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Section 1: Introduction

Nova Southeastern University (NSU) is committed to ensuring all safety practices are utilized in laboratories and that all facilities are safe for the NSU Community. Maintaining compliance with federal, state, local laws and regulations pertaining to laboratory safety and hazardous materials management is essential to this commitment. The Environmental Health and Safety Department (EHS) has overall responsibility for providing information and training concerning health and safety to faculty, staff and students. Implementing safety and assuring all individuals concerned are informed and have a safe laboratory to conduct activities are the responsibility of individual colleges, departments and/or centers. Colleges, departments, centers, or other units may develop internal policies and procedures for laboratory safety, but they must be at least as stringent as university guidelines and are subject to review by EHS.

The Safety Officer at EHS is responsible for developing, maintaining, and monitoring University safety policies and guidelines related to conducting research, teaching and clinical activities. In addition, the Safety Officer is responsible for designing and overseeing the training programs for university personnel regarding regulatory requirements for safely conducting activities in NSU laboratories. Colleges, departments, or other units are responsible for maintaining accurate records related to departmental student training and incident/accident investigation consistent with university safety plans and policies. Records of training performed by EHS will be retained by EHS for at least 3 years.

Section 2: Management and Responsibilities

The Laboratory Safety Plan may differ from laboratory to laboratory depending on the size and the areas/departments of analytical testing and research, but ultimately the goals for implementation of the safety plan will be the same and should cover the following:

- Reduce the risk of chemical and biological exposure.
- Reduce the risk of work-related injury and illness.
- Minimize the risk to the environment.
- The compliance with applicable federal, state, county and city regulations and standards. The

Laboratory Safety Plan can be divided into four parts that represents the acronym – SAFE.

S - Selection of equipment and supplies to maximize safety A -
Annual mandatory employee education
F - Formal documented inspections
E - Evaluation of safety documentation monthly.

The Laboratory Safety Plan should include the following:

- Prevention – will emphasize strategies to prevent any occurrence that would have an adverse effect on all personnel, contractors, and visitors.
- Surveillance – will provide systematic inspection of facilities, collection, analysis, interpretation, and evaluation of safety and health data essential to the planning and

implementation of the safety program with a timely dissemination of this data.

- Protection and Control – will be maintained and include engineering controls; the use of less hazardous alternatives; the use of PPE's and administrative procedures.
- Emergency Preparedness and Response – will seek to identify circumstances requiring advanced preparation and immediate action; develop and maintain contingency plans and procedures to address these circumstances; provide and communicate plans of action for response to fire, medical, first aid, chemical, violence, biohazard, adverse weather, and other incidents that may require advanced preparation and timely response.
- Education, Promotion, and Training – health, safety and chemical awareness will be promoted among all employees, visitors, contractors, and community members through orientation programs, regular education and training sessions.

Laboratory management and EHS have a duty to assure that laboratory personnel work in a safe and healthy environment with a minimum burden on laboratory activities. EHS should provide and promote a safe workplace that will foster a positive health and safety attitude in all personnel including visitors and contractors. EHS is required to ensure the institution of a laboratory safety plan consisting of occupational safety and health programs which are to include all policies and procedures plus all other relevant documents, and to see that the program is maintained and current. Safety knowledge is the responsibility of all personnel and a good relationship between management and employees is essential for an effective safety, health and environmental program. Specific responsibilities for certain positions and departments are set forth below.

2.1 EHS Department

a. Provide training to laboratory supervisors and personnel.
b. Conduct periodic and unannounced laboratory inspections to assure compliance with federal, state and local regulations, as well as the procedures contained in this plan and those contained in any supplementary information developed in the college in response to specific clinical, teaching, or research activities.
c. Undertake necessary enforcement actions to ensure full compliance with all institutional safety policies, up to and including independent authority to shut down laboratories for violations of these policies. Approval of the Dean is not required.
d. Provide hazardous waste disposal services.
e. Provide hazardous material spill response consultative services.
f. Review laboratory construction, modification, and renovation plans safety design.
g. Coordinate fume hood survey and testing.
h. Perform exposure monitoring upon request to determine if the permissible exposure limit or action level has been exceeded.
i. Provide guidance for maintaining compliance with federal, state, and local regulations, as well as the procedures stated in this plan.
j. Conduct laboratory safety evaluations upon request.
k. Provide guidance on personal protective equipment.
l. Maintain copies of medical consultations and examinations for possible exposures from hazardous chemicals.

2.2 Physical Plant

a. Maintain facilities and facility-related safety systems to assure continuous operation of

laboratories.

2.3 Laboratory Supervisor in Charge

a. Design and conduct laboratory processes and operations to assure that employee exposure to risk conforms to procedures and objectives contained in this plan and those contained in any supplemental information developed in the college in response to specific clinical activities or areas of research.
b. Monitor the procurement, safe use, and proper disposal of chemicals.
c. Write Standard Operating Procedures and other information relevant to lab processes in their specific areas as needed to supplement those contained in this plan.
d. Instruct employees and students on the contents of this plan, and any supplements, and the location of the plan and related materials within the workplace.
e. Take all reasonable precautions to protect the safety and health of laboratory workers and the environment.
f. Schedule services for hazardous waste disposal and oversee the handling of hazardous waste pending proper disposal.
g. Conduct regular laboratory safety self-evaluations.
h. Complete and update annual laboratory chemical inventories in accord with the instructions and schedule provided by the EHS office.
i. Inform employees of the permissible exposure limits for the hazardous chemicals listed on inventories and the signs and symptoms associated with exposures to these chemicals.
j. Provide site specific training on laboratory hazards as described in The University's Chemical Hygiene Plan.
k. Determine the required levels of personal protective equipment, fire extinguishers, fume hoods, flammable liquid storage cabinets, biological safety cabinets, eye washes, safety showers, and spill cleanup kits. Assure that all required equipment is available and in working order and that appropriate training for each item has been provided.
l. Have readily available a current copy of a Safety Data Sheet for all hazardous chemicals in the laboratory.
m. Post emergency telephone numbers on the outside of the laboratory door
n. Report to the EHS office if there is reason to believe that exposure levels for a hazardous chemical exceed the action level or the permissible exposure limits and document the incident.
o. Forward documentation on laboratory accidents and exposures to the EHS office.
p. Provide for the safety of visitors.

2.4 Employees, Faculty and Students

a. Maintain a thorough understanding of and follow the laboratory policies and procedures in this plan and those contained in any supplemental information developed in the college in response to specific clinical activities or areas of research.
b. Use and maintain personal protective equipment (i.e., lab coats, chemical splash goggles, face shields, respiratory protection, and gloves) as mandated in this plan for laboratories.
c. Use flammable liquid storage cabinets, acid storage cabinets, biological safety cabinets, fume hoods, and other laboratory safety equipment provided.
d. Inform supervisor immediately of any laboratory safety equipment that is needed but not available or that is not in good working order.
e. Inform supervisor immediately of exposure symptoms, accidents, or chemical releases and

document incident.

f. Complete and keep current with all other applicable training certificates and sessions.

Section 3: General Safety Guidelines

Laboratories are workplaces with the potential to expose employees, faculty and students to many kinds of hazards and risks, possibly more so than anywhere else in the business workplace. Therefore, a risk plan is necessary to help identify, control or reduce the hazards, protect employees, faculty and students and reduce operational costs. Good laboratory practices should be introduced and will be achieved if employees, faculty and students follow the basic guidelines.

3.1 Preparing for Laboratory Work

Before starting to work in a laboratory, familiarize yourself with the following:

- Job Safety Analysis (JSA) indicating the hazards of the materials in the laboratory, as well as appropriate safe handling, storage and emergency protocols.
- Labels and Safety Data Sheets (SDSs) before moving, handling, or opening chemicals. Never use a product from an unlabeled container, and report missing labels to your supervisor.
- The agents, processes, and equipment in the laboratory. If you are unsure of any aspect of a procedure, check with your supervisor before proceeding.
- The location and operation of safety and emergency equipment such as fire extinguishers, eyewash, and shower, first aid and spill response kits, fire alarm pull stations, telephone, emergency numbers and emergency exits.
- Emergency spill response procedure for the material you will handle.
- Emergency reporting procedures and telephone numbers.
- Designated and alternate escape routes.
- Any employee, faculty or student who has a disability and the precautions necessary.

3.2 During Laboratory Work Hours

- Restrict laboratory access to authorized persons only.
- **Eating, drinking, smoking,** and applying cosmetics and handling of contact lenses are prohibited in a laboratory. Do not store food in a refrigerator used for research or clinical purposes.
- Wear labs coats (knee length) and safety glasses in laboratories. Open shoes, such as sandals, should never be worn in the lab.
- Tie back or otherwise restrain long hair when working with chemicals, biohazards, radioisotopes, or moving machinery.
- Keep workplaces clean and free of unwanted chemicals, biological specimens, radioactive material, and idle equipment. Avoid leaving reagent bottles empty or full, on the floor.
- Work only with materials that you know their flammability, reactivity, toxicity, safe handling and storage and emergency procedures.
- Never pipette by mouth, use mechanical transfer devices.
- **Walk, do not run in the** lab particularly if carrying any hazardous material.
- **Know the evacuation** procedures for the work area.
- **Do not use** hallways as storage areas.
- Keep always exits and passageways clear.

- Ensure that access to emergency equipment (eyewashes, safety shower and fire extinguishers) and controls are not blocked.
- Working alone is an unsafe practice at any time. However, if the nature of the work makes it unavoidable, NSU has a Working Alone Policy (11.16.16), which specifies the necessary approvals and documentation process. Take measures to ensure that others are aware of your location and have someone check in with you from time to time, either in person or by telephone.
- Any work conducted outside normal working hours requires necessary approval (See Working Alone Policy 11.16.16). Security must also be notified.
- Report accidents and dangerous incidents ("near-misses") promptly to your supervisor and the safety officer. Complete the prescribed form.
- Wash your hands thoroughly before leaving the laboratory.
- Any procedures involving the release of volatile toxic or flammable materials should be conducted in a chemical fume hood.
- Perform procedures that release infectious bio-aerosols in a biological safety cabinet
- Handle all human blood and body fluids as if potentially infectious (Universal Precautions).

3.3 Cleaning up Before Leaving the Laboratory

Perform a safety check at the end of each procedure and before leaving the labs. Make sure to:

- Turn off gas, water, electricity, vacuum and compression lines and any heating apparatus.
- Return unused materials, equipment and apparatus to their proper storage locations.
- Label, package and dispose of all waste material properly and promptly.
- Remove defective or damaged equipment immediately and arrange to have it repaired or replaced.
- Decontaminate any equipment or work areas that may have been in contact with hazardous materials.
- Leave behind protective clothing (lab coats, gloves, etc.) when leaving the laboratory.
- Close and lock the door to the laboratory if you are the last one to leave.

3.4 Evaluating Laboratory Hazards

There are many categories of hazards that might be encountered in a laboratory setting, and the situation can change frequently. Even after current risks have been identified and controlled, it is critical to understand that new and unexpected dangers can arise.

Regular inspections shall be conducted on the following items:

- Fire extinguishers
- Emergency eyewashes and safety showers -Run all eyewashes for several minutes and document weekly. Check to ensure that Physical Plant is flushing the safety shower(s) monthly and report any deficiencies.

- First aid kit. Contents must be relevant to the risk of the laboratory and comply with OSHA (ANSI approved and no expired items).

- Spill kit.

- Fume hood and other ventilation devices. Annual certification of the fume hoods and biological

safety cabinets required.
- Any tubing / piping for circulating water, vacuum, gases
- Chemical storage compartments. Ensure compatibility.
- Ensure that fire extinguishers and emergency showers are inspected, tested recorded. Remain

alert for the following potential laboratory hazards:

- Chemicals
  - Flammable
  - Toxic
  - Oxidizing
  - Reactive
  - Corrosive
  - Peroxide-formers

- Microbiological disease-producing agents and their toxins
  - Viruses
  - Bacteria
  - Parasites
  - Rickettsia
  - Fungi

- Physical or mechanical hazards
  - Ionizing and non-ionizing radiation
  - Lasers
  - Particles
  - Electrical and other energy sources
  - Poor equipment design or work organization (ergonomic hazards)
  - Tripping hazards
  - Excessive noise or heat

- Psychosocial conditions that can cause psychological stress.

3.5 Labels, Safety Data Sheets, and Training

Labels or hazardous material information are essential as they alert people to the dangers of the product and the basic safety precautions. All individuals are to ensure that all labels are intact on the containers and comply with labeling protocols (See Chemical Hygiene Plan for details). Replace and re-label as necessary.

Safety Data Sheet's provide more safety and hazardous details of the product than the labels. Technical bulletins provide chemical, physical, and toxicological information about each controlled product, as well as information on precautionary and emergency producers. This information must be readily accessible to anyone who work with, or who may otherwise be exposed to, controlled products. (See Chemical Hygiene Plan).

Anyone working in a laboratory is required to complete EHS Laboratory Safety training, which includes:
- Review of general laboratory rules and regulations
- Recognition of laboratory hazards
- Use of engineering controls, administrative controls and personal protective equipment to mitigate

hazards

- Review of reference materials (e.g., SDS) on hazards, handling, storage and disposal of hazardous chemicals
- Procedures for disposing of hazardous chemical waste
- Fire safety and emergency procedures
- Hazard communication and GHS

EHS provides on-line courses that are designed for specific types of laboratories (Research, Teaching, etc.). All supervising and/or working in covered laboratories must keep all applicable training certificates current and available.

Site-specific laboratory training will provide more detailed instruction on specific laboratory procedures including instruction on the content, purpose and interpretation of information found on labels and in SDSs for controlled products.

Hazard-specific or job-specific training refers to instruction in the procedures for the safe handling and storage of the controlled products that are unique to each laboratory. Hazard- specific training also covers spill or leak remediation, waste disposal, and basic first aid instructions which are critical to the proper functioning of any lab. The Laboratory Supervisor in Charge will provide hazard/job-specific training. Topics to be covered in safety training are:

a. *Emergency information* including medical contingencies (general first aid, needle sticks, serious injury, etc.), evacuation and fire escape plans, and spill response procedures.
b. *Fire safety devices* including pull stations, fire extinguishers, etc. The employee must understand the proper circumstances in which to use each item as well as how to use these devices correctly.
c. *Emergency devices* including emergency showers and eyewash fountains. The employee must be familiar with the location and appropriate use of these items. Eyewash bottles are not acceptable alternatives to eyewash fountains.
d. *Personal protective equipment (PPE)* including, but not limited to, safety clothing (lab coats, chemical aprons, surgical scrubs, etc.), gloves, safety glasses, face shields, and respirators. The selection and use of PPE is dependent upon proper hazard identification by the supervisor. Training shall include methods to become familiar with the hazards present in the work area and with the use of the appropriate PPE. The use of respirators in the laboratory is not usually necessary if the proper engineering controls are in place. However, under any circumstances, all respirator usage must be authorized EHS and conducted in accordance with the University's Respiratory Protection Policy.
e. *Chemical fume hoods, biological safety cabinets, and laminar flow hoods (clean benches)*. Training includes usage and operation of devices. These items should not be used for storage or shelf space. Chemical fume hoods are inspected annually or more often as determined by EHS. The supervisor has the responsibility to have the biosafety cabinets and laminar flow hoods certified by an outside contractor annually or whenever physically moved.
f. *Safety Data Sheets (SDSs)* contain safety information on the chemicals in the laboratory. Individuals working in laboratories must be informed of the importance of SDSs and where to obtain them (from EHS).
g. *Chemical labels, hazard warning signs, and Designated Areas*. The employee should be familiar with safety information on chemical labels and with the variety of hazard warning signs (biohazard, laser, NFPA diamond, etc.). Individuals working in Designated Areas in laboratories must be familiar with the Standard Operating Procedures (SOPs) for those areas.
h. *Chemical categories and properties.* Individuals working in laboratories should be familiar

with the safety hazards associated with different chemical categories (flammables, corrosives, combustibles, etc.). Proper storage of chemicals by category should also be explained by the supervisor.

i. *Biomedical, radioactive, and chemical waste disposal.* Training includes the policies and procedures for labeling, storing, and disposing of these wastes.

j. *Hazard Communication Policy.* Training includes information about the hazards associated with laboratory activity. A copy of this policy can be obtained from EHS.

k. *Infection Control Programs.* Individuals working in laboratories must be familiar with the policies and procedures for Bloodborne Pathogens and Tuberculosis.

Federal Law (OSHA's Hazard Communication Standard) mandates that the above listed training information be reviewed whenever the employee is reassigned to a new task or if a new hazard is introduced in the workplace.

3.6 Postings and Signage

The main entrance to each laboratory in which chemical, biological or radiological materials are used or stored must be posted with the following:

- Names and phone numbers of the lab supervisor and other responsible parties to be contacted in the event of a fire, accident, or spill.
- Special hazards that may be encountered in the laboratory (e.g., laser in use, cylinders, biohazardous material, radioactive material, etc.)
- Safety instructions for persons entering the laboratory such as: required protective equipment, access restrictions, etc.
- Prohibitions (e.g., No Food or Drink Allowed).
- National Fire Protection Association (NFPA) 704 diamond.

The interior of the laboratory must be posted with the following:

- Emergency Evacuation Floor Map near the exit (in larger buildings).
- Hazardous Waste Accumulation Area sign marking location where unwanted laboratory materials will be accumulated for collection by EHS.
- Signs identifying location of safety equipment (e.g., fire extinguisher, safety shower, eyewash fountain, etc.).
- Signs, labels and/or warning/caution tape identifying designated use and storage areas for materials or equipment requiring special procedures.

Most required signage and postings are available from EHS upon request.

Section 4: Emergencies and Spill Guidelines

During normal operations in the laboratory, accidents will occur despite our best efforts to prevent them. Spills can be from different sources but require immediate attention by an employee knowledgeable about the spill clean-up procedure, which kit to use and the emergency response if necessary. All spills are to be reported and investigated. If a situation arises that employees have to evacuate due to a hazardous spill, employees must know how to act and react during an emergency by following the emergency procedure using the acronym NEAR; **N**otify, **E**vacuate, **A**ssemble, **R**eport. A

spill clean-up guide must be posted for quick reference.

Specific procedures for responding to chemical spills are in the NSU Chemical Hygiene Plan (See EHS Policy/Procedure 3 Section 12.5)

4.1 Spill Kit Materials

Laboratories should be prepared for chemical spills by having a spill kit or other materials available for spill clean-up and supervisory personnel trained to respond. The spill kit must be in an obvious location and all persons responsible for the activities conducted in the laboratory must be knowledgeable in the use of the spill kit. Spill kits can be specialized for individual laboratories or can contain general supplies necessary to handle a variety of spills. Commercial chemical and mercury spill kits are available, which include protective equipment such as goggles and gloves, neutralizing and absorbing materials, bags, and scoops. You can also make your own spill kits to include the materials described below:

- 1 pair neoprene or nitrile gloves
- 1 pair safety goggles
- 1 scoop
- Spill pillows, sorbent pads
- Disposable shoe covers (plastic bags may work)
- Thick sealable plastic bag or bucket
- High Visibility Label or Sign (SPILL KIT)

4.2 General Chemical Spill Guidelines

Specific procedures for responding to chemical spills are in the NSU Chemical Hygiene Plan (See EHS Policy/Procedure 3 Section 12.5)

4.3 Radioactive Material Spills

Spills of quantities of radiological materials present at NSU cause little or no immediate external hazard. Of bigger concern, is the spread of contamination and the internal contamination of employees, faculty and students? Radioactive material spills must therefore be handled in a manner that prevents this. Prevent the spread of contamination by limiting the movement of persons present in the area of the spill until they have been found free of contamination. A minor radiation spill is one that can be handled safely without the assistance of the radiation safety staff. Most spills at NSU will be small spills due to the small quantities of radioisotopes that are utilized in campus laboratories.

A. Small/Minor Radioactive Material Spill

A small radiation spill is one that can be handled safely without the assistance of the radiation safety staff.

1. Alert persons in the immediate area.
2. Distinguish the spill area with radioactive label tape. Indicate the isotope spilled.
3. Notify the laboratory supervisor or principal investigator.
4. Wear personal protective equipment to include, safety goggles, disposable gloves, shoe covers and long sleeve lab coat. If the substance is a beta emitter a plastic lab apron may be used to provide additional body shielding.
5. Place absorbent towels over liquid spills and dampened towels over spills of solid materials.

6. Clean the spills beginning from the outside edge and moving towards the center.
7. Place the towels in a plastic bag and put in a radiation waste container.
8. Verify the area and responder hands and shoes are free from contamination by using a survey meter or by performing wipe tests. Repeat the cleaning process until there is no contamination remaining.
9. Submit a written account to the Radiation Safety Officer (RSO) within 24 hours of the occurrence.

B. Large/Major Radioactive Material Spill

1. Attend to contaminated and injured persons and protect them from continued exposure.
2. Alert persons in the area to evacuate.
3. Keep contaminated and potentially contaminated persons in one area, (safe distance away from contamination source) until they can be monitored for exposure.
4. Contact the RSO. (They will contact the Radiation Safety Officer.)
5. Ventilation, drafts, and air currents should be controlled to prevent the spread of contamination.
6. Close the doors and prevent entrance to the contaminated area.
7. Submit a written report of the spill incident to the RSO within 24 hours of the occurrence.

4.4 Spill of Biohazardous Radioactive Material

The procedure for spill cleanup of a radioactive biological material requires emergency procedures which protect the person from exposure to the radiochemical while disinfecting the biological material.

1. Avoid inhaling airborne material, notify other room occupants, and quickly leave the area.
2. Remove all contaminated clothing by turning exposed areas inward. Place in a biohazard bag.
3. Wash all exposed skin areas with a disinfectant soap. Rinse for a minimum of 5 minutes.
4. Inform the laboratory supervisor and contact the RSO.
5. Post a spill sign and do not reenter the lab for at least 30 minutes.
6. Contact the radiation safety officer to confirm safe entry into the laboratory.
7. Utilize appropriate protective clothing and reenter the spill area. The use of respirators requires special training. Call EHS if a respirator trained individual is required but not available for spill cleanup.
8. Cover the area with disinfectant soaked towels. Pour the disinfectant around the perimeter of the spill area. As the spill becomes diluted with disinfectant, increase the concentration of the disinfectant. Allow 20 minutes for disinfection. **Please note that the use of bleach on iodinated material may cause the release of radioiodine gas. An alternative such as, phenolic compounds or an iodophor should be used when radioactive iodine has been spilled.**
9. Collect any broken glass with forceps and place in an appropriate broken glass collection container. To clean splashed material, spray with disinfectant solution and wipe clean or saturate a paper towel with disinfectant solution and wipe clean.
10. Personal protective equipment (PPE) must be disinfected with bleach solution and disposed of as radioactive waste. Place the used PPE on absorbent paper. Spray the PPE with 10% bleach solution and allow a 20 minute contact time.
11. Place all decontaminated waste materials in an approved container for radiation and label appropriately. Do not autoclave the waste unless the RSO approves the procedure.
12. Wash hands and potentially exposed areas with a disinfectant.

13. Monitor laboratory occupants for contamination of radioactive materials.
14. Decontaminate under the advisement of the RSO.
15. All contaminated persons must seek medical assistance after decontamination procedures have been completed.
16. Monitor the area for residual activity and handle it according to the Radiation Safety Plan guidelines.

4.5 Biological Spills or Exposures

A minor spill of a biological agent is defined as one that has occurred and is contained within the biological safety cabinet, and which provides personnel protection. It is assumed that no one is contaminated by the spill. Most clinical and research activities conducted at NSU is classified as Biological Safety Level 1 (BL1).

If a spill contains BL 2 agents or greater, or the spill is too dangerous or large to be safely cleaned up by laboratory personnel, EHS must be contacted immediately. Biological clean-up procedures have many safety and regulatory guidelines that must be met. Any person partaking in biological clinical and research activities at NSU should be familiar with the NSU Biological Safety Plan. Contact your department supervisor or EHS for a copy of this plan.

A. Biological Spill Kit

Laboratories utilizing biological materials must be prepared with a biological spill kit. Typical kits are packed in a 5-gallon plastic bucket. The bucket should be clearly labeled to indicate that it is a biological spill kit. Biological spill kits can be assembled to fit specific laboratory needs although basic kits must contain the following items:

- Concentrated household bleach
- A spray bottle for bleach solutions
- Face protection
- Utility gloves and nitrile gloves
- Paper towels or another sorbent
- Biohazard bags
- Forceps for handling sharps
- Biohazard symbol labels (for use on the bucket when the cleanup is complete)

B. Biological Spill Procedures

<u>Blood and Body Fluids Spills</u>:

Blood and body fluid spills with low concentrations of infectious microorganisms must be handled in the following manner:

1. Wear at least the minimal required laboratory personal protective equipment.
2. Absorb fluid with paper towels and place in a biohazard bag.
3. Collect any broken glass with forceps and place in an appropriate broken glass collection container.
4. Clean the area with a detergent.

5. Spray the area with a 10% bleach solution and allow to air dry for 15 minutes.
6. Wipe the area with disinfectant soaked paper towels.
7. Place all contaminated items in a biohazard bag, autoclave, and dispose of according to NSU guidelines.

Table A: Disinfectant Activities

Disinfectant	Disinfectant Level	Bacteria	Lipo-phil. Viruses	Hydro-phili	M. tuberculosis	Fungi	Comments
Alcohols (ethyl and isopropyl) 70%	Intermediate	+	+	-	+/-	+	Not sporicidal; evaporates quickly so that adequate contact time may be achieved, high concentrations of
Phenolics 1/20 Lysol™	Intermediate	+	+	+/-	+	+	Not sporicidal; phenol penetrates latex gloves; eye / skin irritant; remains
Glutaraldehyde (2-5%)	High	+	+	+	+	+	Used to sterilize surgical instruments that cannot be autoclaved; strong odor; sensitizer; use
Quaternary Ammonium (0.5-1.5%)	Low	+	+	-	-	+/-	May be ineffective against Pseudomonas and other gram – bacteria; recommendation
Iodophors (30-1,000	Intermediate	+	+	+	+/-	+/-	Inactivated by organic matter.
Chlorine 1/10	Intermediate	+	+	+	+/-	+	Not sporicidal; inactivated by organic matter, fresh solutions of hypochlorite

4.6 Ethidium Bromide Spill Clean-up and Disposal

Ethidium bromide is a potent tumorigen. When handling ethidium bromide it is imperative that no skin contact occurs and thorough handwashing is performed after handling. In case of a small spill:

1. Absorb freestanding liquid with a compatible absorbent material.

2. Use ultraviolet light to locate the location of the spill material.
3. Prepare decontamination solution by mixing 4.2 grams of sodium nitrite and 20 mL of hypophosphorous acid (50%) in 300 mL of water.
4. Wash the spill area with a paper towel soaked in the decontamination solution. Wash the spill area five more times with paper towels that have been soaked in the decontamination solution (using fresh paper towels each time).
5. After cleaning the area put all the used towels in the decontamination solution for 1 hour.
6. Check the completeness of decontamination using an ultraviolet light.
7. When the decontamination procedure is complete, transfer all the decontamination solution to an appropriately labeled waste container. Call the EHS office for waste pick-up.

To clean contaminated equipment:

Laboratory equipment (e.g., transilluminators, laboratory floors and countertops, etc.) contaminated with aqueous solutions of more than 10 mg/L (0.01 %) EtBr should be decontaminated using the spill clean-up procedures listed above.

4.7 Spill Procedures by Biological Safety Level

A. Biosafety Level 1 (BL1) Spill

Biosafety Level 1 is the classification that applies to agents that are not known to cause disease in healthy adults.

1. Notify other laboratory occupants.
2. Remove contaminated clothing. If necessary, use the safety shower or emergency eyewash. Wash affected area with a disinfectant.
3. Wear at least the required laboratory personal protective equipment.
4. Cover the spill with paper towels. Pour disinfectant around the outside of the spill area and then add disinfectant over the spill area until the spill area has been completely covered. Allow the disinfectant at least 15 minutes to work. To clean splashed material spray with disinfectant solution and wipe clean or saturate a paper towel with disinfectant solution and wipe clean.
5. Pick up any pieces of broken glass with forceps and discard in a broken glass container.
6. All clean up materials must be placed in a biohazard bag, autoclaved and appropriately disposed.
7. Wash hands thoroughly with soap and a handwashing disinfectant.

B. Biosafety Level 2 (BL2) Spill

Biosafety Level 2 is the classification that applies to agents that are associated with human disease, which is rarely serious, and for which preventative or therapeutic intervention are often available.

1. Immediately notify all other persons in the laboratory, hold your breath, and evacuate.

2. Remove all personal protective equipment and turn inwards to decrease the spread of contamination.
3. Wash hands and any other potentially exposed area with soap and water for a minimum of 15 minutes.
4. Post a spill sign and do not reenter the lab for at least 30 minutes.
5. Notify the laboratory supervisor and contact the EHS Office.
6. Immediately seek medical assistance if exposure has occurred.
7. After allowing the aerosols to settle for 30 minutes, put on protective clothing. Only trained individuals may utilize respirators. Contact the EHS Office if cleanup spill requires the use of a respirator.
8. Cover the spill with paper towels. Pour disinfectant around the outside of the spill area and then add disinfectant over the spill area until the spill area has been completely covered. Allow the disinfectant at least 20 minutes to work. To clean splashed material spray with disinfectant solution and wipe clean or saturate a paper towel with disinfectant solution and wipe clean.
9. Pick up any pieces of broken glass with forceps and discard in a broken glass container.
10. Spray the area with a 10% bleach solution and allow to air dry. Alternatively, spray the area with the bleach solution, allow 10 minutes for disinfection, and then wipe the area down.
11. All clean up materials and contaminated protective clothing must be placed in a biohazard bag, autoclaved and appropriately disposed.
12. Wash hands and potentially contaminated skin areas with a handwashing disinfectant or antiseptic soap and water.

C. Biosafety Level 3 (BL3) Spill

A Biosafety Level 3 is the category assigned to all agents with the potential for aerosol transmission and for which the disease may have serious or lethal consequences. If work with this type of agent is being conducted it is imperative to have safety controls in place prior to the onset of the work. The controls required (as recommended by the National Institutes for Health) are defined in the NSU Biological Safety Plan.

The following actions are designed for spills that have occurred outside of the biological safety cabinet that may have resulted in the aerosolization of the agent.

1. Notify others to evacuate immediately. Hold breath and leave the room.
2. Remove PPE in the access room or airlock. Turn the PPE inward and make sure to take your gloves off last.
3. Wash any potentially exposed areas with an antiseptic soap and warm water.
4. Close the doors to the affected area and place a biohazard spill sign on the entry door.
5. Call 911 and notify EHS.
6. Immediately seek medical assistance if exposure has occurred.
7. Do not reenter the laboratory unless it has been approved by the supervisor or EHS.
8. Utilizing the appropriate PPE, cover the spill area with paper towels soaked with disinfectant.

9. Beginning at the outer most edge of the spill area and working toward the center, pour concentrated disinfectant on the spill area.
10. Allow 15-20 minutes contact time.
11. Decontaminate and splashes or areas that aerosols may have settled by wiping down with a towel soaked with a 10% bleach solution.
12. Place all soiled towels in a biohazard bag.
13. Repeat the procedure. Complete by wiping all areas of contamination down with water.
14. Decontaminate any reusable item by wiping down with a disinfectant soaked towel followed by a 20-minute soak in a 10% bleach solution.
15. Remove coveralls; turn all potential exposed areas inward. Place in the biohazard bag.
16. Remove gloves. Place in the biohazard bag.
17. Remove respiratory protection and protective face wear. Wipe down the exterior portions of reusable PPE with a disinfectant bleach solution twice.
18. Wash your hands with antiseptic soap for at least 30 seconds.
19. Autoclave all waste from the spill cleanup. Use fresh gloves while transporting the materials to the autoclave, and wash hands thoroughly after removing the gloves.

4.8 Fires

All employees at the time of hire and all students must be informed at the beginning of each semester of building evacuation routes. It is the laboratory supervisor's responsibility to provide this information. In the event of a fire, immediate evacuation is essential. On the way out of the building remember these safety precautions:

- Never enter a room containing a fire.
- Never enter a room that is smoke filled.
- Never enter a room in which the top half of the door is hot to the touch.

A. Small Fires

1. Pull the fire alarm and call 911 or the Public Safety Office at 2-8999.
2. Alert people in the area to evacuate. Assist those individuals with disabilities.
3. Turn off gas main.
4. If you have been trained to use a fire extinguisher, do so while maintaining a clear exit path behind you.
5. Operate the extinguisher using the P-A-S-S method:

    P – Pull the pin located on the extinguishers handle.
    A – Aim the nozzle at the base of the fire.
    S – Squeeze or press the handles together.
    S – Sweep from side to side at the base of the fire until it is out.

B. Large Fires

1. Pull the fire alarm, when in a safe area; call 911.
2. Alert people in the area to evacuate. Assist those individuals with disabilities.

3. Turn off gas mains, only if time permits.
4. Close the doors to confine the fire.
5. Move to a designated assembly area away from and upwind from the building.
6. Persons having knowledge about the incident and location must provide this information to emergency response personnel.

4.9 Weather Alerts

When a severe weather siren is identified, immediately request all persons in the laboratory to turn off any gases, hotplates, and pressure reactive experiments. Immediately leave the area in an orderly manner. Use the innermost stairway and take cover in the lowest most internal compartment of the building.

4.10 Responding to Injuries and Inhalation Exposures

The first line of defense to avoid injuries and inhalation exposure for any person working or performing clinical or research procedures in a laboratory is knowledge. Always be aware of what you and others in the surrounding area are working with and the associated hazards. This information is available on the product safety data sheet (SDS). SDS must be available for review by faculty, staff, researchers and students prior to utilizing any new chemical product or procedure involving the chemical product at all times.

First aid kits are to be provided and available in all laboratories and the chemistry stockrooms. It is highly advised for each department to provide and maintain first aid kits in a centralized location. First aid kits must be OSHA compliant (ANSI approved) and contain a variety of prepackaged items. Upon each use, and upon item expiration, immediately replenish the first aid kit items.

Emergency responders also must have chemical information readily available. A safe laboratory will have a posted inventory (web link) at each main laboratory entrance. To ensure emergency response preparedness the laboratory supervisor in charge must update the chemical inventory on an annual basis.

Following an injury, the person in charge of the laboratory at the time of occurrence must report the incident to Public Safety, and if there is an employee injury, to Human Resources Workers Compensation. The incident will be investigated by EHS and the information will be used to better prepare the University faculty and staff in the prevention and response of accidents and injuries.

Inhalation of a Biological Material

When a biological material has been spilled take care to minimize aerosolization of the material. Take the following steps if the spill has resulted in aerosolization:

1. Immediately notify all other persons in the laboratory, hold your breath, and evacuate.
2. Remove all personal protective equipment by turning it inwards to decrease the spread of contamination.
3. Wash hands and any other potentially exposed area with soap and water for a minimum of 15 minutes.
4. Post a spill sign and do not reenter the lab for at least 30 minutes.
5. Notify EHS and call 911.
6. Immediately seek medical assistance.

Needle Sticks and Puncture Wounds

Take the following steps in treating minor needle sticks and puncture wounds:

1. Wash well with disinfectant or antiseptic soap (preferably a type with iodine) and water for 15 minutes.
2. Squeeze around affected area to encourage bleeding.
3. Notify the laboratory supervisor.
4. Seek medical assistance immediately.

When a needle stick wound has the potential for BL3 exposure, the following steps are to be followed:

1. Wash the affected area with disinfectant, antiseptic soap and warm water for 15 minutes.
2. Squeeze around the area to encourage flow of blood out of the wound.
3. Notify the laboratory supervisor in charge.
4. Immediately seek medical attention.

Chemical Injury or Exposure Response

When an injury has occurred general response guidelines are as follows:

1. Protect yourself from exposure and stabilize the injured person. When possible, wash your hands prior to and after giving first aid. Use gloves whenever possible.
2. Call 911 when emergency medical attention is required or when not sure how to respond.
3. Utilize the safety shower available in the laboratory when appropriate. Clothing must be removed to prevent prolonged chemical contact with the skin. Rinse the exposed area for at least 15 minutes.
4. Use the emergency eyewash stations to rinse harmful chemicals from the eyes when appropriate. Eyes must be rinsed for a minimum of 15 minutes.
5. Offer the injured person medical attention. Contact 911 immediately if he or she desires medical attention by an emergency room physician. Contact a family member to transport the injured person during non-emergency situations.
6. Contact EHS to report all injuries and complete an accident report. An accident report must be completed within 24 hours of the incident.

7. Report all accidents involving injuries to EHS within 24 hours of the incident. EHS will contact the Safety Committee chairperson. The laboratory chairperson will contact the departmental chairperson and follow-up on the status of the person's injury.

Other Wounds

Cuts and Scratches

In treating small cuts and scratches, clean the area with soap and water and apply a clean dressing over the wounded area**.** If there is significant bleeding from a wound, take the following steps:

1. Immediately call 911.
2. Reassure the injured person.
3. Lay the injured person down.
4. **Do not** remove any objects that may have impaled the person.
5. Place direct pressure on the wound with a clean cloth or sterile bandage. Do not apply a tourniquet.
6. If the pressure does not slow the bleeding, elevate the wound above the heart.
7. If the bleeding is severe, elevate the person's legs approximately 12 inches.

Thermal Burns

First degree burns are characterized by pain, redness and swelling.

1. Run cool water over the burn or soak it for a minimum of 10 to 15 minutes.
2. Cover the burn with a sterile bandage or clean cloth.
3. Do not apply any ointments, salves, or sprays.

Second- and third-degree burns are characterized by red mottled skin and blisters. White or charred skin is indicative of a third-degree burn.

1. Call 911.
2. Do not remove any burnt clothing.
3. Cover the burns with dry sterile or clean bandages.
4. Do not apply ointments, salves, or sprays.

Chemical Burns

When necessary, use the eyewash or safety shower as instructed in the procedures below. Ensure your own safety by wearing the appropriate personal protective equipment.

1. Chemical Burns to the Skin

    - Remove the victim’s clothes, including his/her shoes.
    - Rinse the area for a minimum of 15 minutes.

- Do not apply burn ointments to injured areas.
- Call 911, when the burn is large.

2. Chemical Burns to the Eyes

- Forcibly open the eyelids to insure the all the chemical is removed.
- Wash from the nose to the ear to ensure the chemical does not wash back into the eye.
- The wash must continue for a minimum of 15 minutes.
- Cover the injured person's eyes with clean or sterile gauze.
- Call 911.

3. Responding to Hydrofluoric Acid Burns

NSU requires supervisors having responsibility for laboratories that use or store Hydrofluoric acid (HF) to maintain a commercially prepared gel of calcium gluconate in the laboratory area. The gel is used for immediate treatment of skin exposures to HF. HF causes serious damage to tissues and bones. The faster the treatment, the smaller the chance of serious injury. In the event of a burn caused from HF, the following steps must be immediately taken:

- The skin must be copiously washed, beginning immediately after exposure.
- Apply a bulky dressing soaked in a commercially prepared quaternary ammonia compound, calcium gluconate or magnesium oxide topical ointment. Always follow the manufacturer's directions supplied with the HF burn ointment/solution if they differ from these.
- Seek immediate medical attention.

Chemical Ingestion or Inhalation

1. Ingestion of Chemicals

- Immediately call 911.
- Refer to the SDS to effectively treat the injured person.
- If the injured person is unconscious, turn his/her head or entire body onto the left side. Be cautious about performing CPR. This could potentially poison you from the mouth-to-mouth contact. If available, use a mouth-to-mouth resuscitator.

2. Inhalation of Chemicals

- Evacuate the area and move the victim to fresh air.
- Immediately call 911.
- When the victim is not breathing, perform CPR. Be cautious as the mouth-to-mouth contact can result in the responder becoming poisoned. Where available use a mouth-to-mouth resuscitator.
- When the victim is breathing, loosen his/her clothing and maintain the airway.

- Place one hand under the injured person's neck and gently lift.
- Rotate the injured person's head back to obtain maximum extension of the neck by pressing down on his/her forehead with your free hand.
- If additional airway extension is necessary, pull the injured person's lower jaw into a jutting-out position.
- Treat the person for chemical burns of the eyes and skin.

Section 5: Emergency Equipment

Proper maintenance of the safety equipment is vital to the health and welfare of all laboratory personnel. The emergency items (showers, eyewash stations and fire extinguishers) described below, common to all laboratories, must be properly maintained and regularly inspected to prevent or respond to laboratory accidents or emergencies.

5.1 Safety Showers and Eyewash Stations

All laboratories using hazardous chemicals, particularly corrosive chemicals, and biological specimens must have access to eyewash and/or an emergency shower as per the OSHA Standard, 29 CFR 1910.151 – Medical Services and First Aid. The ANSI Standard, Z358.1-2004 - Emergency Eyewash and Shower Equipment provides guidance by stating that emergency eyewash and/or emergency showers must be readily accessible, free of obstructions and within 10 seconds (not more than 50 feet and perhaps closer if access is through a normally closed door) from the hazard.

The ANSI standard also outlines specific requirements related to flow requirements, use of tempered water, inspection and testing frequencies, and training of laboratory personnel in the proper use of this important piece of emergency equipment.

Each emergency eyewash and shower station must be activated weekly by laboratory staff to check that it works and provides a strong enough stream of water to reach the eyes of someone bending over it, and to help keep the water clean. Record this weekly test where it can be audited in your lab equipment maintenance record book.

A. Safety Showers

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

1. Use and Maintenance

   - Safety showers should be in a **clearly marked and accessible** location. The station should be no more than 50 feet, or 10 seconds, away from every lab workbench.
   - Laboratory workers should be able to locate the shower(s) with their eyes closed (emergency situations may leave victim temporarily blind).

- Safety showers are operated by grasping a ring chain or triangular rod.
- The pull mechanism is designed for people of all heights. It should always be accessible and hang freely.
- Safety shower should supply a continuous stream of water to cover the entire body.
- Individuals should remove clothing, including shoes and jewelry, while under an operating shower.
- Safety showers should be located AWAY from electrical panels or outlets.

- Plumbed equipment shall be activated monthly by Physical Plant to verify proper operation.
- Safety showers should be inspected annually by Physical Plant to assure conformance with ANSI Z358.1 section (4) requirements.
- If at all possible, safety shower facilities should be installed near appropriate drainage systems.

2. Types of Safety Showers

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

B. Eyewash Stations

Eyewash stations provide an effective means of treatment when chemicals or biological items come in contact with the eyes. Eyewash stations should be readily available and accessible to all laboratory personnel and for personnel working in other environments such as studios, shops and garages, where corrosive chemicals are being handled in a way that can create a splash hazard to the face and eyes.

The station should be clearly marked and in accessible locations no more than 10 seconds or 50 feet away from every lab workstation. Laboratory workers should be able to locate the nearest eye wash station with their eyes closed (eye injuries may involve temporary blindness). Eye injury usually accompanies a skin injury. For this reason, eye wash stations should be located near the safety shower so that eyes and body can be washed.

1. Use and Maintenance

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

- Eyelids have to be **forcibly** opened to ensure effective washing behind the eyelid.
- Be sure to wash from the nose out to the ear this will avoid washing chemicals back into the eye or into an unaffected eye.
- Flood eyes and eyelids with water/eye solution for a minimum of 15 minutes.
- Remove contact lenses as soon as possible to rinse eyes of any harmful chemicals.
- Cover both of the victim's eyes with clean or sterile gauze.
- Call 911.

- Plumbed equipment shall be activated weekly to verify proper operation.
- Eye wash stations should be inspected annually to assure conformance with ANSI Z358.1 section (6) requirements.
- Plumbed eye wash stations should have protective covers to protect nozzles from airborne contaminants.

2. Types of Eye Wash Stations

- Gravity Feed Self-Contained: provides the laboratory worker with emergency eye wash treatment in areas inaccessible to plumbing.
- Faucet-Mounted: (pin or push plate activators) provides continuous water flow while freeing hands to open eyelids. It turns a standard faucet into a practical emergency eye wash station.
- Laboratory Bench: sprays with a squeeze handle can be installed through the bench top for instant availability.
- Swivel Eye Wash: mounts on lab bench or countertop adjacent to a sink. It swivels 90 degrees over the sink for use, or out of the way for storage.

3. Personal Wash Unit (Eye Wash Bottles)

The first seconds following an eye injury are often critical to keeping eye injury to a minimum. Eye Wash Bottles may be kept in the immediate vicinity of personnel working in a potentially hazardous area. However, eye wash bottles should never replace permanent emergency eye wash facilities when they are required. The main purpose of Eye Wash Bottles is to supply immediate flushing. When this has been done, the injured person should go to an emergency eye wash and flush the eyes for the required 15 minutes. –ANSI Z358.1-2004.

- The injured person should promptly follow up with a medical evaluation.
- Eye Wash Bottles must be maintained according to the manufacturer's instructions and promptly disposed of by the expiration date.

Due to the flow requirements outlined in the ANSI standard, handheld bottles do not qualify as approved eyewashes.

A handheld drench hose no longer qualifies as an approved eyewash station but may be used as a supplemental washing facility. Such drench hoses have been augmented with approved eyewashes through a special project. Emergency washing equipment is tested annually by Physical Plant to ensure it continues to meet ANSI standard water flow requirements. A tag indicating the last test date should be found on the equipment. Call Physical Plant for maintenance at 954-262-8800

5.2 Fire Safety Equipment

Preventing fires in the laboratory can be largely achieved by close adherence to the National Fire Protection Association (NFPA) guidelines for storage of flammable materials, attention to chemical incompatibilities, care in the use of flammable materials and chemical reactions, appropriate maintenance of equipment, and good housekeeping. All fires require a fuel source, an ignition source, and oxygen to burn. Minimizing any one of these will decrease the risk of fire.

Ignition sources must be located away from flammable and combustible materials. Always use heating apparatus, Bunsen burners, and flammable and combustible chemicals in the fume hood. There are many potential ignition and fuel sources in laboratories.

Common Laboratory Ignition and Fuel Sources are:

- Bunsen burners
- Hot plates and heating mantles
- Peroxides and peroxide formers
- Damaged electrical cords and extension cords
- Class III and IV lasers
- Flammable and combustible chemicals

A. Fire Alarms

Alarms are designed so that all endangered laboratory personnel are alerted. All faculty, staff and students should become familiar with the EXACT LOCATION of the fire alarm stations nearest to their laboratory.

B. Fire Extinguishers

Fire Extinguishers are classified according to a particular fire type and are given the same letter and symbol classification as that of the fire.

TYPE A -- Combustibles wood, cloth, paper, rubber and plastics
TYPE B -- Flammable Liquids - oil, grease and paint thinners
TYPE C -- Energized Electrical Equipment - electrophoresis
TYPE D -- Combustible Metals (magnesium, titanium, sodium, lithium, potassium)

Multipurpose Extinguishers are highly recommended because they are an effective agent against Types A, B, and C fires. Extinguishers should be identified by appropriate signage and securely located on the wall near an exit. All extinguishers should be inspected at least every 12 months for broken seals, damage, low gauge pressure, or improper mounting. Units should be replaced or recharged if they have been used, damaged, or discharged.

How to Use a Fire Extinguisher

Fire extinguishers are not designed or intended to extinguish large fires, but if used properly, can control or extinguish a small fire. A small fire is defined as one that could occur in a standard office trash can. When a fire or suspected fire, i.e., smoke, is discovered, the first reaction should always be to activate the fire alarm system, call 911, and evacuate the building according to the evacuation plan. Fire extinguishers are provided in all University buildings and can be used provided the person is properly trained to use the extinguisher. The following are guidelines in making the decision as whether to use the unit, and how to use the extinguisher.

1. SHOULD I USE THE EXTINGUISHER?
   If you ask yourself this, it's too late. Don't use the unit, leave the building.

2. HOW TO USE AN EXTINGUISHER

   Remember the "PASS" word.

   PULL THE PIN: Place your hand on the top of the cylinder and pull the pin. This will unlock the handle and allow you to activate the unit.
   AIM: the nozzle of the hose at the base of the fire.
   SQUEEZE: the handle (lever) releasing the firefighting agent.
   SWEEP: the nozzle from side to side over the fire. Keep the nozzle/hose directed at the base of the flame. Empty the fire extinguisher onto the fire.

3. PERSONAL SAFETY PRECAUTIONS

   - Never reach over the fire.
   - Never allow the fire to get between you and the exit from the room.
   - Never enter an unknown area to fight a fire, especially in a chemistry lab.
   - Always notify the proper fire officials.

C. Blankets

Laboratory personnel are DISCOURAGED from using fire safety blankets as a means to extinguish a fire. Fire safety blankets should be used to keep shock victims warm.

D. Sand/Absorbent Material

Sand and other absorbent material is designed for fast and easy extinguishing of **small** fires in the laboratory. These materials should be stored in a handy dispenser, appropriately labeled, and used according to the type of fire.

Do not use sand buckets as ash trays!

E. Sprinklers

Sprinkler systems are installed throughout university buildings and are automatically activated. Laboratory workers should not attempt to shut off the system.

- Items in the lab should be stored at least 18 inches away from the sprinkler heads.
- Items should not hang from the sprinkler heads.
- Intense heat should not be used near the sprinkler heads.

Note: Fire detection systems may be temporarily out of service due to utility work performed by the Facilities Office. Notification will be provided to laboratory personnel in the event fire detection systems are temporarily out of service.

Section 6: Personal Protective Equipment (PPE) and Latex Allergy

Personal Protective Equipment (PPE) is used by employees to protect them from the risk of injury and chemical exposure by creating a barrier against workplace hazards. Personal protective equipment must be used when administrative and/or engineering controls are not

effective. PPE is not a substitution for good work practices. 29 CFR 1910.132, Subpart I impose several requirements relating to basic safety and the requirements for the selection and use of PPEs.

Requirements and factors to consider when choosing PPEs include the following:

- Conduct a hazard assessment to determine if the hazards present require the use of PPEs and which PPEs would be selected to protect employees from these hazards.
- Train employees on the correct and appropriate use of PPEs.
- Evaluate the PPE program, and its effectiveness.

Designate one individual to be primarily responsible for employee training and monitoring the use of PPEs; this individual may be a supervisor or the safety officer. In addition, this person must be responsible for the availability of PPEs to employees, proper cleaning program or correct disposal of PPEs.

6.1 Protective Devices

The University shall supply personal protective equipment to all laboratory personnel. PPE shall be maintained in a sanitary and reliable condition. Protective equipment must meet the ANSI and OSHA standards. The design should be safe and constructed so as not to restrict or impede movement or the ability to work.

Table B: ANSI Standards for PPE

Eye and Face Protection	ANSI Z87.1 - 2020
Head Protection	ANSI Z89.1 - 2014
Foot Protection	ANSI Z41 - 1999
Hand Protection	There is no applicable ANSI standard however selection must be based on the performance characteristics of the glove in relation to the tasks to be performed

Table E sets forth minimum PPE requirements based upon associated hazards.

TABLE C: Minimum PPE Requirements

Hazards vs PPE (minimum PPE requirements)

Hazard	Eyes	Face	Body/Hands
Any laboratory or general use of chemicals	Safety glasses (all times in lab)		Normal work/lab attire (no sandals, shorts, etc) with over-garment (smock, lab coat, or coveralls), & gloves
Use of corrosive chemicals, strong oxidizing agents, carcinogens, mutagens, etc.	Chemical splash goggles	Full face shield over goggles (if gallon or more liquid)	Resistant gloves (see glove selection guide), resistant apron or over-garment (full protective suit for work with over 5 gal corrosive liquids)
Sharp objects, glass, insertion of tubes into stoppers	Safety glasses		Heavy cloth barrier or leather gloves
Temperature extremes	Safety glasses (goggles if possible splash)	Recommend full face shield (large quantity gas/liquid or sparking)	Insulated gloves for ovens, furnaces, cryogenics & devices over 100C or below -1C, use over-garment for hot/cold liquids & sparking

A. Eye and Face Protection

Employees who are exposed to hazardous chemicals and infectious materials must wear face protective equipment to prevent contamination of the mucosal membranes from splashing or aerosols. Facial protection can be achieved with different devices such as goggles, masks, face shields or counter face shields. Safety glasses or goggles are

made of impact resistant lenses and stronger frames than regular glasses. Face shields must be worn when working with materials that can affect facial skin or when goggles do not provide adequate protection from splashes. Eyewear must be provided to employees at no cost and in special instances employees may require prescription lenses to be fitted in the goggles. Eyewear must be maintained and cleaned before use, and contaminated eyewear cleaned immediately.

Prescription Safety Eyewear

Prescription glasses worn on their own do not meet the standards. OSHA regulations require that employees who wear prescription lenses while engaged in operations that involve eye hazards shall wear eye protection that incorporates the prescription in its design, or must wear eye protection that can be worn over the prescription lenses (goggles, face shields, etc.) without disturbing the proper position of the prescription lenses or the protective lenses. Any prescription eyewear purchase must comply with ANSI Z87.1-2020.

Additionally, contact lenses by themselves are not considered protective eyewear. Contact lens wearers exposed to hazardous chemicals must protect themselves by using the appropriate face protection.

Safety Glasses

Safety glasses provide eye protection from moderate impact and particles associated with grinding, sawing, scaling, broken glass, and minor chemical splashes, etc. Side protectors are required when there is a hazard from flying objects. Safety glasses are available in prescription form for those persons needing corrective lenses. Safety glasses do not provide adequate protection for processes that involve heavy chemical use such as stirring, pouring, or mixing.
In these instances, splash goggles should be used.

Splash Goggles

Splash goggles provide adequate eye protection from many hazards, including potential chemical splash hazards, use of concentrated corrosive material, and bulk chemical transfer. Goggles are available with clear or tinted lenses, fog proofing, and vented or non-vented frames. Be aware that goggles designed for woodworking are not appropriate for working with chemicals. These types of goggles can be identified by the numerous small holes throughout the facepiece.
In the event of a splash, chemicals could enter into the small holes, and result in a chemical exposure to the face. Ensure the goggles you choose are rated for use with chemicals.

Face Shields

Face shields provide additional protection to the eyes and face when used in combination with safety glasses or splash goggles. Face shields consist of an adjustable headgear and face shield of tinted or clear lenses or a mesh wire screen. They should be used in operations when the entire face needs protection and should be worn to protect the eyes and face from flying particles, metal sparks, and chemical/biological splashes. Face shields with a mesh wire screen are not appropriate for use with chemicals. Face shields must ***not*** be used alone and are ***not*** a substitute for appropriate eyewear. Face shields should always be worn in conjunction with a primary form of eye protection such as safety glasses or goggles.

LASER Eye Protection

A single pair of safety glasses is not available for protection from all LASER outputs. The type of eye protection required is dependent on the spectral frequency or specific wavelength of the laser source. If you have questions on the type of eyewear that should be worn with your specific LASER, contact the Safety Officer at the EHS Office.

B. Protective Clothing

Laboratory gowns or coats must be worn to protect street clothing and provide protection against biological and chemical spills as well as provide additional body protection. Laboratory personnel are to wear the correct attire when working with hazardous materials. Employees should wear clothing that will protect them. Open-toed shoes or sandals are prohibited.

A laboratory gown should be the traditional knee-length, long sleeved, cuffed coat that can be snapped closed to protect clothing and loose-fitting. Plastic or rubber aprons can be worn over laboratory coats for extra protection when working with corrosive or irritating liquids. Coats or gowns are not to be worn outside of the laboratory or working areas. When a coat becomes contaminated or torn, it must be removed immediately and either discarded if disposal or placed in the soiled laundry container. Employees shall be provided with hooks to hang up their coats when leaving the work area.

When ordering laboratory coats from a supplier be sure to inquire if the fabric meets the ASTM requirements, and has been evaluated for the following tests:

- Fluid resistance and spray rating (fabrics resistance to wetting).
- The Suter hydrostatic pressure test (the fabrics resistance to water penetration under static pressure).
- Air porosity specifications (a minimum of 12 cubic feet of air per minute)
- The break test (fabrics durability).

Table F sets forth the various properties of protective clothing materials based upon manufacturers representations.

TABLE D: Properties of Protective Clothing Materials*
*Based on manufacturer's claims

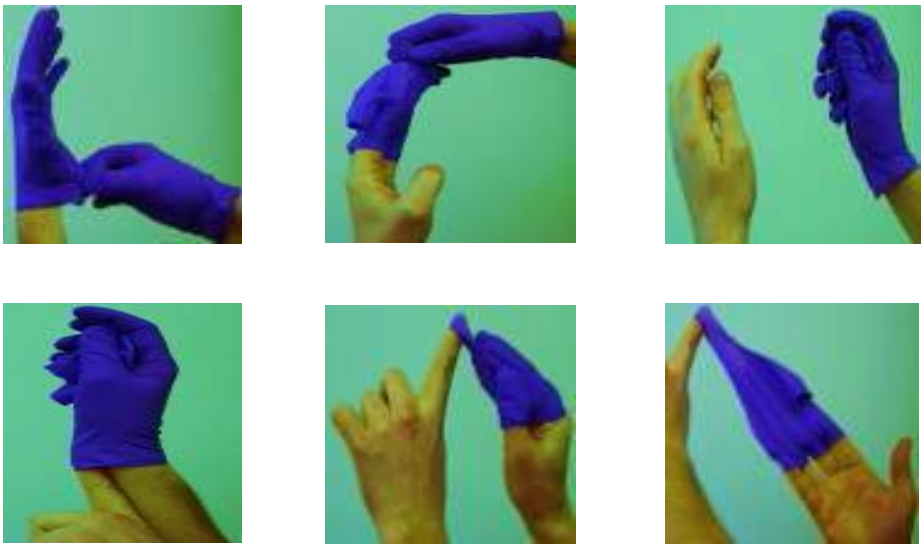
Materials	Properties					
	Strength	Chemical Resistance	Flammability	Static Properties	Comfort	Uses
Cotton	Fair durability	Degraded by acids; binds	Special treatment for flame	No static problems	Comfortable, lightweight	Lab coats
Modacrylic	Resistant to rips and tears but less so than polyamide fibers; abrasion-resistant but less so than nylon or polyester	Resistant to most chemicals	In direct flame, fabric shrinks to resist flame penetration; will not melt or drip; self-extinguishing; rapidly dissipates when source of ignition is removed	Has antistatic properties	Comfortable, soft, and resilient; easy to clean; has soil release properties	Lab coats
Nylon	Exceptionally strong and abrasion resistant	Not water absorbent	Melts when heated; requires flame retardant	Static buildup possible; requires antistatic agent	Lightweight	Lab coats
Plastic	Usually reinforced at points of strain; will not stick together, peel, crack, or stiffen	Resistant to corrosive chemicals	Can be ignited by flammable solvents and others in event of static discharge	Accumulates considerable charge of static electricity	Lightweight	Aprons, sleeve protectors, boots
Polyolefin	Resistant to rips and tears	Excellent chemical resistance; low binding for chemicals	High melting point; flame-resistant	Good static dissociation	Lightweight; good permeability; limited moisture absorbency; wearer perspiration may cause discomfort	Bouffant caps
Polypropylene	Strong	Resistant to most chemicals; oxygen and light-sensitive	Low melting point; requires flame retardant	Static buildup; requires antistatic agent	Lightweight	Aprons
Rayon	Fairly durable			Degraded by acids; binds some chemicals		Lab coats

C. Gloves

Gloves should be worn whenever there is a possibility of skin contact with chemical, radiological and biological agents. Dermatitis, inflammation of the skin or latex allergies accounts for a high number of work-related diseases. Therefore, the correct selection of gloves is required. Nitrile gloves seem to be the most popular in clinical laboratories today. Disposal gloves should be worn when working with chemicals, hazardous materials, and rough or sharp objects. **Always wash hands thoroughly before and after glove use.**

When gloves become contaminated, punctured or torn, they must be replaced immediately. Disposal gloves are not to be reused or washed. When putting on gloves make sure that they overlap the laboratory coat cuff, this will prevent skin contact from hazards.

Illustration 1: Procedure to remove gloves safely



Appendix A consists of a chart on the selection of gloves and the correct usage, but the following characteristics should also be considered when selecting gloves:

- Degradation rating (how well the glove will hold up when exposed to chemicals).
- Breakthrough time (elapsed time between the initial contact of the test chemical on the surface of the glove and the detection of the chemical on the inside of the glove).
- Permeation rate (rate at which the chemical passes through the glove once breakthrough has occurred).

Other considerations to take into account when purchasing gloves is the thickness. Thin gloves may feel better but may provide shorter breakthrough times. The glove length is also important as a short glove will expose the arm and provide no protection against splashes or immersion. Glove size is important as glove that are too tight tend to will cause fatigue, while too loose gloves will make it more difficult to work.

D. Respiratory Protection

Respirators are not recommended for routine laboratory work but should be used when general ventilation or a fume hood does not reduce the chemical exposure to acceptable levels. The use of respirators requires compliance with NSU Respiratory Protection Plan Policy/Procedure Number 14, which includes the medical evaluation, training, and fitting of employees/students. With the threats of pandemics, bioterrorism and tuberculosis, respirators may become more readily utilized.

E. Foot Protection

Because shoes are to be always worn in the laboratory, they must be comfortable. It is preferred that the soles be non-slip and the shoes made from leather, it is not advisable to wear perforated shoes, sandals, or cloth sneakers. Open-toe shoes and clogs are prohibited. The shoes employees wear are to protect them from chemical spills or toxic materials as well as any heavy objects that may fall on the feet therefore it is not advisable to wear perforated shoes, sandals or cloth sneakers.

6.2 Latex Allergy

Latex allergic reactions to natural rubber latex are becoming more common. Due to the increased glove demand in the health care settings, manufacturers have changed the process resulting in higher levels of allergens. Latex gloves expose employees through two routes – skin contact with the latex allergens and inhalation of latex proteins that are released into the air bound to the powders used to lubricate the gloves. Employees that are repeatedly exposed to latex products are at an increased risk of developing an allergy to latex. Sensitization can develop over time when a person is repeatedly in contact with latex products such as gloves. A person with an allergic reaction to latex exposure develops symptoms such as skin rash and inflammation, respiratory irritation, asthma and can lead to life-threatening anaphylactic reactions.

Not all hand rashes in the laboratory are caused by latex allergies. Rashes can be a result of the powder in the gloves or not related to the use of latex gloves at all. The sensitization will decrease when the exposure to latex is stopped. Nitrile gloves have become more popular in laboratories today.

Section 7: Engineering Controls

Engineering controls are usually automatic devices that will protect employees from the risk of hazardous exposure and is considered the first line of defense in the laboratory for protection. Examples of engineering controls used in laboratories at NSU may include chemical fume hoods, glove boxes, safety shields, and proper storage facilities.

The OSHA Laboratory Standard requires that fume hoods and other protective equipment function properly and that specific measures are taken to ensure proper and adequate performance of such equipment. General laboratory room ventilation is not adequate to provide proper protection against bench top use of hazardous chemicals. Laboratory personnel need to consider available engineering controls to protect themselves against chemical exposures before beginning any new experiment(s) involving the use of hazardous chemicals.

All equipment used in the laboratory must function properly and safely. To ensure this, laboratories must maintain equipment according to manufacturer's specifications or established guidelines. Routine inspections should also be performed to check for common problems like damaged electrical cords, corrosion, worn parts, excessive contamination, leaks, etc. Alarms, guards, interlocks, or other safety devices should also be checked to ensure that they have not been disconnected or defeated.

The equipment will be inspected annually by a qualified vendor coordinated by EHS. An inspection tag/card/sticker should be attached to the equipment with a record of inspection dates.

It is the responsibility of laboratory personnel to immediately report malfunctioning protective equipment, such as fume hoods, or mechanical problems to EHS as soon as any malfunctions are discovered.

7.1 Fume Hoods

A fume hood is one of the most important pieces of laboratory safety equipment NSU can afford faculty, researchers, staff, and students. A fume hood prevents the inhalation of potentially harmful substances, deters uncontrolled splashes and spills from entering the lab environment, and removes flammable vapors from the indoor atmosphere.

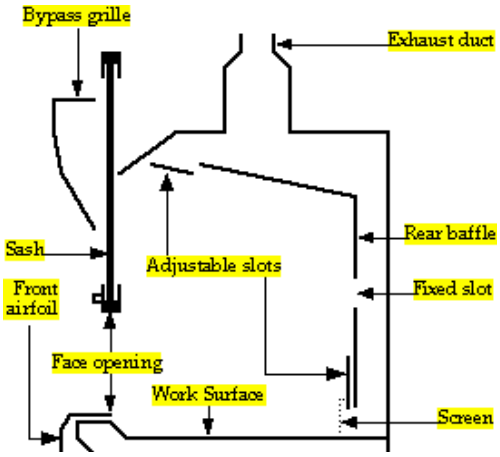
A. When to Use a Chemical Fume Hood

A chemical fume hood is a necessary part of your laboratory procedure when:

- Working with hazardous or suspect hazardous chemicals
- Working with chemicals having unknown properties
- Pouring, mixing, weighing and dispensing chemicals

B. How to Use a Fume Hood

Fume hoods are minimally equipped with a blower, cabinet, and exhaust ductwork. The cabinet is designed to contain hazardous chemicals. The blower is designed to pull air away from the front of the cabinet and keep the hazardous chemicals from reaching the indoor environment and user. The exhaust ductwork is independent from other indoor air ductwork and is used to transport any hazardous chemical fumes, gases, vapors, or aerosols to the outside environment.



Baffles are located across the inside rear of the hood. They assist in controlling the airflow pattern through the hood. Baffles can be adjusted to minimize hazards caused by the different characteristics of chemicals being utilized in the hood system.

- For normal use, the top, bottom, center and side slots are all adjusted to the open position to provide an even airflow.
- Gases or fumes that are heavier-than-air require the baffles to be adjusted for the maximum airflow at the bottom of the hood. To adjust the hood, close the top slot then arrange the center, bottom, and side slots in the open position.
- Gases or fumes that are lighter-than-air require a maximum airflow at the top of the hood. In those instances, open the top baffles to their maximum position and maintain the side and center baffles in their normal position and completely close the bottom slot.

A fume hood must have a face velocity sufficient to pull the air away from the user. The American National Standards Institute (ANSI) recommends that laboratory fume hood face velocity be between 80 to 120 feet per minute (fpm) for optimal safety. 100 fpm is approximately

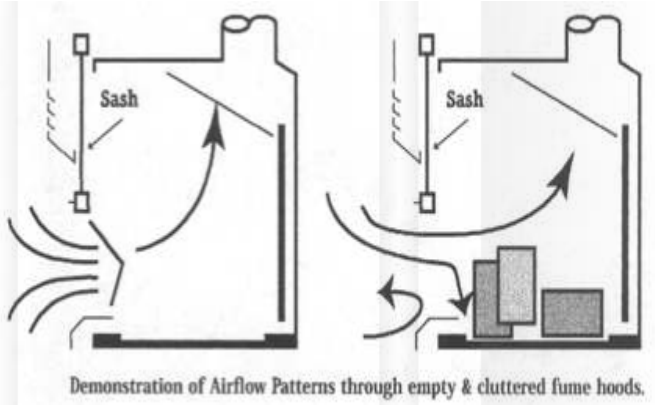
the same as three miles per hour, which feels like the air going past somebody who is walking briskly. In traditional systems, the user does not have control over the face velocity or exhaust rate of the hood. Exhaust rates in newer fume hoods are often controlled by a variable air volume system.

Variable air volume technology allows for the maintenance of a constant face velocity while varying exhaust volume in response to changes in the sash position. The exhaust volume is varied in response to a series of sensors that receive and send signals to the exhaust valve. Annual calibration of the VAV system is necessary to ensure the appropriate flow is being afforded the user. The point of optimal flow is established through calibration of the equipment. When the sash is opened above or below the optimal flow point the face velocity will decrease.

Fume Hood Safety Practice

A chemical fume hood cannot provide complete safety against all hazards. A functioning fume hood and appropriate laboratory ventilation will provide adequate protection during standard laboratory manipulations. The fume hood should be used in conjunction with other safety equipment when toxic chemicals having exposure limits in the low parts per million ranges are being utilized. More stringent safety requirements are left to the discretion of laboratory supervisors. The following is a list of mandatory laboratory safety practices:

1. Keep all apparatus at least 6 inches from the face of the hood.
2. Do not put your head in the hood when contaminants are being generated.
3. Do not use the hood to evacuate containers of volatile waste chemicals.
4. All protective clothing should be worn when working with chemicals in the hood. In addition to gloves, safety glasses, and lab coats, a face shield will provide an extra measure of safety from reactive chemicals.
5. Minimize the quantity of chemicals and apparatus being used in the hood. Excessive storage of items in the fume hood will impair its performance.



Demonstration of Airflow Patterns through empty & cluttered fume hoods.

6. All operations that may generate air contaminants above their exposure limits must be conducted inside a fume hood.
7. Do not use a fume hood if it is not working appropriately. Test the airflow periodically. If a flow meter is not available, a Kim wipe placed at the base of the hood will be gently lifted when appropriate airflow is provided. The Kim wipe should not be pulled into the exhaust. This indicates the airflow is too high.
8. An emergency plan should exist in case of hood ventilation malfunction.
9. Maintain the slots in the hood baffle free from obstructions.

10. Minimize traffic in front of the hood while in use.
11. Keep laboratory doors and windows closed unless specifically designed for opened doors.
12. Do not remove the hood sash, panels or sensors. Keep all wiring between hood electronics and sensors intact.
13. The laboratory supervisor must approve the use of hazardous solids (powders). (Many potential problems arise when the solid is fine enough to become airborne.)
14. Do not place receptacles or other sources of sparks inside the hood when flammable liquids or gases are present.

15. Use an appropriate barricade if an explosion or other violent reaction is possible.
16. Do not remove hood labels that indicate the maximum safe operating level of the sash.
17. Use only specially designed fume hoods for operations that may require the use of perchloric acid. The use of this material may cause the formation of explosive perchlorate crystals. Special fume hoods, commonly known as **Perchloric Acid Fume Hoods**,

    MUST be used for this purpose. These hoods have self-contained wash-down units to inhibit crystal formation.
18. Ensure all fume hoods have a spill protection lip.

The hood should always be in good condition and capable of routine use. Solid objects or materials should not be allowed to enter the exhaust ducts at the rear of the hood, as they can become lodged in the duct or fan. Any hood or component of ventilation not properly functioning must be taken out of service and clearly tagged.

The lab worker should not be able to detect strong odors released from materials in the hood area. If odors are detected, check to make sure that the ventilation fan is turned on. If the operating condition of a fume hood needs to be checked, call EHS.

7.2 Perchloric Acid Fume Hoods

Procedures using concentrated perchloric acid (>70%) or which heat any amount or concentration of perchloric acid must be performed in a closed system or within a specially designed perchloric acid fume hood with wash down systems to prevent the accumulation of explosive perchlorates in the hood and ducting. For assistance in locating a perchloric acid fume hood call EHS.

7.3 Glove Boxes

A glove box is a sealed container that is designed to allow one to manipulate objects where a separate atmosphere is desired. Glove boxes generally operate under either positive or negative pressure to the laboratory, depending on the process or material used. Positive pressure glove boxes are used when you are trying to protect your material from contamination. Negative pressure glove boxes are used to provide increased operator protection. Glove boxes should be thoroughly tested before each use and there should be a method of monitoring the integrity of the system (such as a pressure gauge).

7.4 Biological Safety Cabinets

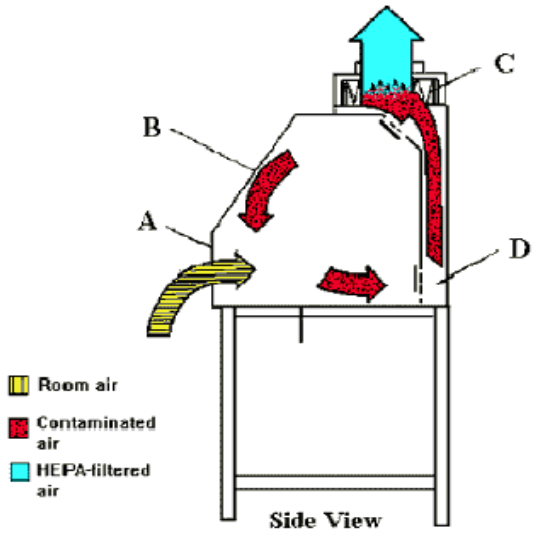
Biological Safety Cabinets are the most common and effective primary containment devices in the laboratory for working with infectious agents. With the increased awareness of bioterrorism, it is important to determine the biohazard levels of microorganisms and clinical materials encountered in the laboratory and classify according to the four Biosafety Levels (BSLs). Most laboratories fall into the BSL - 1 or BSL–2 level. The CDC has a publication entitled "*Primary Containment for Biohazards: Selection, Installation and Use of Biological Safety Cabinets"* which is available on their website at: https://www.cdc.gov/biosafety/publications/index.htm

Biological Safety Cabinets are designed to combine directional airflow with high efficiency particulate (HEPA) filters to protect employees and the environment from airborne microorganisms. Discharged air passes through the HEPA filters which remove 99.97% of the particles with a mass median aerodynamic diameter (MMAD) of 0.3 microns thus eliminating most bacteria, viruses and spores from circulation. The Class II BSC is most common for clinical

laboratories and approved for BSL-2 and BSL-3 use while the Class III BSC is approved for BSL-4 microbiological agents.

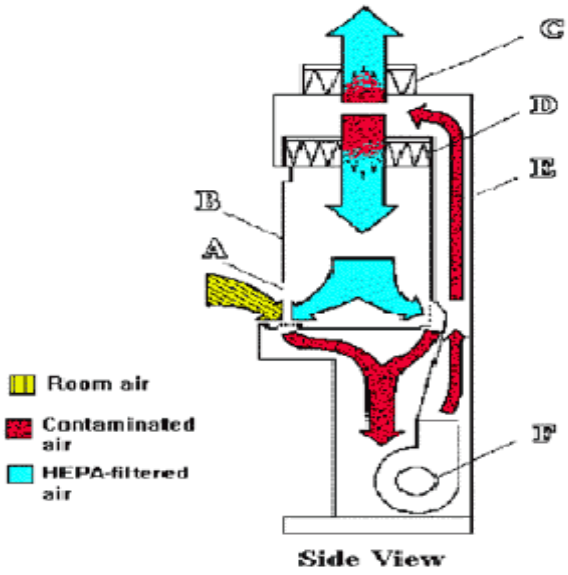
TABLE E: Comparison of Biosafety Cabinet Characteristics

BSC Class	Face Velocity	Airflow Pattern	Applications	
			Nonvolatile Toxic Chemicals and Radionuclides	Volatile Toxic Chemicals and Radionuclides
I	75	In at front; exhausted through HEPA to the outside or into the room through HEPA	YES	YES
II, A	75	70% recirculated to the cabinet work area through HEPA; 30% balance exhausted through HEPA back into the room or to the outside through a thimble unit	YES	NO
II, B1	100	Exhaust cabinet air must pass through a dedicated duct to the outside through a HEPA filter	YES	YES
II, B2	100	No recirculation; total exhaust to the outside through hard-duct and a HEPA filter	YES	YES
II, B3	100	Same as II, A, but plenums are under negative pressure to room; exhaust air is thimble-ducted to the outside through a HEPA filter	YES	YES
III	N/A	Supply air inlets and hard duct exhausted to outside through two HEPA filters in series	YES	YES



The Class I BSC

A. front opening
B. sash
C. exhaust HEPA
D. exhaust plenum



The Class II, Type A BSC

A. front opening
B. sash
C. exhaust HEPA filter
D. rear plenum
E. supply HEPA filter
F. blower

A. Certification

The functional operation and integrity of each BSC should be certified to current performance standards at the time of installation and annually thereafter by qualified technicians, according to the manufacturer's instructions. Evaluation of the effectiveness of cabinet containment should include tests for cabinet integrity, HEPA filter leaks, down-flow velocity profile, face velocity, negative pressure/ventilation rate, air flow smoke pattern, and alarms and interlocks. Optional tests for electrical leaks, lighting intensity, ultraviolet light intensity, noise level and vibration may also be conducted. Special training, skills and equipment are required to perform these tests and it is highly recommended that they are undertaken by a qualified professional.

B. Cleaning and Disinfection

All items within BSCs, including equipment, should be surface-disinfected and removed from the cabinet when work is completed, since residual culture media may provide an opportunity for microbial growth. The interior surfaces of BSCs should be disinfected or decontaminated before and after each use. The work surfaces and interior walls should be wiped with a disinfectant that will kill any microorganisms that might be found inside the cabinet. At the end of the work day, the final surface decontamination should include a wipe-down of the work surface, the sides, back and interior of the glass. A solution of bleach or 70% alcohol should be used where effective for target organisms. A second wiping with sterile water is needed when a corrosive disinfectant, such as bleach, is used. It is recommended that the cabinet is left running. If not, it should be run for 5 min in order to purge the atmosphere inside before it is switched off.

C. Decontamination

BSCs must be decontaminated before filter changes and before being moved. The most common decontamination methods are by fumigation with formaldehyde gas or vaporized hydrogen peroxide. BSC decontamination should be performed by a qualified professional.

D. Personal Protective Equipment

Personal protective clothing should be worn whenever using a BSC. Laboratory coats are acceptable for work being performed at Biosafety Levels 1 and 2. Gloves should be pulled over the wrists of the gown rather than worn inside. Elasticized sleeves can be worn to protect the investigator's wrists. Masks and safety glasses may be required for some procedures.

E. Alarms

BSCs can be equipped with one of two kinds of alarm. Sash alarms are found only on cabinets with sliding sashes. The alarm signifies that the operator has moved the sash to an improper position.

Corrective action for this type of alarm is returning the sash to the proper position. Airflow alarms indicate a disruption in the cabinet's normal airflow pattern. This represents an immediate danger to the operator or product. When an airflow alarm sounds, work should cease

immediately and the laboratory supervisor should be notified. Manufacturers' instruction manuals should provide further details. Training in the use of BSCs should cover this aspect.

7.5 Chemical Storage Cabinets

Chemical Storage Cabinets should be labeled with the relevant hazard information associated with the chemicals stored in them. Storage of flammables and corrosives in the lab should be limited to as small a quantity as possible and should be stored in ventilated cabinets which meet OSHA 1910.106d and NFPA 30 specifications.

- Chemicals should **NEVER** be stored in alphabetical order (unless already separated out into compatible groups). This system may contribute to the high probability of incompatible materials being stored next to one another.
- Incompatible reagents should not be stored next to each other.
- Storage outside the cabinet should be kept to a minimum.
- Glass containers should be stored on the bottom shelf of storage cabinets, if possible.

Types of Cabinets.

- Flammable liquid cabinets: designed for storage of flammable or combustible liquids.
- Acid/corrosive cabinets: designed for corrosion resistance.
- Bulk storage cabinets: can be used for storage of flammable and corrosive liquids outside the laboratory setting.

7.6 Individual Storage Containers

Many types of containers are required depending on the quantities and classes of flammable or combustible liquids in use. A ***safety can*** is an approved container of not more than 5 gallons capacity that has a spring closing lid and spout cover. Safety cans are designed to safely relieve internal pressure when exposed to fire conditions. A ***closed container*** is one sealed by a lid or other device so that liquid and vapor cannot escape at ordinary temperatures.

Section 8: Laboratory Equipment and Procedures

All equipment in the laboratory must be operated in a safe manner and if the equipment is malfunctioning, an out of order sign needs to be placed on this piece of equipment to warn employees of its unsafe function. Safety devices on equipment must not be tampered with or disconnected.

8.1 Refrigerators

While domestic refrigeration units are appropriate for keeping foods cold, they are not designed to meet the special hazards presented by flammable materials. Therefore, laboratory refrigerators should be carefully selected for specific chemical storage needs. To prevent potential safety hazards, the length of storage of any material should be kept to a minimum. In addition, refrigerators should be periodically inspected.

A. Refrigerator and Freezer Hazards

The potential hazards posed by laboratory refrigerators and freezers involve vapors from the contents, the possible presence of incompatible chemicals, and spillage. Loss of electrical power can produce extremely hazardous situations. Flammable or toxic vapors may be released from refrigerators and freezers as chemicals warm up and/or certain reactive materials may decompose energetically upon warming.

B. Laboratory Refrigerator/Freezer Design

Only refrigerators and freezers designed for laboratory use should be utilized for the storage of chemicals. These refrigerators have been constructed with special design factors, such as heavy duty cords and corrosion- resistant interiors to help reduce the risk of fire and explosion. Only chemicals should be stored in chemical storage refrigerators; lab refrigerators should not be used for food storage or preparation.

C. Refrigerator / Freezer Labeling

Refrigerators and freezers should be labeled clearly for their intended purpose (e.g., “No Food or Drink to be Stored in this Refrigerator”, “Refrigerator For Food Only”, "NO FOOD - CHEMICAL STORAGE ONLY", "Not For Flammable Storage", etc.)

Flammable Liquid Storage Standard refrigerators have electrical fans and motors that make them potential ignition sources for flammable vapors. Therefore, flammable chemicals or chemical mixtures that must be kept below room temperature must be stored in refrigerators or freezers specifically designed by the manufacturer to be explosion proof.

Flammable liquid-approved refrigerators are designed with spark-producing parts on the outside to avoid accidental ignition. If refrigeration is needed inside a flammable-storage room, you should use an explosion-proof refrigerator.

All other refrigerators or freezers not specifically designed to be explosion proof should be labeled with a prominent warning sign indicating that they are unsuitable for the storage of flammable substances. Electric heaters used to defrost the freezing coils can also spark. To ensure its effective functioning, a freezer should be defrosted manually when ice builds up

Frost-free refrigerators should also be avoided since many of them have a drain tube or hole that carries water, and possibly any spilled materials, to an area near the compressor, which may present a spark hazard.

D. Refrigerator/Freezer Contents

All materials in refrigerators or freezers should be labeled with the contents, owner, date of acquisition or preparation, and nature of any potential hazard. All containers should be sealed, preferably with a cap, and placed in secondary containers or catch pans. Since refrigerators are often used for storage of large quantities of small vials and test tubes, a reference to a list outside of the refrigerator could be used. Labels and ink used to identify materials in the refrigerators should be water-resistant.

E. Refrigerator/Freezer Explosions

Flammable liquids must only be stored in refrigerators which have no internal ignition sources.

Consider the picture below from a laboratory refrigerator explosion. Many small tubes of petroleum ether were stored in an ordinary domestic freezer.

Petroleum ether, a very flammable liquid, has a flash point as low as -56° F, and is classified as a Class 1A flammable with an NFPA 704 fire hazard rating of 4. Apparently, the tubes were not sealed well, and over time, the petroleum ether evaporated in sufficient quantity that the concentration exceeded the low explosive limit, about 1.0%. A spark from an internal component (e.g., thermostat, light switch) caused the vapor of the liquid to detonate.

F. Preventing Explosions

To prevent refrigerator and freezer explosions, laboratory supervisors must vigorously enforce the following:

- All materials with a flashpoint below 100° F may only be stored in a UL approved flammable materials storage refrigerator or freezer. These units do not have any internal ignition sources.

- All ordinary domestic refrigerators and freezers should be labeled with the phrase "No materials with a flashpoint below 100° F may be stored in this refrigerator/ freezer" or "Not for flammable storage."

8.2 Incubators

An incubator is a chamber type equipment that is primarily used for creating a controlled environment by regulating the humidity, temperature, and ventilation within its body. Laboratory incubators are used for several purposes in different section of science and research.

Laboratory personnel are responsible for checking temperatures and CO_2 levels, changing charts on chart recorders if applicable, and for general maintenance and cleaning of incubators. All temperatures and fyrite CO_2 values must be documented. When cleaning or maintaining incubators, personnel are to use good laboratory practices. Further, personnel shall wear safety glasses when working with 70% (v/v) Isopropyl Alcohol. Any maintenance of incubators must be documented.

Materials and equipment needed to maintain and clean incubators include the following:

- Distilled Water
- 70% (v/v) Isopropyl Alcohol
- Chart Recorder with probe if applicable
- FYRITE CO_2 instrument or equivalent
- Disinfectant-detergent (hydrogen peroxide/bleach or equivalent)
- Decontamination Kit
- Cleanroom wipes
- Bioshield

Facilities personnel are responsible for scheduling annual maintenance and preventative calibration by authorized service representatives.

Cleaning Procedures

The humidity pan may be autoclaved or sterilized prior to use. The humidity pan should be filled with 5 Liters of distilled water and should be placed on the floor of the incubator. The water level in the humidity pan should be checked frequently, and water should be changed weekly.

Document activities on the maintenance log sheet.

1. Set the chamber temperature: The overtemp safety may be reset after the chamber temperature has stabilized at setpoint.
    - If a chamber temperature of 37°C is desired, set the variable/37°C switch to the 37°C position.
    - If a value other than 37°C is desired refer to Operators Manual.
2. Set the overtemp safety thermostat: Once the chamber temperature has stabilized (as indicated by the digital display), the overtemp safety should be set. The overtemp

setpoint can be set within 0.1 degree of operating setpoint, but it is recommended that it not be set within 0.5 degrees of setpoint.

3. Zero the CO_2 controller: This adjustment is made using the CO_2 gas content of ambient air (0.33%), the most accurate standard available. NEVER USE A FYRITE OR OTHER ANALYZER FOR THIS ADJUSTMENT. The adjustment must be made on initial start-up, bi-annually, and it must also be made if a change in the humidification of the incubator is required.
4. Stabilize the incubator: Stabilize the incubator at the operating temperature and humidity level with no CO_2 in the interior chamber. This will take a minimum of 8 hours, but on initial startup allow 3 days.
5. Adjust the CO_2 control zero point
6. Turn on the CO_2 at the supply
7. Turn the CO_2 setpoint to the desired %
8. Allow the incubator to reach setpoint: Allow the incubator to reach setpoint and control for a minimum of 30 minutes.
9. Check the CO_2 level with a FYRITE: If the FYRITE and display are not within ± 1.0%, alert the supervisor and facilities, and the incubator should be taken out of service until the issue is resolved. All contents should be moved to another calibrated incubator.
   a) Hold the FYRITE upright and away from your face.
   b) Press the plunger momentarily to vent the tester.
   c) Invert the FYRITE to drain the fluid into the top.
   d) Turn the FYRITE upright and allow the fluid to drain to the bottom.
   e) Hold the FYRITE at eye level.
   f) Loosen the locknut at the rear of the scale.
   g) Slide the scale until the top of the fluid column lines up with the zero on the scale.
   h) Tighten the locknut.
   i) Either the top or the bottom of the meniscus can be used for setting the zero as long as the same point is used when making measurements.
   j) Attach the open end of the rubber gas sampler hose to the sample port on the incubator. DO NOT attach the tube to the FYRITE tester at this time.
   k) Pump the aspirator bulb a few times to clear the air from the sampler line.
   l) Hold the FYRITE upright and place the rubber connector tip from the sampler tube over the plunger valve and pump the aspirator 18 times and hold aspirator bulb during the final squeeze.
   m) Invert the FYRITE and allow all the liquid to drain to the top.
   n) Turn upright and allow all the liquid to drain to the bottom. Repeat once.
   o) Momentarily hold the FYRITE at a 45-degree angle to allow the fluid droplets to drain to bottom.
   p) Hold the FYRITE upright. Allow the fluid a few seconds to stabilize.
   q) Determine the percent CO_2 from the level of the fluid column. A delay of 5 to 10 seconds in taking the reading may result in a slight error; a longer delay may result in a substantial error.
   r) When finished remove the FYRITE hose from the sample port to allow the chamber to breathe.
10. Document activities: Document activities on the maintenance log sheet.
11. Set the CO_2 concentration.

Maintenance Instructions

1. Record incubator metrics: Record temperature, thermometer and CO_2 levels every day.
2. Clean incubator regularly: Spray 70% (v/v) Isopropyl Alcohol onto a wipe or use wipes saturated with Alcohol to clean the incubator interior at least once a week and record on maintenance log sheet. NOTE: Alarm may sound during this process.
   a) Remove shelves, duct sheets and blower channel, and clean all interior surfaces with 70% (v/v) Isopropyl Alcohol, taking care not to saturate the CO_2 sensor.
   b) Thoroughly clean the door gasket.
   c) Clean inside of glass door.
   d) Wash shelves and duct sheets.
   e) Rinse all the duct sheets and shelves.
   f) Allow all surfaces to dry, and incubator to air out prior to filling humidifier pan and closing doors.
3. Check overtemp safety monthly: The overtemp safety should be checked monthly to insure proper operation. Document activities in the maintenance log sheet.
4. Disinfect incubator semi-annually: Disinfecting the incubator and installation of decontamination kit, should be performed every 6 months or if any contamination is seen in cultures or specimens stored in the incubator.
   a) Disconnect incubator from power supply.
   b) Remove shelves, duct sheets, humidifier pan and blower channel from incubator interior and clean all interior surfaces with disinfectant-detergent, taking care not to saturate the CO_2 sensor.
   c) Rinse the surfaces at least twice with distilled water, or until satisfied that all of the disinfectant-detergent has been removed.
   d) Thoroughly clean the door gasket.
   e) Clean inside of glass door with solution, and rinse with distilled water.
   f) Wash shelves and duct sheets, humidifier pans and blower channel with disinfectant-detergent
   g) Rinse the surfaces at least twice with distilled water, or until satisfied that all of the disinfectant-detergent has been removed.
   h) Wrap shelves and duct sheets, humidifier pans and blower channel with bioshield and autoclave.
   i) Install decontamination kit according to manufacturer's instructions.
   j) Reinstall shelves, duct sheets, humidifier pans and blower channel.
   k) Verify everything is in working order.

Document all maintenance in maintenance log.

8.3 Centrifuges

A centrifuge is a piece of equipment, generally driven by an electric motor that puts an object in rotation around a fixed axis, applying a force perpendicular to the axis. Centrifugation is a process that involves the use of the centrifugal force for the separation of mixtures, used in laboratory settings. Centrifugation may present two serious hazards: mechanical failure and dispersion of aerosols. Below describes the safety and maintenance procedures to minimize centrifuge hazards.

A. Safe Procedures for Centrifugation

Before centrifugation

- Train each operator on proper operating procedures, review the user manual.
- Use only rotors compatible with the centrifuge. Check the expiration date for ultracentrifuge rotors.
- Check tubes, bottles, and rotors for cracks and deformities before each use.
- Make sure that the rotor, tubes, and spindle are dry and clean.
- Examine O-rings and replace if worn, cracked, or missing.
- Never overfill centrifuge tubes (don't exceed ¾ full).
- Always cap tubes before centrifugation.
- Always balance buckets, tubes, and rotors properly.
- Check that the rotor is seated on the drive correctly, close the lid on the centrifuge, and secure it.
- When using swinging bucket rotors, make sure that all buckets are hooked correctly and move freely.

During centrifugation

- Close lids at all times during operation. Never open a centrifuge until the rotor has stopped.
- Do not exceed safe rotor speed.
- The operator should not leave the centrifuge until full operating speed is attained and the machine appears to be running safely without vibration.
- Stop the centrifuge immediately if an unusual condition (noise or vibration) begins and check load balances.

After centrifugation

- Allow the centrifuge to come to a complete stop before opening.
- Wear new pair of outer gloves to remove rotor and samples.
- Check inside of centrifuge for possible spills and leaks, clean centrifuge and rotor thoroughly if necessary.
- Wash hands after removing gloves.

B. Centrifuging infectious materials or human samples

- Always wear gloves when handling tubes or rotors.
- Avoid the use of celluloid tubes with biohazards. If celluloid tubes must be used, an appropriate chemical disinfectant must be used to decontaminate them.
- Always use sealed safety cups, safety buckets, or sealed rotors with O-rings as secondary containment.
- Place a biohazard label on the centrifuge.

- Fill centrifuge tubes, load into rotors, remove from rotors, and open tubes within a biological safety cabinet whenever possible.
- Wipe exterior of tubes or bottles with disinfectant prior to loading into rotor or bucket.
- Seal rotor or bucket, remove outer gloves, and transport to the centrifuge.
- Wait at least 10 minutes after the run to allow aerosols to settle before opening the centrifuge.
- Check for possible spills or leaks.

C. Spills, Malfunctions and Failures

Centrifuge spills of infectious materials transmitted **by inhalation**

- If a spill has occurred in the centrifuge, hold breath, close the centrifuge lid, turn centrifuge off, and immediately leave the lab.
- Notify others to evacuate the lab, close the door, post a biohazard spill sign at the lab door.
- Remove any contaminated protective clothing and place in a biohazard bag. Wash hands and any exposed skin surfaces with soap and water. Seek medical attention as necessary.
- Report spills to laboratory supervisor. Call Safety Officer or EHS Office for assistance.

Centrifuge malfunction, rotor failure, or tube breakage of materials **not transmitted by inhalation**

- If a centrifuge malfunctions while in operation, turn it off immediately and unplug.
- If tube breakage occurs, turn centrifuge off immediately. Leave for 30 minutes to reduce the risk of aerosols. The operator should wear proper gloves, remove debris, clean and disinfect centrifuge interior, rotors, safety cups or buckets following the manufacturer's instructions.

D. Centrifuge Maintenance

Moisture, chemicals, strong cleaning agents, and other substances can promote corrosion of centrifuge parts and cause centrifuge failure. The following are general maintenance recommendations:

- Follow manufacturer instructions for maintenance and cleaning.
- Keep the centrifuge clean and dry.
- Clean all spills immediately and decontaminate the rotor after use with biological or radioactive materials.
- Clean rotors and cups with non-corrosive detergents (mild detergent and distilled water are recommended), then dry the surface thoroughly.
- Never clean rotors and associated parts with abrasive wire brushes.
- Store the rotor upside down in a dry place, with lids or plugs removed, to prevent condensation.
- Remove adapters after use and inspect for corrosion.

- Inspect rotor regularly. Remove rotors from use that show any sign of defect and report it to a manufacturer's representative for inspection.

8.4 Autoclaves

An autoclave is a device to sterilize equipment and supplies. No one should use an autoclave unless they have received recent instructions in autoclave procedure or are working under the direct supervision of an experienced employee with autoclave knowledge. Use caution when removing equipment and supplies from an autoclave as glassware may have cracked during autoclaving.

Steam (sterilizing) Autoclaves

The major hazards include, but are not limited to:

1. Burns resulting from physical contact with the structure of the autoclave.
2. Steam burns arising from contact with steam issuing from the apparatus.
3. Explosive breakage of glass vessels during the opening and unloading.
4. Burns arising from careless handling of vessels containing boiling liquids.

Top-loading Autoclaves

Beware of residual steam in the apparatus. Remove the lid cautiously keeping the body as far away from the apparatus as possible. Do not lean over the autoclave to examine the contents.

Front-loading Autoclaves

In using front-loading autoclaves, it is recommended to stand so that as the door is opened it shields your body from the contents of the autoclave. Watch your feet! Sometimes boiling liquid accumulates in the autoclave and runs out as the door opens.

8.5 Vacuum Systems

Vacuum systems pose severe implosion hazards. All vacuum equipment is subject to possible implosion. Conduct all vacuum operations behind a table shield or in a fume hood. Do not underestimate the pressure differential across the walls of glassware that can be created by a water aspirator.

When using vacuum systems, follow the below guidelines and requirements to ensure system safety:

1. Ensure that pumps have belt guards in place during operation.
2. Ensure that service cords and switches are free from defects.
3. Always use a trap on vacuum lines to prevent liquids from being drawn into the pump, house vacuum line, or water drain.

4. Replace and properly dispose of vacuum pump oil that is contaminated with condensate. Used pump oil must be disposed as hazardous waste.
5. Place a pan under pumps to catch oil drips.
6. Do not operate pumps near containers of flammable chemicals.
7. Do not place pumps in an enclosed, unventilated cabinet.

The glassware used with vacuum operations must meet the following requirements:

1. Only heavy-walled round-bottomed glassware should be used for vacuum operations. The only exception to this rule is glassware specifically designed for vacuum operations, such as an Erlenmeyer filtration flask.
2. Wrap exposed glass with tape to prevent flying glass if an implosion occurs.
3. Carefully inspect vacuum glassware before and after each use. Discard any glass that is chipped, scratched, broken, or otherwise stressed.

Glass desiccators often have a slight vacuum due to contents cooling. When using desiccators, follow these guidelines:

1. When possible, use molded plastic desiccators with high tensile strength.
2. For glass desiccators, use a perforated metal desiccator's guard.

8.6 Compressed Gas Cylinders

Compressed gases are used in many laboratories for analytical or instrument operations, but these gases can be toxic, combustible, explosive, poisonous, corrosive, inert or a combination of hazards. As compressed gases are under a great deal of pressure, there is the potential for simultaneous exposure to both mechanical and chemical hazards. A flammable gas having a flash point lower than room temperature compounded by high rates of diffusion present a danger for fire or explosion. Thus, careful handling procedures are necessary when working with various compressed gases and cylinders; the regulators or valves used to control gas flow, and the piping used to confine gases during flow. The types of gases that may be found in a laboratory are:

- Compressed - pressurized gas at a temperature greater than there boiling point (oxygen, nitrogen, and argon).
- Liquefied – gases stored under high pressure at a temperature greater than there boiling point (carbon dioxide, propane, butane, and chlorine).
- Dissolved – another container is inside the cylinder where the gas is dissolved (acetylene is a gas dissolved in acetone).

Although each DOT approved gas cylinder is designed, constructed, and tested to safely contain its contents, additional procedures should be followed in handling and storing compressed gas cylinder. These additional procedures are:

a. Cylinders must be clearly labeled with their contents.
b. Regulators must be compatible with the cylinder contents and valve.
c. Cylinders must be properly and always secured.

d. Cylinders must be stored in a cool, well-ventilated area away from sources of ignition, electricity, and heat.
e. Empty or unused gas cylinders must always be capped.
f. Cylinder carts must be used to transport capped cylinders.
g. Cylinders containing flammable gases must not be stored near oxidizers.
h. Cylinders must not be stored near corrosives.
i. Cylinders must be stored away from doors and exits.

The Receiving Department of each campus will handle the delivery and collection of gas cylinders. All cylinders (new, used, or empty) must be always secured. Chains, belts, or clamps should be used to secure cylinders to the walls or benches in the laboratory. Do not store gas cylinders in the hallway.

The use of disposable or lecture size cylinders is strongly discouraged. If special circumstances warrant the use of these types of cylinders, the Principal Investigator is responsible for the additional costs of disposal.

Although cryogenic liquefied gases (e.g., liquid nitrogen) are generally not stored under pressure, laboratory personnel must become familiar with the special hazards associated with the use of these gases. Contact EHS for additional information.

8.7 Cryogenic Liquids

Cryogenic fluids, such as liquid air, liquid nitrogen, or liquid oxygen, are used to obtain extremely cold temperatures. Most cryogenic liquids are odorless, colorless, and tasteless when vaporized. When cryogenic liquids are exposed to the atmosphere, however, they create a highly visible and dense fog. All cryogens other than oxygen can displace breathable air and can cause asphyxiation. Cryogens can also cause frostbite on exposed skin and eye tissue.

Cryogens pose numerous hazards. For example, cryogenic vapors from liquid oxygen or liquid hydrogen may cause a fire or explosion if ignited. Materials that are normally noncombustible (e.g., carbon steel) may ignite if coated with an oxygen-rich condensate. Liquefied inert gases, such as liquid nitrogen or liquid helium, are capable of condensing atmospheric oxygen and causing oxygen entrapment or enrichment in unsuspected areas. Extremely cold metal surfaces are also capable of entrapping atmospheric oxygen.

Additional hazards associated with cryogenic liquids include the following:

Cryogenic Hazard Source	Hazard
Hydrogen, methane, and acetylene	Gases are flammable.
Oxygen	Increases the flammability of combustibles.
Liquefied inert gases	Possible oxygen entrapment.
Extremely cold surfaces	Oxygen atmosphere may condense.

Because the low temperatures of cryogenic liquids may affect material properties, take care to select equipment materials accordingly.

Follow these guidelines when working with cryogenic liquids:

- Before working with cryogenic liquids, acquire a thorough knowledge of cryogenic procedures, equipment operation, safety devices, material properties, protective equipment usage.
- Keep equipment and systems extremely clean.
- Avoid skin and eye contact with cryogenic liquids. Do not inhale cryogenic vapors.
- Pre-cool receiving vessels to avoid thermal shock and splashing.
- Use tongs to place and remove items in cryogenic liquid.
- When discharging cryogenic liquids, purge the line slowly. Only use transfer lines specifically designed for cryogenic liquids.
- Rubber and plastic may become very brittle in extreme cold. Handle these items carefully when removing them from cryogenic liquid.
- Store cryogenic liquids in double-walled, insulated containers (e.g., Dewar flasks).
- To protect yourself from broken glass if the container breaks or implodes, tape the exposed glass on cryogenic containers.
- Do not store cylinders of cryogenic liquids in hallways or other public areas.

IMPORTANT: Be aware of the tremendous expansion and threat of asphyxiation when a cryogenic liquid vaporizes at room temperature.

8.8 Electrophoresis

Electrophoresis equipment may be a major source of electrical hazard in the laboratory. The presence of high voltage and conductive fluid in this apparatus presents a potentially lethal combination. Many people are unaware of the hazards associated with this apparatus; even a standard electrophoresis operating at 100 volts can deliver a lethal shock at 25 milliamps. In addition, even a slight leak in the device tank can result in a serious shock.

Protect yourself from the hazards of electrophoresis and electrical shock by taking these precautions:

- Use physical barriers to prevent inadvertent contact with the apparatus.
- Use electrical interlocks.
- Frequently check the physical integrity of the electrophoresis equipment.
- Use warning signs to alert others of the potential electrical hazard.
- Use only insulated lead connectors.
- Turn the power off before connecting the electrical leads.
- Connect one lead at a time using one hand only.
- Ensure that your hands are dry when connecting the leads.
- Keep the apparatus away from water and water sources.
- Turn the power off before opening the lid or reaching into the chamber.
- Do not disable safety devices.

- Follow the equipment operating instructions.

8.9 Ultraviolet Light

Ultraviolet light (UV) is non-ionizing radiation in the 180 to 400-nanometer wavelength region of the electromagnetic spectrum. The ultraviolet spectrum is commonly divided into the following three regions:

Region	Region Name	Wavelength (nm)
UVA	Black Light	315-400
UVB	Erythermal	280-314
UVC	Germicidal	180-280

Exposure to ultraviolet radiation is typically limited to the UVA region resulting from exposure to direct sunlight. The Earth's atmosphere shields us from the more harmful UVC and greater than 99% of UVB radiation. However, some equipment can generate concentrated UV radiation in all the spectral regions that, if used without the appropriate shielding and personal protective equipment, can cause injury with only a few seconds of exposure.

There are several sources of UV radiation in the laboratory including germicidal lamps in biological safety cabinets, nucleic acid transillumination boxes, nucleic acid crosslinkers and UV lasers.

A. Hazards associated with exposure to ultraviolet light

An unfortunate property of UV radiation is that there are no immediate warning symptoms to indicate overexposure. Symptoms of overexposure include varying degrees of erythema (sunburn) or photokeratitis (welder's flash) typically appear hours after exposure has occurred.

Skin Injury

UV radiation can initiate a photochemical reaction called erythema within exposed skin. This “sunburn” can be quite severe and can occur because of only a few seconds exposure. Effects are exaggerated for skin photosensitized by agents such as coal tar products, certain foods (e.g., celery root), certain medications and photoallergens. Chronic skin exposure to UV radiation has been linked to premature skin aging, wrinkles, and skin cancer.

Eye Injury

UV radiation exposure can injure the cornea, the outer protective coating of the eye. Photokeratitis is a painful inflammation of the eye caused by UV radiation-induced lesions on the cornea. Symptoms include a sensation of sand in the eye that may last up to two days. Chronic exposures to acute high-energy UV radiation can lead to the formation of cataracts.

B. Special work practices

Never allow the skin or eyes to be exposed to UV radiation sources. The UV radiation generated by laboratory equipment can exceed recommended exposure limits and cause injury with exposures as brief as three seconds in duration.

1. Biological Safety Cabinets**:** Never work in a biological safety cabinet while the germicidal lamp is on. If possible, close the sash while lamp is on.
2. Transilluminators**:** Never use a transilluminator without the protective shield in place. Shields must be kept clean and replaced when damaged.
3. Crosslinkers**:** Crosslinkers must not be used if the door safety interlock is not working properly.

C. Equipment labeling

Many overexposures to UV radiation have occurred because of individuals not knowing the hazards associated with UV-emitting equipment. To help prevent eye and skin injuries, any equipment that emits UV radiation must be conspicuously labeled with a caution label. The label should contain language similar to:

CAUTION

UV RADIATION HAZARD

USE ONLY WITH SHIELDING IN PLACE

PROTECT EYES AND SKIN FROM EXPOSURE TO UV LIGHT

Caution labels are available from the EHS office or may be available from the manufacturer of the UV light product.

D. Personal Protective Equipment

Protective Clothing

Wear standard laboratory apparel including a fully buttoned lab coat, long pants and closed toe shoes. While working with UV radiation sources, lab workers must be particularly vigilant to prevent gaps in protective clothing that commonly occur around the neck and wrist areas.

Eye/Face Protection

If there is any potential for the eyes and face to be exposed to UV radiation, a polycarbonate face shield stamped with the ANSI Z87.1-2029 UV certification must be worn to protect the eyes and face. Ordinary prescription eyeglasses may not block UV radiation. UV certified goggles and safety glasses will protect the eyes, but it is common for lab workers to suffer facial burns in the areas not covered by the goggles or glasses.

Gloves

Wear disposable nitrile gloves to protect exposed skin on the hands. Ensure wrists and forearms are covered between the tops of gloves and the bottom of the lab coat sleeves.

E. UV light/radiation services

EHS has instrumentation to accurately measure UV radiation generated by laboratory equipment. Based upon the strength of the UV radiation source and the duration of worker exposure, we can provide information on recommended occupational exposure limits. EHS can also confirm the performance of safety equipment including equipment shielding and personal protective equipment.

8.10 Glassware

Glass breakage is a common cause of injuries in laboratories. Only glass in good condition should be used.

Handling of glassware

1. Discard or send for repair all broken, chipped, starred, or badly scratched glassware. Hand protection should be used when picking up broken glass.
2. Clean all glassware before sending for repair.
3. When using glass tubing, all ends should be fire polished. Lubricate tubing with glycerin or water before inserting into rubber stoppers or rubber tubing.
4. Protect hands with leather gloves when inserting glass tubing. Hold elbows close to the body to limit movement when handling tubing.
5. Do not store glassware near the edge of shelves. Store large or heavier glassware on the lower shelves.
6. Use glassware of the proper size. Allow at least 20% free space. Grasp a three-neck flask by the middle neck, not a side neck.
7. Do not attempt to catch glassware if it is dropped or knocked over.
8. Conventional laboratory glassware must never be pressurized.

Disposal of broken glassware

Inspect all glassware before use. Do not use broken, chipped, starred or badly scratched glassware. If it cannot be repaired, discard it in containers specifically designated for broken glass. All broken glass requires special handling and disposal procedures to prevent injury not only to lab personnel, but members of the janitorial staff as well.

All broken glass shall be disposed in rigid, puncture proof containers such as a cardboard box with taped seams, or a plastic bucket or metal can with a sealing lid. All broken glass disposal containers shall be clearly marked "DANGER - BROKEN GLASS" Limit quantities to no more than approximately 15 to 20 pounds so that lifting of the container will not create a situation that could cause back injury.

1. Food, beverage, and uncontaminated glassware: Dispose in a rigid, puncture proof container such as a box with sealed or taped edges or a metal or thick plastic can or bucket with a sealing lid. Label container "DANGER - BROKEN GLASS".;
2. Radioactive glassware: Contact the Safety Officer for specific instructions.
3. Glassware with biological contamination: Glassware that has been in contact with infectious agents may include used slides, cover slips, test tubes, beakers, pipettes, etc. Contaminated glassware shall be disinfected before disposal. Dispose in a rigid, puncture proof container such as a box with sealed or taped edges or a metal or thick plastic can or bucket with a sealing lid. Label container "DANGER - BROKEN GLASS". Contact the Safety Officer if you require further information.
4. Glassware with chemical contamination: Empty the contents of the glassware into a suitable container if safe to do so. Contact EHS, for assistance with decontamination and disposal of the contaminated glassware.

Section 9: Laser Safety

Laser is the acronym for "light amplification by stimulated emission of radiation" which produces monochromatic light beams. Lasers and laser systems are classified as potential hazard according to the ANSI standard Z136.1. Lasers are classified based on various factors - its wavelength, power output, accessible emission level and duration. The ANSI classifications are as follows:

- Class 1: Laser with the lowest power that does not emit hazardous levels and incapable of causing eye damage. Exempt from labeling requirements.

- Class 2: Low-power laser poses as a hazard but only capable of producing eye damage if the beam is stared at directly for extended periods.

- Class 3: Medium-power laser that poses a moderate risk and causes injury.

- Class 4: High energy, high-risk laser capable of causing severe eye and skin damage with a short duration of exposure from direct or diffused reflection.

Laser devices require engineering controls to ensure safety of all employees. Measures to take when operating lasers for hazard control:

1. Do not look into a laser beam or at the reflection of the beam.
2. Work with lasers in an area that consists of high general illumination to keep pupils constricted.
3. Safety glasses should be worn to filter out specific injurious frequencies of the unit.
4. Should be adequate clear space around the laser path.
5. Operate a laser at the minimum power necessary.

6. All operators must be trained in the safe and proper use of lasers.

Class 3 and 4 lasers require several additional requirements in protective and remote firing capabilities.

Section 10: Emergency Information

A. Evacuation Procedures

During various emergency situations (fire, explosion, bomb threat, etc.) it will be necessary to evacuate the building. Everyone will be instructed to leave the building through the nearest exit, and get away from the building. Individuals with mobility impairments should be assisted into the nearest stairwell in the building. Immediately notify the police or fire department if a disabled individual is waiting on a stairwell landing and provide them with the location. Public Safety is responsible for sweeping parts of the building to be sure everyone has evacuated and moved away from the building. During evacuation the building is considered closed; Public Safety should be called if/when patrons refuse to leave the building.

B. First-aid Kits

Every laboratory should contain a first aid kit which should contain all the items required by OSHA/ANSI Z308.1

The supervisor in charge is responsible for restocking or notifying EHS (if the kit is under a service contract) the first aid-kit.

C. Chemical Spills

Specific procedures for responding to chemical spills are in the NSU Chemical Hygiene Plan (See EHS Policy/Procedure 3 Section 12.5)

D. Laboratory monitors or alarms

Alarms are maintained by NSU Public Safety.

E. Fighting Small Fires Safely

In the event of a small fire:

1. Call the fire department (911) even if the fire is extinguished.
2. Feel closed doors– if it is hot, leave the door closed. Put towel or shirt in crack to confine smoke. If the door is cool, open it a crack to see if the fire is confined and small enough to fight safely.
3. Select the right type of extinguisher for the specific type of fire.

Labs are equipped with one, or both, of two types of extinguishers: **carbon dioxide and dry powder.** Carbon dioxide extinguishers are distinguished by their flared hoses, versus dry chemical ones which have a straight hose. Also, dry powder extinguishers have a pressure gauge—carbon dioxide extinguishers do not.

All fires and uses of fire extinguishers **must** be promptly reported to 911, even if the fire is out. Note, once activated, an extinguisher will slowly leak away its propellant, thus rendering the extinguisher useless. Call to have it properly recharged.

- **Class A:** Ordinary combustibles, such as wood, paper, cloth, rubber, and many plastics.
  Proper Extinguishers:
  - Dry chemical
  - Pressurized Water (corridor)
- **Class B:** Flammable or combustible liquids or gases.

  Proper Extinguishers:
  - Dry chemical
  - Carbon dioxide

  Class C: Energized electrical equipment. Cut the power source. Do not use water on such fires unless the equipment has been unplugged.
  Proper Extinguishers:
  - Dry chemical
  - Carbon dioxide
- **Class D** Combustible metals. Do not attempt to extinguish with ordinary fire extinguishers.
  Proper Extinguishers:
  - Special Class D extinguisher (generally yellow and labeled "For Metal Fires Only". If these are unavailable attempt to smother the fire with dry sand).

There are a few **Class D** extinguishers — in the corridors of Chemistry for example — for fighting "metal fires".

Procedure for using Fire Extinguishers:

1. Always stay between the fire and your exit when using extinguishing equipment.
2. Never turn your back on the fire - step backwards. If possible, have someone watch your back.
3. Aim the extinguisher or fire hose at the base of the fire, sweeping across the fire in a side- t o - s i d e motion. Start 8-10 feet back from fire.
4. Continue to spray even after the fire is out to soak the burning material.
5. Stay as low as possible, out of the heat and smoke.
6. In case clothing catches fire, the best thing to do is to stop, drop to the ground and roll.
7. Have extinguisher recharged after use

F. Other

Per campus policy, all significant **injuries must be r e p o r t ed** to NOVALERT (954-262-8999) as soon as possible. This is necessary for potential reimbursement for personal medical costs, or Worker's Compensation Claims.

NOVALERT (954) 262-8999

Medical Help

Call 911 and give Emergency Personnel:

1. Your EXACT location - what building, floor, etc.
2. The type of injury (bleeding, fracture, etc.)
3. Your name
4. Stay on the line
   Police or fire personnel will request that you wait. Help will be sent, and then you will be asked for additional information.

If Rendering Help to the Injured

1. Do not move the victim (unless in a dangerous area).
2. Restore breathing and/or heartbeat - (CPR if trained).
3. Keep others away from the victim.
4. Stop the bleeding.
5. Know your own limitations on type of aid to render
   DO NOT OVERREACT!

In the Event of a Fire

Pull the nearest fire alarm, call 911 for the fire department and give them your location and the following information.

1. The exact location of the fire
2. Type of fire - trash can, smoke, flames, etc.
3. Your name

Take residents, class, team, etc. away from the building within a safe secure distance and keep them together! **BE SURE ALL ARE ACCOUNTED FOR!**

Per Broward County Fire and campus policy, **all fires must be reported to 911 immediately** – even if the fire is out. This is particularly true if there is use of an extinguisher (must be replaced); an injury; or property damage.

When a Police Officer is Needed

1. Phone 911 (if emergency)
2. Give police -
   - The exact location
   - Type of problem (disturbance, vandalism, etc.)
   - Your name
3. Keep other persons away from the scene
4. DO NOT touch or disturb anything
5. If possible, get a description of suspect, vehicle, etc.
6. Attempt to keep others safe and calm
7. Call NSU Public Safety

SECTION 11: Laboratory Self-Inspection Checklist

Under Florida law (OSHA), supervisors (PIs) are required to include procedures for identifying and evaluating workplace hazards including scheduled periodic inspections to identify unsafe conditions and work practices. Also, both Broward County Fire and the Florida State Fire Marshal expect that labs do regular inspections and corrections of safety problems.

Accordingly, lab supervisors (PIs) and departments are responsible for performing regular safety inspections using the current year's checklist below provided by EHS will audit the department's program on an annual basis with its own lab visit.

APPENDIX A

GLOVE SELECTION CHART

Gloves	Usage	Comments	Recommended for	Not recommended
Latex (Natural rubber) low cost	Incidental contact	Good for biological and water-based materials. Poor for organic solvents. Little chemical protection. Can puncture holes. Can cause or trigger latex allergies	Weak Acids, Weak bases, alcohols, aqueous solutions	Oils, greases and organics
Nitrile (synthetic rubber) low cost	Incidental contact	Good for solvents, oils, greases, and some acids and bases. Clear indication of tears and breaks. Good alternative for those with latex allergies	Oils, greases, acids, caustics, aliphatic solvents	Aromatic solvents, many ketones, esters, many chlorinated solvents
Butyl (synthetic rubber)	Extended contact	Good for ketones and esters. Poor for gasoline, aromatic, and halogenated hydrocarbons	Aldehydes, ketones, esters, glycol ethers, polar organic solvents	Aliphatic, aromatic and chlorinated solvents
Neoprene (synthetic rubber) medium cost	Extended contact	Good for acids, bases, alcohols, fuels, peroxides, hydrocarbons, and phenols.	Oxidizing acids, bases, alcohols, aniline, phenol, glycol ethers	Chlorinated solvents
PVA (poly-vinyl alcohol)	Specific use	Good for aromatic and chlorinated solvents. Poor for water-based solutions	A wide range of aliphatic, aromatic and chlorinated solvents, ketones	Acids, alcohols, bases, water
PVC (poly-vinyl chloride)	Specific use	Good for acids, bases, oils, fats, peroxides, and amines. Good resistance to abrasions. Poor for most organic solvents	Strong acids and bases, salts, other aqueous solutions, alcohols, glycol ethers	Aliphatic, aromatic and chlorinated solvents, aldehydes, ketones.
Viton (Fluoro-elastimer)	Extended use	Good for chlorinated and aromatic solvents. Good resistance to cuts and abrasions. Poor for ketones.	Aromatic, aliphatic and chlorinated solvents, and alcohols	Some ketones, esters, amines
Silver Shield(laminate)			Wide range of solvents, acids and bases	