquids can rapidly freeze human tissue and can cause many common materials to become brittle. All cryogenic liquids produce large volumes of gas when they vaporize. If these liquids are vaporized in a sealed container, they can produce substantial pressures which could rupture the vessel.

Personnel should be thoroughly instructed and trained in the nature of cryogenic hazards and the proper steps to avoid them.

This should include appropriate emergency procedures and personal protective equipment required. When flammable gases are being used, potential ignition sources must be carefully controlled.

When practical, it is advisable that the work area have a monitoring system to automatically warn personnel of a dangerous condition.

Safety goggles must be worn during the transfer process and during normal handling of cryogenic liquids. Appropriate 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. Jewelry should not be worn by personnel working with cryogenic fluids.

Cryogenic liquids are stored, shipped, and handled in several types of containers. The most common containers for laboratory use are the dewar or the liquid cylinder.

- **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.

- **Cylinders -** The cylinder is an insulated, vacuum-jacketed container. Safety relief valves and rupture disks protect the cylinders from pressure buildup. Cylinder capacities can vary between 100 and 200 liters.

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 (41-46EC [105-115EF]) 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.

- Tissues which have been frozen show severe, widespread cellular injury and are highly susceptible to infections and additional trauma. Therefore, rapid rewarming of tissues in the field is not recommended if transportation to a medical facility will be delayed.

- If the body temperature is depressed, the patient must be warmed gradually. Shock may occur during the correction of hypothermia. Cardiac dysrhythmias may be associated with severe hypothermia.

6.6. ***Oxygen Deficient Atmospheres -*** Adding any gas (other than oxygen) to air in sufficient quantities dilutes the oxygen concentration, creating an oxygen deficient atmosphere. Atmospheres with less than 19.5% oxygen are considered Oxygen Deficient. A lowered oxygen concentration can cause giddiness, mental confusion, loss of judgment, loss of coordination, weakness, nausea, fainting, and death. Persons suffering from lack of oxygen should quickly be moved to areas with normal atmosphere. If the victim is not breathing, assisted ventilation should be the immediate step. Give supplemental oxygen with ventilation if oxygen is available.

Effects

Within five seconds after inhaling only a few breaths of oxygen-free gas there is a rapid drop in oxygen content in the blood. Mental failure and coma follow a few seconds later.

The effects of continued exposure to oxygen deficient atmospheres depend on various factors:

- The degree of oxygen deficiency.
- The degree of physical exertion.
- Individual health factors (i.e., smoker/non-smoker).

Symptoms

15%-19% oxygen - Decreased ability to work strenuously. May impair coordination and may induce early symptoms in persons with coronary, pulmonary, or circulatory problems.

12%-14% oxygen - Respiration deeper, increased pulse rate, impaired coordination, perception, and judgment.

10%-12% oxygen - Further increase in rate and depth of respiration, further increase in pulse rate, performance failure, giddiness, poor judgment, blueness of lips.

8%-10% oxygen - Mental failure, nausea, vomiting, fainting, unconsciousness, ashen face, blueness of lips.

6%-8% oxygen - 8 minutes, 100% fatal; 6 minutes, 50% fatal; 4-5 minutes, recovery with treatment for all exposures.

4% oxygen - Coma within 40 seconds, convulsions, respiration ceases, death.

6.7. ***Compressed Gases*** -

- 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 Material Safety Data Sheets for the particular gases being used.
- The Laboratory Supervisor should provide proper training and instruction for all personnel handling compressed gases.
- Safety glasses and gloves are recommended for handling compressed gas cylinders. For corrosive or other hazardous products, chemical goggles or a full face shield should be used.
- Minimize potential problems associated with hazardous gases by ordering the smallest quantity required.
- Be thoroughly familiar with all emergency procedures and equipment necessary to deal with leaking cylinders.
- Refer to all federal, state, and local regulations regarding storage and use of compressed gas cylinders. If any doubt exists as to the correct storage or handling procedures for a particular gas, contact the Eberly College Safety Program Coordinator.

6.7.1. **Handling**

- Avoid dragging or sliding cylinders. Cylinders should be moved by using a suitable hand truck.
- Securely fasten the cylinder cap prior to transporting a gas cylinder.
- Never drop cylinders or permit them to strike each other violently. When cylinders are moved, they should not be subjected to abnormal mechanical shocks which may cause damage to their valves, to their safety devices, or to the cylinders themselves.
- 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.
- Never tamper with safety devices in valves or cylinders.
- 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.
- Compressed gas cylinders should not be refilled except by qualified producers of compressed gases.

- Shipment of a compressed gas cylinder that has been filled without the consent of the owner is a violation of federal law.
- When returning empty cylinders, close the valve before shipment. Leave some positive pressure in the cylinder. Remove the regulator and replace the cylinder cap. Promptly return empty or unneeded cylinders to the gas cylinder room in the Life Sciences Building (Room B37).

6.7.2. **Storage**

- Inspect incoming cylinders to ensure they are free of leaks and contain the correct product.
- Cylinders should be stored in an upright position. Cylinders should be assigned to a definite, isolated area for storage and the area posted with the names of the gases stored. Separate cylinders of gases belonging to various categories, taking into account the nature of the gases. Segregate full and empty cylinders. 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.
- Open flames are prohibited in flammable gas cylinder storage areas.
- Cylinders containing oxidizers must be separated from flammable gas storage areas or combustible materials by at least 20 feet (6 meters) or by a noncombustible wall.
- 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.
- Ascertain that an adequate supply of water is available for first-aid, fire action, or dilution of corrosive material in the event of a spill.

6.7.3. **Use**

- 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 130EF (54EC). 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.

- Use check valves or traps to prevent backflow of water or other contaminants if backflow can occur into the cylinder. If backflow occurs, mark the cylinder "CONTAMINATED" and notify the supplier immediately.
- 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 a 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.
- Use soapy water or approved explosimeters to detect flammable gas leaks.

6.7.4. **Aluminum Cylinders**

- Aluminum cylinders are used primarily for specialty gases, which are considered to be more stable in aluminum cylinders than in steel cylinders. Some companies paint their aluminum cylinders with a clear polyurethane enamel, giving these cylinders an apparent aluminum color.
- Special storage and handling procedures are required for aluminum cylinders.
- Do not heat aluminum cylinders in any manner. Exposure to temperatures above 130EF (54EC) may result in an unsafe condition. Exposure to heat or fire may adversely affect the cylinder integrity and cause violent cylinder failure. A change in color of the polyurethane coating (if so equipped) from aluminum color to a gold color is an indication that an aluminum cylinder may have been exposed to heat or fire. Report any heating of aluminum cylinders to the supplier immediately.
- Compared to steel, aluminum is a "soft" metal and special care must be taken to prevent the scratching or gouging of the cylinders which can adversely affect cylinder integrity. Do not subject aluminum cylinders to mechanical abuse.

6.7.5. **Gas Regulators**

- 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.
- 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.
- A Single-Stage Regulator reduces the pressure from the main supply line pressure to the desired operating pressure.

- A Two-Stage Regulator is actually two regulators combined into one to automatically give uniform regulation over a wider supply range. It contains two diaphragms, two springs, and two seats arranged in such a way as to reduce the pressure in two steps. In the first stage, the variable supply pressure is reduced to a constant intermediate pressure. Once the pressure is set, the two-stage regulator automatically keeps it constant.

6.7.6 **Putting the Regulator into Service**

- 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.

6.7.7 **Safety Checking 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. If possible, do not leave it open when the equipment is unattended or not in operation.

6.7.8 **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.

6.7.9 **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.

6.7.10 **Fires and Leaks**

- Before working with any flammable material, first ascertain the best method to use in fighting that particular kind of fire if you are uncertain.

  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.

- 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, follow emergency action procedures and notify the supplier. 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.

7. Biological Safety Program

7.1. ***Purpose*** **-** The Biological Safety Program at West Virginia University has been established to protect WVU employees, subcontractors, visitors, and the environment against disease resulting from exposure to biohazards. These biohazards include infectious microorganisms and pathogens, such as:

- Human pathogens
- Animal or plant pathogens which might affect agriculture
- Human body fluid, tissue, bone, and teeth
- Plant or animal genetic engineering
- Toxin gene clones

7.2. ***Institutional Biohazards Committee*** - All activities which involve recombinant DNA; infectious agents of plants, animals, and humans; or the use of serum and/or tissue from humans or subhuman primates must be approved by the Institutional Biohazards Committee (IBC).

All inquiries regarding biological safety and IBC approval at West Virginia University should be directed to **Andrew Cockburn, Ph.D., Director of Institutional Biosafety, (304) 293-7157, acockbur@wvu.edu**

7.3. ***General Procedures*** - Individuals working with biohazards will:

Follow the requirements of applicable research protocol, SOP, and this CHP.

Institute biosafety measures consistent with U.S. Department of Health and Human Services, May 1993, "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.

7.4. ***Experimentally or Naturally Infected Animals*** – When handling or using experimentally or naturally infected animals, workers will ensure that exposure to zoonoses (e.g., tetanus, rabies, plague, Lyme disease, Rocky Mountain spotted fever, and hanta virus) is minimized by implementing the following work practices:

- Perform first aid immediately and contact the Director of Institutional Biosafety if an animal bites, scratches, or causes other injury.
- Wear insect repellent and regularly check for ticks when performing field research or fieldwork.
- Use a trap that kills or humanely captures the animals. If trapping a rodent for the purpose of controlling rodent exposure in an occupied work area, a trap that kills the rodent should be used. Properly dispose of trapped animals.
- When disposing of trapped animals, wear, at a minimum, double rubber gloves for handling any wildlife material or surface that wildlife may have contacted.
- Do not use vacuums for cleaning up rodent droppings. Fecal materials shall be saturated with EPA-approved disinfectant (e.g., 10% bleach) and collected in a plastic bag.
- Launder contaminated clothing with detergent and hot water.
- Soak contaminated materials with disinfectant and double-bag them in plastic for proper waste disposal.

7.5. ***Incidental/Accidental Contact with Infected Wildlife*** – To reduce the potential for incidental and accidental exposure to rodents or other wild animals and their waste, observe the following practices:

- Reduce the amount of food and water available to rodents
- Keep food covered or in a refrigerator
- Clean dirty dishes promptly
- Keep all bulk grains and animal foods outside in secure containers

- Improve housekeeping in work spaces and storage areas to limit the availability of nesting areas
- Place garbage in rodent-proof containers and empty the containers regularly (preferably daily)
- Seal, cover, or screen all openings that are large enough for mice to enter (anything over ¼ inch), which includes areas where pipes and wires enter the building
- Contact the facility manager if animal nests, droppings, or carcasses are discovered in a work area.

7.6. ***Notes on Engineering and Work Practice Controls*** -

Drawing blood or collecting urine samples for private reasons, e.g., life insurance policies, is prohibited on WVU property.

Engineering and work practice controls designed to eliminate or minimize worker exposure shall be implemented. PPE shall be used only when engineering and work practice controls do not adequately control occupational exposure.

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.

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, 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.

7.7. ***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 (e.g., 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 (e.g., chemical splash goggles) when splashes may contaminate eyes, nose, or mouth.

7.8. ***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.

7.9. ***Biosafety Employee Information and Training*** -

Annual training shall be provided for those working with biohazards by lab supervisors and/or university personnel from biosafety office (Andy Cockburn @ (304) 293-7157). Information and training shall include:

- 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.

7.10. ***Useful Biological Safety Web Sites*** -

Biosafety in Microbiological and Biomedical Laboratories (BMBL):
http://www.cdc.gov/od/ohs/biosfty/bmbl4/bmbl4toc.htm

West Virginia University Institutional Biohazards Committee (IBC):
http://www.wvu.edu/~rc/ibc/index.htm

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

The OSHA Bloodborne Pathogen Standard:
http://www.osha-slc.gov/OshStd_data/1910_1030.html

World Health Organization information:
http://www.who.org/

World Health Organization's "Guidelines for the Safe Transport of Infectious Substances and Diagnostic Specimens":
http://www.who.int/emc/biosafety/html

National Institutes of Health "Guidelines for Research Involving Recombinant DNA Molecules":
http://www4.od.nih.gov/oba/rac/guidelines/guidelines.html

8. Radiation Safety Program at West Virginia University

8.1. ***Purpose*** **-** The Radiation Safety Office of West Virginia University (WVU) is responsible for all laboratories at WVU and WVU Hospitals, Inc. which use radioactive materials as part of their research. Their goal is to ensure that personnel use radioactive materials and dispose of waste safely and in compliance with federal regulations.

8.2. ***WVU Radiation Safety Office*** **-** The Radiation Safety Office hours of operation are Monday through Friday, 8:00 a.m. to 4:30 p.m. You can contact the Radiation Safety Office at (304) 293-3413 or via Fax at (304) 293-4529. In the event of an emergency, the Radiation Safety staff member on call can be paged at (304) 987-1586.

8.3. ***Useful Radiation Safety Web Sites*** **-**

WVU Radiation Safety Department:
http://www.hsc.wvu.edu/rsafety/

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

Decommissioning Guides:
http://techconf.llnl.gov/radcri/java.html

Center for Devices and Radiological Help:
http://www.fda.gov/cdrh/index.html

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

9. Acronyms

ACGIH	**American Conference of Governmental Industrial Hygienists**
ANSI	**American National Standards Institute**
BMBL	**Biosafety in Microbiological and Biomedical Laboratories**
BSO	**Biological Safety Officer**
CAS	**Chemical Abstracts Service**
CDC	**Centers for Disease Control**
CFR	**Code of Federal Regulations**
CGA	**Compressed Gas Association**
CHO	**Chemical Hygiene Officer**
CHP	**Chemical Hygiene Plan**
DOT	**Department of Transportation**
EHS	**Environmental Health and Safety**
EPA	**Environmental Protection Agency**
HBV	**Hepatitis B Virus**
HCV	**Hepatitis C Virus**
HEPA	**High Efficiency Particulate Air**
HIV	**Human Immunodeficiency Virus**
IARC	**International Agency for Research on Cancer**
IBC	**Institutional Biosafety Committee**
IDLH	**Immediately Dangerous to Life and Health**
MSDS	**Material Data Safety Sheets**
NEC	**National Electrical Code**
NFPA	**National Fire Protection Association**
NIH	**National Institutes of Health**
NIOSH	**National Institute of Occupational Safety and Health**
NRC	**Nuclear Regulatory Commission**
NTP	**National Toxicology Program**
OEL	**Occupational Exposure Limit**
OSHA	**Occupational Safety and Health Administration**
PEL	**Permissible Exposure Level**
PPE	**Personal Protective Equipment**
SOP	**Standard Operating Procedures**
TLV	**Threshold Limit Value**
TWA	**Time Weighted Average**
WHO	**World Health Organization**

10. Glossary

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.

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, especially metal hydroxides and alkali materials.

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 affects 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 or can cause visible destruction of or irreversible alteration in living tissue at the point of contact.

Dose Equivalent---A measurement of radiation exposure; the product of the absorbed dose, quality factor, and other factors.

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

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---Any chemical which is a physical or health hazard.

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

High Efficiency Particulate Air (HEPA) filter---An air filter which 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.

Irritant---A substance which produces an inflammatory effect on contact with living tissue.

Lachrymator---A substance that has an irritant or burning effect on skin, eyes, and respiratory tract. Lachrymators are dangerous in very small quantities (opening the cap has an immediate effect on the eyes).

Material Safety Data Sheet---A document which contains relevant information about a material, as referenced by OSHA 29 CFR, Part 1910.1200. For consistency purposes, a 16-section standard format has been established by ANSI:

1. Material identification
2. Composition
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. Toxicological information
12. Ecological information
13. Disposal considerations
14. Transport information
15. Regulatory information
16. Additional information

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

Nonflammable---A material which 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, safety 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.

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.

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 a "carcinogen", because it causes statistically significant tumor incidence in animals according to the criteria that are listed in Section 2, Paragraph b.

Teratogen---A substance that causes growth abnormalities in embryos.

Threshold Limit Value---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 8-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 8-hour work day or 40-hour work week.

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

11. References

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Eberly College of Arts and Sciences
Department of Biology

Emergency Telephone Numbers

Campus Emergency Telephone Number 9-911

Poison Control Center 1 (800) 222-1222

University Police (304) 293-3136

Barbara L. Foster, (304) 293-2729 office
Eberly College Safety Program Coordinator (304) 276-0099 cell

William Peterjohn, Chemical Hygiene Officer (304) 293-5201 x 31510

Jonathan Cumming, Chair (304) 293-5201 x 31501

Marlene DeWitt, Building Manager (304) 293-5394 (work); (304) 278-5339 (home)

Radiation Safety Office (304) 293-3413

Biological Safety Office (304) 293-7157

University Health Service (304) 293-2311

Environmental Health & Safety (304) 293-3792

Post these numbers for easy access.

Eberly College of Arts and Sciences
Department of Biology
Chemical Hygiene Plan Sign-Off Sheet

I have read and understand the Department of Biology Chemical Hygiene Plan. I will follow the safety procedures and precautions it contains and incorporate them into my standard operating procedures when working with hazardous materials in the laboratory.

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Name (Signature) Date

Name (Print)

Social Security Number

Sign and return this form to Dr. William Peterjohn,
Chemical Hygiene Officer, Department of Biology