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https://nccu.edu/administration/administration-and-finance/environmental-health-and-safety

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NORTH CAROLINA CENTRAL UNIVERSITY IS A CONSTITUENT INSTITUTION OF THE UNIVERSITY OF NORTH CAROLINA
I. Purpose

This plan provides general information about chemical hazards that may be encountered while working at NCCU and safety precautions to prevent accidents and minimize exposure.

At NCCU, each laboratory’s Chemical Hygiene Plan is comprised of this University Chemical Safety Manual and the laboratory’s Lab-Specific Safety Plan in partial fulfillment of Occupational Exposure to Hazardous Chemicals in Laboratories 29 CFR 1910.1450.
II. Scope

North Carolina Central University (NCCU) is committed to providing a safe and healthful environment for all persons including staff, students, visitors, and the surrounding community. Many different departments use hazardous chemicals on campus.

III. Responsibilities

While Environmental Health and Safety (EHS) has administrative responsibility for the chemical safety program, everyone involved in campus operations that utilize hazardous chemicals – from the highest administrative level to individuals who actually use the chemicals – must be part of the safety culture.

A. Supervisor (for non-laboratory chemical users)

1) Ensure that personnel meet all safety training requirements.
2) Ensure that proper safety supplies and equipment, such as gloves, safety glasses and/or goggles, lab coats, etc. are available.
3) Train staff on location of safety data sheets
4) Keep accurate chemical inventory.
5) Post appropriate hazard information signs as needed.
6) Ensure that proper labeling is used on all hazardous materials for correct disposal via EHS

B. Principal Investigator (for laboratory chemical users)

7) Prepare a Laboratory Specific Safety Plan which along with this Chemical Safety Manual constitute the Chemical Hygiene Plan as required by OSHA.
8) Ensure that all laboratory workers submit a Submit a NCCU Laboratory Worker Registration Form at hire and whenever there is a change in work location or laboratory task.
9) Provide required initial and annual training to laboratory personnel on the contents of the Chemical Hygiene Plan.
10) Ensure that staff and visitors observe safety rules and don proper Personal Protective Equipment (PPE) when working in or visiting the laboratory.
11) Train staff on location of safety data sheets for hazardous chemicals used in the laboratory
12) Keep accurate laboratory chemical inventory.
13) Post appropriate hazard information signs within the laboratory.
14) Conduct an “exit interview” with laboratory workers prior to their departure to ensure that they have properly labeled and prepared hazardous materials for disposal by EHS or use by other workers.
15) Notify EHS prior to vacating laboratory space when moving on campus and notify department chair and EHS of planned departure from NCCU or discontinuance of the use of hazardous materials. Decontaminate laboratory surfaces and prepare hazardous materials for disposal by EHS or use by other laboratories.

C. NCCU Staff/Laboratorians

1) Familiarize yourself with this Chemical Safety Manual and lab/area-specific safety plans
2) Complete appropriate training
3) Follow safety guidelines when handling hazardous materials, including the proper use of personal protective equipment.
4) Notify EHS of accidents, spills, or conditions that may warrant further investigation and/or monitoring.
5) Review materials to ensure that you have properly labeled and prepared all hazardous materials for disposal by EHS

D. Environmental Health & Safety

1) Provide and document hazard communication and chemical safety manual training for personnel.
2) Inspect laboratories and other chemical use areas at least annually for safety and health hazards and for compliance with state and federal regulations.
3) Investigate potential safety and health hazards identified by employees
4) Monitor personnel as needed for chemical hazards.
5) Advise personnel on proper disposal of waste chemicals and other hazardous materials.
IV. Emergency Numbers

<table>
<thead>
<tr>
<th>Agency</th>
<th>Phone</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Health &amp; Safety</td>
<td>919-530-7125</td>
<td>8:00 a.m. – 5:00 p.m</td>
</tr>
<tr>
<td>University Police</td>
<td>919-530-6106 or 911</td>
<td>24 hours</td>
</tr>
<tr>
<td>Work related injuries</td>
<td>919-530-6106 or 911</td>
<td>24 hours</td>
</tr>
<tr>
<td>Fire or Smoke</td>
<td>919-530-6106 or 911</td>
<td>24 hours</td>
</tr>
<tr>
<td>NC Poison Control</td>
<td>1-800-84 TOXIN (1-800-848-6946)</td>
<td>24 hours</td>
</tr>
<tr>
<td>Gas Leaks or Odors</td>
<td>919-530-7125</td>
<td>8:00 a.m. – 5:00 p.m</td>
</tr>
<tr>
<td>Physical Plant</td>
<td>919-530-6392</td>
<td>8:00 a.m. – 5:00 p.m</td>
</tr>
<tr>
<td>Chemical Spills</td>
<td>919-530-7125</td>
<td>8:00 a.m. – 5:00 p.m</td>
</tr>
</tbody>
</table>

V. Training

NCCU staff must be advised of chemical hazards at the time of initial assignment, and whenever new exposure risks are identified. Required information for this training includes:

- Contents of the OSHA Laboratory Standard
- Location and availability of the Chemical Hygiene Plan
- The PELs of OSHA regulated substances and recommended exposure limits to non-regulated substances
- Physical and health hazards of chemicals in the workplace
- The signs and symptoms associated with exposures to hazardous chemicals used
- The location and availability of known reference material, including safety data sheets, on the hazards, safe handling, storage, and disposal of hazardous chemicals
- Measures employees can take to protect themselves, including emergency procedures and personal protective equipment

Chemical Hazard training is included in the New Employee Orientation for the Laboratory Environment.
Formaldehyde training is also required for laboratorians who will work with or around formaldehyde for compliance with 29 CFR 1910.1048. NCCU Formaldehyde Training

VI. Required Documentation and Record Keeping

OSHA regulations require maintenance of monitoring and medical records for a period of thirty years following termination of employment. The records that EHS maintain include:

- Copies of Laboratory Specific Safety Plans
- NCCU Laboratory Worker Registration Form
- Monitoring results
- Medical examination and consultation records
- Reports and investigations of accidents

The following documents must be available to and/or completed by NCCU staff. Review these with all new staff before allowing them to perform work with hazardous chemicals and annually thereafter, and document these reviews.

1. NCCU Chemical Safety Manual
2. Laboratory Specific Safety Plan (for laboratories only)
3. Access to online or printed Safety Data Sheets (SDS) for those chemicals used routinely. Personnel are directed to consult the SDS when using a particular compound for the first time.

VII. Chemical Safety Surveys

As required by state and federal law, EHS inspects and surveys all campus research groups at least annually using the checklist in the NCCU Laboratory Safety Manual. These inspections address record keeping, fire safety, egress, engineering controls, personal protective equipment, work practices, hazardous waste management and chemical safety. Referral inspections are used to follow-up on issues noted during annual inspections or upon receiving reports of non-compliance or unsafe and unhealthy conditions.

Non laboratory chemical users will also be inspected every two years or when requested by EHS to review records and ensure compliance with chemical storage, use and disposal protocols.
A. Request for Hazard Investigation

The Occupational Safety and Health Act of North Carolina makes provisions for employees to request an inspection or evaluation of conditions that they believe may constitute a health or safety hazard. University employees are encouraged to report such conditions to EHS and to request an investigation into the need for corrective action. This can be done by calling 919-530-7125 or by submitting an online Safety Hazard/Incident Report. Persons requesting an inspection by EHS may request confidentiality, and by law, their name will not appear on any record published, released, or made available to the public, their immediate supervisor, or department head.

After EHS has concluded its investigation, results are communicated, in writing, to the party requesting the investigation and other appropriate University personnel, with due consideration to anonymity requests. EHS will initiate corrective action if there are reasonable grounds to believe that a violation or danger exists. If EHS cannot implement corrective action within a reasonable period, EHS may terminate the operations pending corrective action.

VIII. Compliance with Laboratory Safety Standards

The health and safety of workers and building occupants is the most important factor to consider in a workplace. In addition to these health and safety concerns, compliance with OSHA, NFPA, EPA and state regulations is also important because of the severe financial consequences, especially related to EPA hazardous waste regulations. Fines for seemingly minor violations, e.g., improper labeling, lids not screwed-on tight, etc., may run into the tens of thousands of dollars; therefore compliance with these regulations must receive special attention.

### Violation Severity and Enforcement

<table>
<thead>
<tr>
<th>Violation and Severity</th>
<th>Enforcement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Imminent danger</strong> - reasonable certainty a hazard exists that can be expected to cause serious physical harm</td>
<td>EHS notifies personnel to cease operations immediately, evacuate the site and restrict access. EHS will work with group for immediate abatement or a plan for isolating the hazard. University Police may be used to secure the area if necessary.</td>
</tr>
<tr>
<td><strong>Critical departure</strong> - will probably lead to physical harm or significant exposure to</td>
<td>EHS notifies of the violation and sets a deadline for abatement, and may recommend that the group shut down the operation until</td>
</tr>
</tbody>
</table>
IX. Emergency Planning

It is the responsibility of each group to establish site-specific emergency plans in the events of fire, chemical spills or other emergencies resulting from accidents. Be familiar with the emergency plans and evacuation routes for your building.

In the event of major uncontrolled incidents such as fire, major releases of hazardous chemicals to the environment, or life threatening injuries, call 911 immediately.

Communication between onsite personnel, building supervisor, EHS and other response personnel is very important. Personnel who know the hazardous materials involved and/or the particular circumstances of the accident must be present at the incident command site. Safety data sheets for all chemicals involved should be made available to first responders.

A. Emergency Response to Chemical Spills

Many chemical spills are of limited hazard potential, and personnel can clean up the spill safely. Your work area should be equipped to handle small, low-hazard spills.

If a dangerous situation arises due to chemicals in a work area, do not touch the container. As best as possible, try and determine the contents and potential hazards and call EHS (919-530-7125) immediately to report during work hours and University Police after hours (919-530-6106).
The EHS Chemical Safety Specialist or another trained EHS Specialist will immediately respond, assess the situation, remove the container or spill or leave in place and sequester the area until it can be safely removed.

Do not try to clean up any chemical incident that involves any of the following:

- a respiratory hazard
- a threat of fire or explosion
- more than 100 mL of an OSHA regulated chemical carcinogen or a highly toxic chemical
- more than 1 liter of a volatile or flammable solvent
- more than 1 liter of a corrosive (acid or base) liquid
- elemental (liquid) mercury spills

These more hazardous spills may only involve EHS or the NCCU Emergency Response Plan may need to be activated which involves the Durham Fire Department, University Police, local hazardous material teams and potentially state of NC resources.

B. Chemical Spill Response Kit

Sites must be equipped with protective clothing and spill cleanup materials to respond to small low-hazard chemical spills. Specialized chemical and corrosives spill kits are commercially available. The EHS office can assist you in selecting the right spill kit for the chemicals used in your group.

C. Response Steps for Chemical Spills

Step 1: Leave and Control Spill Area
- Evacuate personnel from the immediate spill area.
- Remove any injured personnel from spill area
- Block off immediate spill area – close corridor doors, use lab carts, wastebaskets, etc.
- Eliminate any fire hazard, especially if spill is flammable or combustible- turn off burners, electrical equipment, etc.
- Post sign, “Spill Area – Keep Out”.
- Alert other personnel in laboratory and adjacent areas of a chemical spill including the PI or Instructor.

Step 2: Help Injured Personnel
Remove contaminated clothing, flush skin with water, use eyewash and/or safety shower, etc. If there is a chemical splash to the eyes and/or there are burns or respiratory problems, seek medical attention.

**Step 3: Evaluate Hazard**

Make preliminary evaluation of hazard and identification of risks and decide whether you should call EHS. If it can be handled safety without respiratory protection, continue with clean up.

**Step 4: Clean Up Spill**

- Contain the spill.
- Use spill pads to absorb the rest of the liquid.
- Place the spill pads in a plastic bag. Double bag if necessary.
- Close the plastic bag and prepare bag for disposal via EHS.
- Wash and deactivate the spill surfaces of trace amounts of the spilled chemical. Contact EHS for advice.
- Replace used materials in spill kit.

**D. Mercury Spills**

**Campus wide, all non-essential uses of elemental mercury should be eliminated.**

Supervisors/Principal Investigators wishing to maintain inventories of mercury or mercury containing items such as some light bulbs, thermometers, etc. can request an exception from EHS. Mercury waste is always referred to EHS for proper disposal.

Supervisors or Principal Investigators are responsible for identifying mercury containing devices in their areas that should be eliminated. If a group uses any devices that contain liquid elemental mercury, such as thermometers, some light bulbs, or sphygmomanometers, you must have a small mercury spill kit available to contain the spill. Contact EHS for assistance during or immediately after completing initial containment. Prior to EHS arrival, seal off the immediate spill area so that no one can walk on spilled mercury.

**X. Reporting Injuries and Illnesses**

Report all personal injuries and accidents that occur on the job to EHS. EHS may take corrective action to minimize the probability of recurrences in your work area. It is your responsibility to notify your
supervisor immediately of any job-related injury or illness. If unable to do so, a co-worker should notify your supervisor as soon as possible.

Supervisors must ensure that employees have access to a fully stocked first-aid kit as described in the Laboratory Safety Manual and Chemical Safety Plan. If treatment requires more than basic first aid, personnel should dial 911 and request assistance. Do not send injured employees unescorted to seek medical attention and do not transport in non-emergency vehicles. Students who have a laboratory work-related illness or injury should go to NCCU Student Health Clinic. For severe or life-threatening injuries call 911 and notify EHS immediately.

Any person who experiences an occupational illness or injury is required to complete the [Workers’ Compensation Employee Statement Form](#) and each Supervisor must complete the [Supervisor’s Accident/Incident Investigation Report Form](#). The Supervisor’s form must be submitted to the Workers’ Compensation Administrator within 24 hours of a workplace incident.

XI. Engineering Controls

A. Fume Hoods

The fume hood is often the primary control device for protecting laboratory workers when working with flammable and/or toxic chemicals. When used properly, it will protect the user from exposure to potentially harmful chemicals. The EHS office will ensure that all fume hoods will be inspected and tested at least annually. Each hood will be marked with a calibration sticker indicating the date of the performance test and indicating the sash height needed to obtain the desired flow. Promptly report any hood that is not functioning properly to your supervisor. Any hood that is not functioning properly should be removed from service and posted as such until hood can be evaluated/repaired and air flow verified by EHS.

XII. Personal Protective Equipment and Clothing

Personal protective equipment (PPE) is an important way to minimize exposure by preventing absorption, inhalation, and physical contact. PPE includes gloves, safety glasses, and lab coats. Proper selection and use of PPE is critical to protection; contact EHS for advice.
The PI/Supervisor is responsible for providing all NCCU staff with appropriate PPE, which should be designed for the task and should fit the employee well. EHS consultation can be provided upon request.

A. Eye and Face Protection

The type of safety device required is determined by risk assessment based on the nature of the hazard and the frequency with which the wearer encounters it. Supervisors must determine the appropriate level of eye protection for particular tasks, and enforce eye protection rules.

OSHA requires that the employer provide eye and face protection devices without cost to students, employees and visitors. Each department is responsible for funding its eye and face protection program. If prescription safety glasses are necessary, the employee and/or student are responsible for scheduling and payment for eye examinations to obtain a current prescription. Prescription safety glasses are available for State Employees at a discounted rate from Correction Enterprises.

Contact lenses do not provide adequate eye protection for hazardous operations and must be worn in conjunction with approved safety eyewear. The University permits the wearing of contact lenses, only if the wearer includes an approved method eye protection. Earlier guidance recommended against wearing of contact lenses in laboratories, due to concerns about lenses trapping chemicals. However, several years of subsequent studies have shown that contact lenses do not create an additional hazard; in fact, the improved visual acuity from contact lenses might help prevent accidents, compared to no corrective lenses.

Eye protective devices issued to employees, students and visitors remain the property of the University. Persons issued eye protective devices return it when the use of the device is no longer necessary. The department shall determine the disposition of prescription glasses. You may replace eye protective devices damaged during normal wear and use without charge at the discretion of the PI. Replacement of lost or stolen devices is the responsibility of the employee or student issued the equipment.

Eye protective devices are personal items, issued for the exclusive use of each individual. Clean with soap and water and store in a clean, protected area. Thoroughly clean and disinfect all eye protective devices before issuing to another person.

There are three basic types of eye and face protection that meet the basic eye protection standards for frontal exposure to flying particles: safety glasses with side shields, goggles, and face shields.
**Ordinary prescription glasses do not provide adequate protection from injury to the eyes**

1) Safety Glasses

Safety glasses must be hardened-glass or plastic safety spectacles with side shields that comply with the Standard for Occupational and Educational Eye and Face Protection (Z87.1) established by the American National Standards Institute (ANSI). This standard specifies a minimum lens thickness of 3 mm, impact resistance requirements, passage of a flammability test, and lens-retaining frames.

Prescription safety spectacles are recommended for employees wearing glasses. Do not wear photogrey (transition) lenses indoors in laboratory environments, because the percentage of light transmitted under normal light conditions is below ANSI standards.

2) Goggles

Goggles provide a tighter face seal than safety glasses, and are not for general laboratory use. Wear them when there is a hazard from splashing chemicals or flying particles. For example, wear goggles when using glassware under reduced or elevated pressure, or using glass apparatus in combustion or other high temperature operations.

Impact-protection goggles have perforated sides to provide ventilation and reduce fogging of the lens, but do not offer full protection against chemical splashes. Use chemical goggles with splash-proof sides for protection from harmful chemical splash.

There are also specific goggles and masks for glassblowing and intense light sources such as welding or lasers. For questions about laser safety, contact EHS.

3) Face shields

Goggles or safety glasses alone do not meet ANSI standards for protection to the face and neck. When you need greater protection from flying particles and harmful liquids, wear full-face shields that protect the face and throat.

Consider using a face shield or mask when operating a vacuum system (which may implode), or conducting a reaction with the potential for mild explosions. Always use a UV-blocking face shield when working with transilluminators or other devices that produce ultraviolet radiation.
B. Gloves

Wear proper protective gloves for potential contact with hazardous materials, sharps, and hot or cold materials. Select gloves based on the material handled, the particular hazard involved, and their suitability for the operation conducted. It is the responsibility of the supervisor to provide the proper gloves for each task in the work area and to enforce the glove policy including glove types and proper disposal. OSHA has provided guidance on glove selection and chemical resistance.

While it is important to wear gloves to protect the hands against potentially hazardous materials, it is equally important to remove gloves before contacting “clean” areas such as food area surfaces, or common equipment such as telephones, computer keyboards, and photocopiers.

General glove considerations:
- Consider double gloving when handling highly toxic or carcinogenic materials
- Before each use, inspect gloves for discoloration, punctures, and tears
- Dispose single-use gloves after you remove them – never re-use single-use disposable gloves
- Always store gloves properly (e.g. away from windows, transilluminators, etc.), since some glove materials are susceptible to ultraviolet damage.
- Never wear gloves outside of the laboratory – remove gloves and wash hands before exiting the lab
  - Use secondary containment for items transported outside of the lab that should not be handled with bare hands
  - Remove gloves even if you believe they are non-contaminated, as others do not know if you might have handled hazardous materials with your gloved hand(s)
- You can dispose gloves in the regular trash if they are not contaminated with biohazards, chemicals or radionucleotides. For gloves contaminated with these substances, dispose in the proper waste stream. Do not dispose of contaminated gloves in a manner that could expose other personnel
- All disposable gloves have an expiration date on the box. Do not use gloves past the expiration date.

C. Laboratory Clothing and Protective Apparel

The clothing you wear in the laboratory can affect your safety. Do not wear loose or town clothing and avoid clothing which does not provide adequate protection by exposing skin (e.g., shorts, halter-tops) in the laboratory. Unrestrained long hair can easily catch fire, dip into chemicals, or become ensnared in apparatus and moving machinery.
Laboratory coats help prevent contact with dirt and the minor chemical splashes or spills encountered in laboratory-scale work. The cloth laboratory coat is, however, primarily a protection for clothing and may itself present a hazard (e.g., combustibility) to the wearer. Cotton and synthetic materials are satisfactory, whereas rayon and polyesters are not. Laboratory coats do not significantly resist penetration by organic liquids. Remove your lab coat immediately upon significant contamination.

Do not take lab coats home and launder them because of the potential for contamination of the home environment.

Plastic or rubber aprons provide better protection from corrosive or irritating liquids but can complicate injuries in the event of fire. Furthermore, plastic aprons accumulate a considerable charge of static electricity, so avoid use in areas with flammable solvents or other materials ignitable by static discharge.

In some cases, disposable outer garments (e.g., Tyvek®) are preferable to reusable ones. One example is handling appreciable quantities of known carcinogenic materials, for which EHS also recommends long sleeves and gloves. Wear disposable full-length jump suits for high-risk exposure situations, which may also require the use of head and shoe covers. Many disposable garments, however, offer only limited protection from vapor penetration and you need to exercise considerable judgment when using them.

Know the appropriate techniques for removing protective apparel if contaminated. Chemical spills on leather clothing accessories (watchbands, shoes, belts, etc.) are especially hazardous, since many chemicals absorb in the leather, which holds the chemical close to the skin for long periods. Remove such items promptly to prevent chemical burns. If possible, decontaminate the items or discard them via EHS as chemical waste.

Wear sturdy, closed-toed shoes at all times in laboratories or other chemical use and storage areas. Do not wear perforated shoes or sandals in laboratories. In some chemical laboratories, shoes made of cloth may be prohibited to protect against chemical spills and splashes.

XIII. Exposure Monitoring

The greatest potential for over-exposure generally occurs during transfer or movement of concentrated chemicals. Conduct these operations in a fume hood to minimize the potential for over-exposure.

EHS will arrange for personal monitoring upon request, or if there is reason to believe that exposure levels for a substance routinely exceed the OSHA-defined Permissible Exposure Limit (PEL) or action level.
Any employee may request monitoring and be notified of the results, in writing, within 15 days of the receipt of the results. To file a formal request for monitoring, complete Appendix X.

XIV. Exposure

It is important that everyone who handles or works around hazardous chemicals know the major routes of exposure and safe handling practices that can minimize your while working with chemical substances.

A. Introduction

All chemicals can have toxic effects at some dose level and particular route(s) of exposure. It is therefore wise to minimize exposure to chemicals. Chemicals can have local or systemic effects. Local toxicity refers to the direct action of chemicals at the point of contact. Systemic toxicity occurs when the chemical agent is absorbed into the bloodstream and distributed throughout the body, affecting one or more organs. Health effects can be acute or chronic. Acute effects last for a relatively short time and then disappear. Chronic effects are not reversible.

Do not confuse acute and chronic exposure with acute and chronic effects. Acute exposures to chemicals are for short periods. Chronic health effects can develop from acute exposures depending on the properties and amount of the chemical. Acute or chronic adverse health effects can also occur with chronic (repeated) exposure to chemicals, even at low concentrations.

B. Dermal Contact

Skin contact is one of the most common chemical exposure routes in the work area. Spills and splashes can result in overt skin contamination. In addition, personnel may unknowingly contaminate themselves when they touch work surfaces, glassware, or equipment.

A common result of skin contact is localized irritation or dermatitis. However, a number of materials are absorbed through the skin to produce systemic poisoning. The main portals of entry for chemicals through the skin are the hair follicles, sebaceous glands, sweat glands, and cuts or abrasions of the outer layers of the skin. The follicles and the glands contain blood vessels, which facilitate the absorption of chemicals into the body. Chemicals can also enter the body when contaminated hands touch the mouth, nose, eyes, sores or cuts.
C. Inhalation

Inhalation of toxic vapors, mists, gases, or dusts can produce poisoning by absorption through the mucous membrane of the mouth, throat, and lungs, and can seriously damage these tissues by local action. Inhaled gases or vapors may pass rapidly through the capillaries of the lungs and enter the circulatory system. The degree of injury from inhalation of toxic substances depends on the material’s toxicity, solubility in tissue fluids, concentration, and the duration of exposure.

Although inhalation hazards are more often associated with gases and volatile chemicals, both solids and non-volatile liquids can also present an inhalation hazard for personnel. Chemicals in the form of dusts and particulates can become airborne when transferred from one container to another. Grinding and crushing procedures can also produce aerosols. Splashes created from spills and vigorous shaking and mixing form aerosols. Many of these generated particulates do not settle out but remain suspended in the air and travel along air currents in the room. Some of these particulates can be inhaled and deposit in the respiratory tract. For many operations, you might not recognize that aerosols are present and a hazardous situation exists. All operations involving an open vessel will result in aerosol release. Such operations include weighing, stirring, pouring, pipetting, injections with a needle and syringe, handling animals, and removing caps and stoppers. Take care not to create aerosols.

D. Ingestion

Ingestion of toxic materials in the work area can occur when contaminated hands come in contact with the mouth, or with food items. The work area environment can contaminate food items and utensils. Do not mouth pipette, as this can result in aspiration of toxic materials.

E. Injection

Accidents involving needles and syringes can result in injection of toxic and/or infectious materials through the skin. Needles and syringes are among the most hazardous items used in the laboratory, especially when combined with the task of inoculating an uncooperative animal. If a needle stick occurs, seek medical attention and notify your supervisor. Containers of toxic chemicals may break, resulting in hazard from contact with contaminated broken glass.
F. Ocular exposure

The eyes are of particular concern, due to their sensitivity to irritants. Ocular exposure can occur via splash, or rubbing eyes with contaminated hands. Few substances are innocuous with eye contact, and several can cause burns and loss of vision. The eyes have many blood vessels, and rapidly absorb many chemicals.

XV. Hazard Communication Signage

A. Laboratory entrances

Laboratory entrance signs are required at all entrances to each functionally separate laboratory and are essential to safety by providing critical information about specific hazards found in the laboratory to lab users, visitors, and emergency responders. In an open space lab each bench will have signs posted to specify the Principal Investigator and specific hazards located on that bench. EHS provides a Laboratory Door Sign Template to be used by PIs for laboratory entrances. Contact EHS if you have any questions or concerns about signage at entrances to or within laboratories. In addition to entrances, post laboratory areas that have special or unusual hazards with hazard information signs and labels.

B. Non Laboratory Work Areas

Non laboratory work areas are also required to have signage to provide critical information about specific hazards found in the work area to personnel, visitors, and emergency responders. The Laboratory Door Sign Template can be used or you may create your own as long as the sign contains the relevant information.

XVI. Glassware

Accidents involving glassware are a leading cause of injuries. Use careful handling and storage procedures to avoid breaking glassware. You can prevent injuries when you use adequate hand protection when inserting glass tubing into rubber stoppers or corks or when placing rubber tubing on glass hose connections. Tubing must be fire polished or rounded, and lubricated. Hold your hands close together to limit movement of glass should it break. Consider the use of plastic or metal connectors.

Handle vacuum-jacketed glass apparatus with extreme care to prevent implosions. Tape or shield equipment such as Dewar flasks. Only use glassware designed for vacuum work for that purpose.

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Provide proper instruction in the use of glass equipment designed for specialized tasks, which can represent unusual risks for the first-time user. (For example, separator funnels containing volatile solvents can develop considerable pressure during use).

Glassware that is heated should be Pyrex® or a similar heat-treated type. Wear cut-proof gloves to pick up broken glass. Otherwise, sweep up small pieces with a brush into a dustpan. Dispose broken glassware in a cardboard box lined with a sturdy plastic liner marked “CAUTION: BROKEN GLASS– Non-Hazardous Materials Only”.

XVII. Safe Handling Practices for Chemicals

A. Access Control

Access to areas where chemicals are stored must be secure.

Keep doors closed while chemicals are in use. This practice not only protects persons who might otherwise enter the space, it reduces interruptions to staff that could lead to accidents. When the doors to the laboratory are closed, fume hoods work better and offer more protection to the worker.

B. Personal Practices

Wash your hands immediately after completion of any procedure involving chemicals, and when leaving the laboratory. Soap must be either liquid or foam in a pump dispenser. Do not use bar soap in laboratories. Do not use liquid soap bottles that you must invert and squeeze. Soap dispensers can be wall-mounted type or freestanding countertop bottles.

When working with chemicals, do not eat, drink, smoke, chew gum, apply cosmetics, or store utensils, food, and food containers. Remove gloves or other personal protective equipment that could introduce contamination before you leave the chemical area. Consider posting a reminders or labeling equipment.

Use mechanical pipetting aids for all pipetting procedures. NEVER MOUTH PIPETTE.
C. Decontamination of Laboratory Work Surfaces

In the lab, protect work surfaces from contamination by using “bench paper” (disposable plastic-backed absorbent paper) or spill containment trays. Change worn or contaminated bench paper and dispose properly.

Decontaminate other items and equipment with appropriate solvents when contaminated during experiments.

D. Minimizing Aerosols

Since a procedure with an open vessel of liquids or powders generates aerosols, you should develop techniques that will minimize the creation of aerosols. Dropping the contents from a height generates more aerosols. Also, avoid rapid mixing.

Take extra care when discarding contaminated gloves or plastic-backed absorbent paper used to cover the work surface, to avoid aerosolizing contaminants. Clean floors with a wet mop or with a vacuum cleaner equipped with a HEPA filter, as dry sweeping or dry mopping contaminated laboratory floors could aerosolize contamination.

E. Specific Handling Procedures for Hydrofluoric Acid

1) Hazards

Hydrofluoric acid (HF) differs from other acids because it readily penetrates the skin and dissociates into fluoride ions, causing destruction of deep tissue layers, including bone. The fluoride ion affects tissue integrity and metabolism by liquefaction necrosis, decalcification and destruction of bone, and production of insoluble salts. Loss of calcium (hypocalcemia) results from precipitation of calcium from the blood as CaF₂. This results in calcium loss from the bones to equilibrate the decreased serum calcium. The development of hypocalcemia can be rapidly fatal because calcium is important for muscles, including the cardiac muscle (heart), to function properly. Fluoride ions might also bind to potassium and magnesium ions, leading to myocardial irritability and arrhythmia. Death from metabolic acidosis, hypocalcemia, or ventricular arrhythmias can occur several hours after exposure.

Pain associated with skin exposure to HF may not occur for 1-24 hours. Unless you can rapidly neutralize the HF and bind the fluoride ions, tissue destruction may continue for days and result in limb loss or death. HF is similar to other acids in that the initial extent of burn depends on the concentration,
temperature, and duration of contact with the acid. Eye exposure to concentrations of HF greater than 0.5% can result in severe ocular damage, with delayed signs and symptoms.

Hydrofluoric acid vapors are also hazardous. Ocular irritation and injury can occur from working with HF outside a vented enclosure (laboratory hood). Inhalation can cause severe throat irritation, cough, dyspnea, cyanosis, lung injury and pulmonary edema. In severe exposure cases, these can result in death.

2) Handling and Personal Protective Equipment

- Familiarize yourself with the hazards specific to HF before handling.
- Always handle HF in a properly functioning fume hood, and in an area equipped with an eyewash and safety shower.
- Do not work alone when using HF and alert colleagues when using the material.
- Ensure that calcium gluconate antidote is on hand before handling HF.
- Required Personal Protective Equipment:
  - Goggles
  - Face shield (plastic)
  - Gloves
    - Thin disposable gloves (such as 4, 6, or 8 mil blue nitrile gloves) used in laboratory operations provide a contact barrier only and should be disposed immediately when contamination is suspected.
    - Thicker (10-20 mil) PVC or neoprene gloves provide better resistance to HF but do not provide the necessary dexterity for many lab procedures. Thinner PVC or poly gloves can provide some resistance to HF, but require immediate changing at the first sign of contamination. Do not wear disposable gloves without double gloving because of the potential for exposure through pinholes.
  - Acid resistant apron
  - Long pants and sleeves (note that these are required when working with all corrosive materials, including HF)
  - Closed toe shoes

3) Post-Exposure Treatment

In the event of a skin or eye exposure to HF:

- Have someone call 911 immediately, to facilitate arrival of medical assistance.
• Remove all exposed clothing and immediately wash all exposed areas with copious amounts of water from the safety shower or eyewash. Flush exposed eyes for at least 15 minutes, but flush exposed skin for only **five minutes**, followed by treatment with a calcium source.

• For skin exposures, after flushing for five minutes, apply a gel or slurry of calcium gluconate (preferred) or calcium carbonate directly to the exposed area. Use concentrations between 2.5% and 33%.

Note that calcium gluconate gel has an expiration date. Make sure that you always have access to a non-expired supply if you are working with HF.

4) Incompatibilities and Storage

Store HF and HF waste in a cool, dry place away from incompatible materials. Storage areas should be clearly marked as containing HF. HF reacts with many materials; therefore, avoid contact with glass, concrete, metals, water, other acids, oxidizers, reducers, alkalis, combustibles, organics and ceramics. Store in containers made of polyethylene or fluorocarbon plastic, lead, or platinum. Place storage bottles in polyethylene secondary containment trays.

**Never store HF, or HF waste, in glass containers.**

5) Spills

Ensure all areas where HF is used are equipped with proper spill response equipment. You can neutralize small spills (100 mL or less) by covering with magnesium sulfate (dry) and absorbing with spill control pads or other absorbent materials. Add sodium bicarbonate or magnesium oxide to any absorbent and place in a plastic container for disposal. Wash the spill site with a sodium bicarbonate solution.

Use 3M’s Universal Sorbent or similar, as it does not react with HF. Do not use spill sorbents that contain silicon, such as vermiculite or sand, as this can produce silicon tetrafluoride, an odorless toxic gas.

If the spill is large, in a confined space, or in an area where there is not adequate ventilation, evacuate the room and immediately report the spill to 911. Contact EHS at 919-530-7125 if you have questions about spill response, or if you do not feel comfortable trying to clean up the spill yourself.
XVIII. Eyewash and Safety Shower

Indoors, emergency eyewash and safety showers are required within 10-seconds travel distance and not more than 75 feet from where corrosive chemicals are used. These facilities must be on the same level as the chemical area; there can be no stairs/ramps or blockages between the hazard and the eyewash and/or safety shower.

Per ANSI/ISEA Z358.1-2014 plumbed eyewashes shall be activated weekly for a period long enough to verify operation and ensure that flushing fluid is available and all eyewashes shall be inspected annually to assure conformance with the standard. Safety Showers must be activated at least monthly to verify operation and all safety showers shall be inspected annually to assure conformance with the standard.

Supervisor/PI will ensure that the weekly operational check for the eye washes and monthly check for the safety showers is performed for all eye washes and showers in their space and documented on the associated tag weekly and monthly. Annual inspections and repairs will be arranged by EHS either in house or with a plumbing contractor.

Signage for eye washes and safety shower stations are available from EHS.

XIX. Chemical Inventory and Storage

A. Inventory

All work areas are required to inventory their chemicals at least once a year as part of the Chemical Safety Plan. Chemicals that are unwanted or no longer needed should be removed from the work area and disposed of through EHS.

Examples of chemicals in poor condition, that you should NOT keep stored in your work area:
- Expired/outdated chemicals
- Illegible/removed labels
- Degraded containers
- Leaking lids

Most chemical manufacturers include chemical storage symbols on their labels. Many manufacturers use symbols that include a hazard ranking system, such as the National Fire Protection Association (NFPA 704) diamond symbol or the Hazardous Materials Identification System (HMIS) colored rectangle.
Pictographs are another common label element.

![NFPA diamond symbol and HMIS label]

Figure 1. NFPA diamond symbol (left), HMIS label (right)

The United Nations has created a worldwide Globally Harmonized System (GHS) for label elements and safety data sheets. Because of the numerous languages used by the worldwide research community, the GHS relies heavily on pictographs to convey the basic information.

![United Nations GHS label elements]

Figure 2. United Nations GHS label elements (left to right): Flammable, Harmful, Oxidizing, Toxic to the Environment, Corrosive, Compressed Gas, Explosive, Human Health Hazard, Highly Toxic.
Optimally, incompatible chemicals such as acids and alkalis should be stored completely separate from one another to prevent mixing in the event of an accidental spill or release of the materials. Limited storage space within work areas, however, sometimes prevents such prudent practice of chemical segregation and storage. If space is limited, you can store incompatible chemicals in the same storage cabinet if you segregate the chemicals according to their hazard class and you store them in tubs, trays, or buckets while in the cabinet. These secondary containers reduce the chance that incompatible chemicals will inadvertently contact each other.

B. Storage Spaces

Do not store chemicals in laboratory hoods because the containers may impede airflow and thereby reduce the effectiveness of the hood.

1. Refrigerated Storage

Store flammable solvents that require storage at reduced temperature (such as isopentane) in refrigerators or freezers designed for storage of flammable liquids. “Safety” refrigerators for flammable liquid storage and “explosion proof” refrigerators are both acceptable. Ordinary household refrigerators are not appropriate for storage of flammable liquids because of interior arcing contacts. Because refrigerators and freezers have no interior space venting, all chemicals should have tightly sealed caps. Apply signage to the doors of chemical refrigerators stating: NO FOOD, BEVERAGE, OR ICE FOR HUMAN CONSUMPTION.”

Fire protection regulations limit the storage of flammable and combustible liquids to 10 gallons (37.9 liters) in open storage, 25 gallons (94.7 liters) in “safety cans”, and 60 gallons* (227.3 liters) in “flammable liquid storage cabinets” per laboratory room. These limits are for the total quantities on hand, including chemicals in storage, chemicals in use, and wastes.

*Note that only 30 gallons (113.6 liters) of Class I liquids are permitted per room. Class I liquids have a flash points less than 100 °F (37.8 °C), and are traditionally known as “flammable” liquids. Most liquids labeled as flammable are Class I liquids. Combustible liquids are Class II or III liquids, and have flashpoints above 100 °F (37.8 °C). Regulations permit up to 60 gallons (227.3 liters) of combustible plus flammable liquids per room, provided no more than 30 gallons are Class I.

Also, the International Fire Code (adopted by the State of North Carolina) places limits on the amounts of flammable and combustible liquids stored in new or renovated buildings as the number of floors above grade increases. For some laboratories located on higher floors in new or renovated buildings, the

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flammable liquid storage limit per room might be less than 30 gallons. Contact EHS if you have questions about the flammable storage limits for your lab spaces.

2. Cabinets

You can use cabinets under hoods and laboratory benches for storage of chemicals. In some cases, laboratory furniture manufacturers design cabinets specifically for storage of flammable and/or corrosive materials. However, do not store laboratory chemicals near or under sinks where there may be exposure to water. Storage of cleaning supplies under sinks is acceptable.

Cabinets for chemical carcinogens or highly toxic chemicals should have a lock. Regulations of the Drug Enforcement Administration and Bureau of Alcohol, Tobacco, and Firearms require locked storage for controlled substances and some specific explosive compounds.

3. Desiccator Jars or Cabinets

Desiccator jars and cabinets are useful for storage of air and water reactive, toxic, and malodorous chemicals. In case of especially malodorous compounds such as mercaptans, replace the desiccator material with a vapor adsorber (e.g. charcoal) to control odors.

4. Bench Tops and Shelves

Chemical storage on bench tops is undesirable, and is vulnerable to accidental breakage by laboratory, housekeeping, and emergency response personnel. Do not store liquids on shelves that are above eye-level. When storing chemicals on open shelves, consider several factors such as compatibility grouping (see below), the container material (plastic or metal versus breakable glass), physical state of the chemical (it’s riskier to store liquids on open shelves compared to solids), the relative toxicity of the chemical, and the height and depth of the shelving.

C. Storage by Compatibility Group

Store chemicals in the laboratory according to their compatibility groups. Chemicals in different compatibility groups should be stored separately, especially chemicals with an NFPA 704 or HMIS reactive rating of 3 or higher and in dedicated and labeled cabinets.
1. **Group A - Acids, Inorganics**

Store large bottles of acid in special acid cabinets, cabinets under lab benches, or on low shelves. Place acids in plastic trays for secondary containment in case of breakage. Segregate inorganic and oxidizing acids from organic compounds including organic acids (e.g., acetic acid) and other combustible materials. Segregate nitric acid (>40%) from organic chemicals, including organic acids. Store acids separate from bases and other reducing agents. Inorganic salts, except those of heavy metals, may be stored in this group. Glacial acetic acid should be stored with flammable and combustible materials since it is combustible.

2. **Group B - Bases**

Segregate bases from acids and oxidizers on shelves near the floor. The preferred storage container for inorganic hydroxides is polyethylene instead of glass. Place containers in trays for secondary containment in the event of leakage or breaks.

3. **Group C - Organic chemicals**

Segregate organic compounds from inorganics. Organics and inorganics with NFPA 704 or HMIS reactive hazard rating of two (2) or less may be stored together. Chemicals with a reactive hazard rating of three (3) or four (4) are to be stored separately.

4. **Group D - Flammable and Combustible Organic Liquids**

Flammable and combustible liquid storage per room is limited to 10 gallons (37.9 liters) in open storage and use, 25 gallons (94.7 liters) in safety cans, and 60 gallons (227.3 liters) in flammable storage cabinets. Remember that only 30 gallons (113.6 liters) of Class I liquids are permitted per room, and International Fire Code restrictions might limit this even further if your lab is located on an upper floor in a new or renovated building. Store flammable and combustible materials away from sources of ignition such as heat, sparks, or open flames, and segregated from oxidizers.

5. **Group E - Inorganic Oxidizers and Salts**

Store inorganic oxidizers in a cool, dry place away from combustible materials such as zinc, alkaline metals, formic acid, and other reducing agents. Inorganic salts may also be stored in this group. Store ammonium nitrate separately.
6. Group F - Organic Peroxides and Explosives

Peroxides contain a double-oxygen bond (R₁-O-O-R₂) in their molecular structure. They are shock and heat sensitive (e.g. benzoyl peroxide), and readily decompose in storage. Store shock and heat-sensitive chemicals in a dedicated cabinet.

Some non-peroxide chemicals can readily form shock-sensitive, explosive peroxides when stored in the presence of oxygen. Examples include ethyl ether, tetrahydrofuran, and cumene. Dispose of, or use, these by their expiration date. See Chapter 12 for information on safe storage of peroxidizable compounds.

Common explosive compounds include 2,4,6-trinitrotoluene (TNT), nitroglycerin, and several metal fulminates and azides. 2,4,6-trinitrophenol, also known as picric acid, is normally sold as a saturated solution containing at least 40% water, and classified as a flammable solid. If allowed to dry to less than 10% water, picric acid becomes a DOT Class 1.1 explosive. Nitroglycerin in research is usually sold as a tincture mixed with alcohol, but if the alcohol evaporates, the result is explosive nitroglycerin. Please contact EHS if you use or handle compounds that are explosive or can become explosive with age or evaporation.

7. Group G - Reactives

Water Reactives

Store water reactives in a cool dry place protected from water sources. Alkali metals (lithium, sodium, potassium, rubidium, and cesium) should be stored under mineral oil, or in waterproof enclosures such as glove boxes. A Class D fire extinguisher should be available in case of fire. Contact EHS if one is not available in your laboratory. As an added precaution, consider storing containers in trays or other secondary containers filled with sand.

Pyrophorics (Air Reactives)

Store pyrophorics in a cool, dry place, and provide for an air tight seal. Store white or yellow phosphorous under water in glass stoppered bottles inside a metal can for added protection.
8. Group H - Cyanides and Sulfides

Cyanides and sulfides react with acids to release highly toxic gases. They must be isolated from acids and other oxidizers.

9. Group I - Carcinogens, Highly Toxic Chemicals, and Reproductive Toxins

A dedicated lockable storage cabinet in a “designated area” for carcinogens and highly toxic chemicals is the preferred storage method. Stock quantities of reproductive toxins are to be stored in designated storage areas. Use unbreakable, chemically resistant secondary containers. Post the storage cabinet with a sign stating “CANCER SUSPECT AGENT”, “HIGHLY TOXIC CHEMICALS”, or “REPRODUCTIVE TOXINS”.

D. Proper Sealing of Chemical Containers

To prevent leakage, odors, or reaction with air, tightly seal all containers of highly toxic, highly volatile, malodorous, carcinogenic or reactive chemicals. Make sure that caps and other closures are tight on all hazardous chemicals. A limited exception is freshly-generated mixtures such as acids and organics that may generate gas pressure sufficient to burst a tightly sealed bottle. Use commercially available vent caps or keep the lids loose until sufficient time passes to complete the reactions, and then tightly close the lids. Until all reactions are completed, the contents of the bottle are not waste, but are instead the last step of the chemical procedure.

The best seal is the screw cap with a conical polyethylene or Teflon insert (Figure 4.2). Seal the caps with tape or Parafilm® “M” as a further precaution. Additional protection can include wrapping the container in an absorbent paper, sealing it inside a plastic bag, and storing the bag inside a metal can with a friction fitting lid.

E. Smaller Container Sizes - Less is Better

The real, or “life-cycle”, cost of a chemical includes its initial purchase price plus the ultimate disposal costs. Keep the quantity of accumulated chemicals in the work area at a minimum to reduce the risk of exposures, fires, and waste disposal problems. Smaller package sizes provide the following advantages:

- Reduced storage hazards
- Reduced storage space
• Safety in handling smaller quantities
• Reduced losses due to out-of-date chemicals
• Minimized cost of disposal of “leftovers”

Frequently, it costs many times more than the original purchase price to dispose of leftover chemicals.

XX. Hazardous Waste Management

The characterization, management storage and disposal of chemical wastes (i.e., chemical waste including hazardous and non-hazardous solid waste, radioactive or mixed waste, biohazardous and medical waste, and universal waste) is regulated and requires strict compliance with regulatory obligations. EHS is charged with ensuring compliance with provisions of 40 CFR 262. The Supervisor/PI has the overall responsibility for managing hazardous waste in their work area prior to waste pickup and disposal by EHS.

All new personnel are trained on chemical waste management procedures via the Chemical Safety Manual training. If they work in a laboratory, they also get training in the New Laboratorian Safety Orientation and the PI should provide new laboratorians training in their Lab Safety Plan which addresses lab-specific hazardous waste management. This is reviewed by all laboratorians as part of the annual Lab Safety Plan review. If hazardous waste issues are reported or found during laboratory inspections the lab will be asked to take a refresher training to ensure future compliance.

A. Chemical Waste

EHS personnel conduct the transfer of chemical wastes, radioactive wastes, and mixed wastes from campus areas to the NCCU EHS building (i.e., bulking) or package consolidation and managed storage prior to the transport to off-site treatment and disposal facility.

NCCU is a small quantity generator (SQG) of hazardous waste. The management and storage of hazardous waste is subject to regulatory compliance obligations; the University is regularly audited and inspected for compliance with these regulatory compliance obligations by the NC Department of Environmental Quality Division of Waste Management (NCDEQ DWM) and the U.S. Environmental Protection Agency (EPA) Hazardous Waste Section.

Hazardous Waste includes substances that are solids, liquids and gases. The EPA definition of includes substances that possess a hazardous characteristic (e.g. toxic, ignitable, corrosive, or reactive), or
substances that are listed by the EPA based on their usage or chemical constituents. Consider all waste chemical formulations a hazardous waste unless EHS determines otherwise. Contact EHS for technical assistance.

Hazardous waste labels are available from EHS. The full chemical name (no formulas, abbreviations or structures) of each component in the waste container must be listed as well as the estimated percentages. The accumulation start date must also be noted when waste is first added to the container. If the size of the container or number of contents does not fit on a label, an associated tracking sheet may be used.

B. Chemical Waste Removal

The University requires that all hazardous waste are removed from work areas no more than 1 month from the accumulation fill date indicated on the container label. When the waste container is full, submit a pickup via the Hazardous Pickup Request Form on the EHS website. EHS will review your request and may require more information before pickup.

Collection limits for each laboratory are set at 55 gallons of chemical waste or 1 quart of acute reactive waste. Acute reactive wastes include one or more of the following P-listed chemicals or a mixture that has one or more of the following:

- P006: Aluminum Phosphide
- P009: Ammonium Picrate
- P065: Mercury Fulminate
- P081: Nitroglycerine
- P112: Tetranitromethane
- P122: Zinc Phosphide (>10%)

If either of the volumes listed above are exceeded, the waste must be removed from the laboratory within 10 calendar days of the date that the limits were exceeded. Contact the EHS (919-530-7125) immediately if you exceed the limit.

C. Containers

Waste containers and lids must be in good condition and chemically compatible with the waste inside the container. Waste containers must have securely fitting lids, preferably the original lid(s) for the container(s); do not use corks or stoppers. Laboratory beakers, flasks, or plastic milk cartons are not
acceptable as waste containers. Metal containers are not acceptable unless they are the original container for the chemical waste being managed (no mixtures). Glass or plastic reagent bottles are generally the most convenient to use.

All containers of waste must be kept closed at all times, except:

1. When waste is being added to, removed from, or consolidated in the container.
2. When venting of the container is necessary for either the proper operation of laboratory equipment (such as HPLC), or to prevent the dangerous build-up of extreme pressure that may result from a reaction between the wastes being added. In some cases, a vented container lid should be employed to prevent gas build-up. For help in locating a vented lid for waste storage containers, contact EHS.

Liquid wastes may be accumulated in glass or plastic reagent bottles compatible with the waste. If you generate a large volume of liquid waste, consider 5-gallon carboys for solvent accumulation. Filled containers of liquids must have at least ten percent headspace (roughly 1.5 liters) to accommodate thermal expansion during transport and storage. Store glass waste containers in rubber safety carriers, buckets, or similar containers to protect against breakage and spillage. All waste containers holding 4 liters or less of liquid chemical waste, and all glass containers of liquid chemical waste stored on the floor, require secondary containment.

Solid wastes may go into a double-lined cardboard box or plastic bag. Liners must be 1.5 mil or greater polypropylene bags. Do not use biohazard or radiation waste bags for solid waste accumulation, regular, labeled trash bags are preferred. Tie and seal each bag individually. Ethidium bromide-containing solid and semi-solid waste (e.g. used gels) is also collected in double bags within cardboard boxes. Collect liquid ethidium bromide waste in carboys or bottles and manage accordingly.

Reactive chemicals must be disposed in their original shipping containers, or in containers provided by EHS.

D. Chemical Waste Segregation

Acids and Bases

Segregate containers of acids and bases from one another in individual, compatible containers while accumulating as waste. EHS will pick up concentrated acids and bases as chemical waste. Do not discharge
acids or bases containing heavy metals to the sanitary sewer, i.e., through the laboratory sinks. Do not mix acids and bases containing heavy metals with other acidic or basic wastes and do not include neutralization disposal of aqueous waste into the sanitary sewer as the last step in laboratory procedures.

Oxidizers

Package oxidizers separately; store and accumulate away from organics including flammable materials. Oxidizers should never be stored or accumulated adjacent or proximate to any organic substances.

Solvents

Segregate and collect halogenated and non-halogenated solvent wastes in separate waste containers. Please also note that in accordance with the City of Durham Sewer Ordinance, pollutants that can create a fire or explosion hazard (e.g. non-halogenated hydrocarbons) should not be sewered. Moreover, toxic solvents including all chlorinated ethenes and ethanes must not be sewered.

Compressed Gas Cylinders

Disposal of non-returnable (e.g., lecture-size) cylinders that are not “empty” can be very expensive, especially for reactive gases. Consider residual gas disposal options before purchasing reactive or highly toxic compressed gases. Compressed gas suppliers generally are not licensed to receive hazardous waste, and thus cannot accept non-returnable cylinders. However, suppliers can accept reusable cylinders with residual gas. Make every effort to purchase from suppliers who have a cylinder return program. For disposal, fill out the waste disposal form online for pickup. Even if the cylinder seems empty, it cannot be thrown in the trash. Always treat pressurized cylinders it as waste.

“Unknowns” – Unidentified Chemicals

Unlabeled chemicals present a challenging and potentially very costly disposal problem. Waste disposal firms require certification of the waste characterization by the generator. If the generator is unable to provide this certification based on process knowledge of the chemicals in the waste, a laboratory analysis is required. Depending upon the hazard class associated with the unknown waste, the cost to sample, analyze, treat and dispose of this waste (after it has been identified) can be very significant. EHS provides periodic identification and removal of unknowns through contract with qualified waste management and disposal companies. Exercise every precaution to avoid generating unknowns in the laboratory. If you discover unknown chemicals in a laboratory, please contact EHS for assistance and handling information.
E. Chemical Inventory and Disposal

The most significant way that you can assist in the management of chemical waste is to reduce the volume that must be disposed. Supervisors are encouraged to consider ways to reduce the volume of waste or preserve the reuse of materials through the redesign of experiments. Keep recyclable materials separate from other wastes.

F. Disposal to Sewage System

Do not use the sanitary sewer for the disposal of chemical waste, with the exception of trace quantities associated with cleaning and washing operations, e.g., glassware. Under no circumstances should halogenated or non-halogenated solvents be sewered directly or in aqueous solution when the solvent concentrations are more than trace (e.g. >1% by volume). The following discharges to the sanitary sewer are prohibited by the Clean Water Act:

- Wastes that may create a fire or explosion hazard.
- Corrosive wastes with a pH less than 6.0 standard units (s.u.) or greater than 10.0 s.u.
- Solid or viscous waste in quantities that would obstruct flow or interfere with operations.
- Heated waste discharges which could either inhibit biological activities or increase the wastewater treatment plant influent temperature to 104°F (40°F) and higher.
- Waste discharges of any toxic waste material(s) in volumes or strengths to cause interference with wastewater treatment processes, or possibly contaminate waste sludge or effluent from the wastewater treatment plant so as to violate its National Pollutant Discharge Elimination System (NPDES) permit.
  - Note on Biocides: Do not release concentrated solutions to the sanitary sewer. Limit disposal to one gallon of “working strength” solution per laboratory per day. This also applies to germicides and disinfectants. Pesticides and other chemicals that are persistent in the environment cannot go to the sewer.

Only neutral salts and buffer solutions may be disposed of down the sanitary drain. Do not dispose any of the following down the drain:

- acids with a pH < 6.0 s.u.
- bases with a pH > 10 s.u.
- solvents

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• alcohols, ethers, esters, ketones, aldehydes, amines, amides, nitriles, ethidium bromide, carbon disulfide, phenol or phenolic materials, other halogenated or non-halogenated hydrocarbons, or other chemical agents unless present as trace constituents in aqueous solution
• sodium azide containing wastes
• formaldehyde containing wastes
• solutions with heavy metals

XXI. Formaldehyde Exposure Control Policy

The Occupational Safety and Health Administration (OSHA) issued a standard (29 CFR 1910.1048) to ensure proper protection of all workers exposed to formaldehyde. The standard applies to all forms of formaldehyde including gas, aqueous solutions, solids, and materials that can release it. The OSHA permissible exposure limit (PEL) for formaldehyde is 0.75 parts per million (ppm) as an 8-hour time weighted average (TWA) and a short-term exposure limit (STEL) of 2 ppm in a 15-minute period. The OSHA action level (AL) for formaldehyde is 0.5 ppm as an 8-hour TWA. The action level is the threshold for increased exposure monitoring and initiation of medical surveillance.

The Formaldehyde Exposure Control Policy applies to all laboratories and laboratory personnel on campus.

A. Responsibilities

Principal Investigators

• Designate and address the use of formaldehyde as part of lab-specific Laboratory Safety Plan.
• Ensure that laboratory personnel are aware of and trained in the hazards related to formaldehyde exposure and complete the online Formaldehyde training
• Ensure that laboratory personnel are utilizing the proper engineering controls, work practices and personal protective equipment (PPE) to minimize formaldehyde exposure.

Laboratory Employees

• Complete the online Formaldehyde training as required
• Review and follow proper work practices, utilize proper engineering controls and wear proper PPE to minimize formaldehyde exposure.
Department of Environmental Health & Safety (EHS)

- Implement the NCCU Formaldehyde Exposure Control Plan.
- Conduct formaldehyde exposure monitoring.
- Review and provide feedback on individual Laboratory Safety Plans that identify formaldehyde use and recommend appropriate work procedures, controls and PPE.
- Administer formaldehyde safety resources such as the online Formaldehyde training.
- Annually review and update of the Formaldehyde Exposure Control Plan as part of the Lab Safety Manual annual review.

B. Health Effects

There are several health effects both chronic and acute that can result from exposure to formaldehyde.

- Acute exposure to formaldehyde in the range of 0.1-3 ppm can irritate the eyes, nose, and throat.
- Shortness of breath, cough, and chest tightness occurring in the range of 10-20 ppm.
- Chronic exposure to formaldehyde can lead to sensitization, asthma-like respiratory problems, dermatitis, and in some cases, cancer.

Due to the above acute and chronic symptoms that can occur with exposure to formaldehyde, both the OSHA action level for formaldehyde monitoring and the best workplace practices when working with formaldehyde are designed to keep potential formaldehyde exposures below the level where we would expect to see acute or chronic symptoms.

C. Hazard Assessment

Processes or occupational activities in NCCU laboratories that may result in formaldehyde exposure include (but are not limited to):

- Handling biological specimens/tissues preserved in formaldehyde.
- Sterilization or disinfection procedures.
- Fumigation procedures.

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Approved by: Kristin Long-Witter
D. Training

All employees exposed to formaldehyde (including those that receive or transport biological samples/tissues preserved in formaldehyde) must be trained on its hazards and the available methods of protection at the time of initial job assignment and whenever a new exposure to formaldehyde is introduced into the work area.

All employees assigned to workplaces where formaldehyde concentration meets or exceeds 0.1 ppm must be trained on an annual basis to confirm their understanding of formaldehyde, its hazards and the available methods of protection. Formaldehyde training is available online.

E. Hazard Communication

All mixtures or solutions composed of formaldehyde should be labeled to identify formaldehyde. Labels should be clear and should not just include the chemical formula but the full chemical name. Safety Data Sheets (SDSs) should be easily accessible to employees so they may review safety data on formaldehyde.

F. Medical Surveillance

Employee health complaints should be brought to the attention of the supervisor and EHS to provide the employee an avenue for receiving immediate medical attention.

Medical surveillance will be implemented for all employees exposed to formaldehyde at or above the AL or STEL. In addition, employees who develop signs and symptoms of overexposure to formaldehyde and employees exposed to formaldehyde in emergencies will also be medically surveilled.

G. Exposure Monitoring

Exposure monitoring is required for work areas where the concentration of formaldehyde exceeds the STEL or AL. Representative sampling will be performed in order to determine which university work activities fall within this scope.

EHS will conduct initial exposure monitoring for employees who may be exposed at or above the STEL or AL. Initial monitoring will be repeated each time there is a change in production, equipment, personnel, or control measures which may result in new or additional exposure to formaldehyde.
If an employee exhibits signs and symptoms of formaldehyde exposure, EHS will promptly monitor the affected employee's exposure. Periodic monitoring will be conducted for those employees with initial monitoring results at or above the STEL or AL. If the last monitoring results reveal employee exposure at or above the AL or STEL, EHS will repeat monitoring at least every six months. Periodic monitoring will be discontinued if the results from two consecutive sampling periods show that the employee exposure is below the AL and the STEL.

1) Monitoring and Reporting Results

Monitoring results must be relayed to the employee 15 days after exposure monitoring occurred. The principal investigator or supervisor will be responsible for discussing the results with the employee and the employee will verify that they have received and reviewed the results and send a signed copy back to EHS. The signed copy will be retained by EHS. If the employee's exposure is over the STEL and/or AL, then EHS will develop and implement a plan to reduce employee exposure and give notice to the employee. The notice to the employee will contain a written description of the corrective action being taken to decrease the exposure.

2) Regulated Areas

The university shall establish regulated areas where the concentration of airborne formaldehyde exceeds either the TWA or the STEL and post and maintain legible signs bearing the following information at all entrances or access ways:

DANGER
FORMALDEHYDE
IRRITANT AND POTENTIAL CANCER HAZARD
AUTHORIZED PERSONNEL ONLY

Access to the regulated area shall be limited to authorized persons who have been trained to recognize the hazards of formaldehyde.

H. Engineering Controls

Ventilation is the best method for reducing the concentration of airborne substances in the breathing zone of workers. Local exhaust ventilation in the form of a chemical fume hood, snorkel or downdraft table should be used whenever possible.
I. Work Practices/Administrative Controls

Work practices and administrative controls can also help in reducing airborne concentrations of formaldehyde and potential exposures. Recommended laboratory work practices include:

- Develop a standard operating procedure (SOP) for formaldehyde and/or formaldehyde solution use
- Keep solution containers of formaldehyde closed when not in use
- Use the minimal amount of formaldehyde required for each procedure
- Perform tasks involving formaldehyde in well ventilated areas
- Do not autoclave or microwave formaldehyde solutions
- Use formaldehyde preservative substitutes whenever possible

J. Personal Protective Equipment (PPE)

PPE is important to prevent for employee splash or other sudden contact with formaldehyde by creating a barrier between the user and formaldehyde. PPE minimizes the potential for employee exposure, but unlike engineering and work practice controls, does not reduce ambient formaldehyde exposure levels.

PPE should only be used as a supplement to engineering and work practice controls. Recommended PPE includes impermeable gloves, eye protection, lab coats and in some cases respiratory protection.

K. Spill Response and Emergency Plan

In areas where formaldehyde is utilized and spills may occur, provisions must be made to contain spills, decontaminate the work area and dispose of the waste. Prior to cleaning up any spill, employees should be properly trained and wear appropriate PPE.

- Small spills (<100 ml aqueous solution)
  - Remove all ignition sources, isolate the hazard area and deny entry to unnecessary persons
  - Contain the spill with absorbent materials
  - Dispose of all contaminated materials as hazardous waste

For larger spills (>100 ml aqueous solutions) or emergencies where the PEL or STEL may be exceeded, evacuate the area and call EHS (919-530-7125) during work hours or University Police (919-530-6106) after hours.

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Labs with large volumes of formaldehyde or those that are more likely to have a spill based on the work process must include a formaldehyde-specific emergency plan in the Laboratory Safety Plan. This information should be communicated to employees and posted in an accessible area. EHS should also be informed of these work areas in the event they or first responders need to respond to a major incident.

XXII. Respiratory Protection

Respiratory protection might be necessary when working with highly toxic chemicals, biological hazards, or dusts known to cause asthma or pulmonary fibrosis. However, respirators are a “last line” of defense, and should not be used until all engineering controls (e.g. ventilation) and work practice controls (e.g. product substitution) are exhausted.

NCCU has developed a Respiratory Protection Plan in compliance with 29 CFR 1910.134 which details all requirements and training for wearing respirators at NCCU.
XXIII. Appendix A – Request for Monitoring

Name: Click or tap here to enter text.  820 Number: Click or tap here to enter text.
Title: Click or tap here to enter text.
Laboratory/Department: Click or tap here to enter text.
Phone: Click or tap here to enter text.  Building/room(s): Click or tap here to enter text.
Principal Investigator: Click or tap here to enter text.
Chemical for which monitoring is requested: Click or tap here to enter text.
Describe how chemical is used in laboratory: Click or tap here to enter text.
Describe procedures/assays for which monitoring is requested: Click or tap here to enter text.
When (date) will operations be performed to be monitored? Click or tap to enter a date.
Other Comments: Click or tap here to enter text.

Please deliver this form via email to EHS at ehs@nccu.edu
and you will be contacted to arrange for monitoring.

Results will be sent within 15 days after monitoring results have been received by NCCU
XXIV. Appendix B – Equipment Safety Clearance Form

Faculty/Staff Name:  Click or tap here to enter text.
Department:  Click or tap here to enter text. Building/Room Number:  Click or tap here to enter text.

Equipment (manufacturer/model):  Click or tap here to enter text.
Serial Number:  Click or tap here to enter text. NCCU Property ID:  Click or tap here to enter text.

This is to certify that the laboratory equipment and/or room listed above is considered safe for maintenance work and/or occupancy. All hazardous materials have been removed. All potentially contaminated surfaces have been decontaminated in accordance with Environmental Health & Safety requirements.

<table>
<thead>
<tr>
<th>Hazardous materials removed</th>
<th>Yes ☐</th>
<th>No ☐</th>
<th>N/A ☐</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleaned</td>
<td>Yes ☐</td>
<td>No ☐</td>
<td>N/A ☐</td>
</tr>
<tr>
<td>Decontaminated</td>
<td>Yes ☐</td>
<td>No ☐</td>
<td>N/A ☐</td>
</tr>
<tr>
<td>Rad safety survey conducted</td>
<td>Yes ☐</td>
<td>No ☐</td>
<td>N/A ☐</td>
</tr>
<tr>
<td>&lt;600 dpm/100 cm²</td>
<td>☐ OR</td>
<td>&lt;0.05 mR/hr or 500 cpm ☐</td>
<td></td>
</tr>
<tr>
<td>Additional info:</td>
<td>Click or tap here to enter text.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hazard/warning signage removed/defaced</td>
<td>Yes ☐</td>
<td>No ☐</td>
<td>N/A ☐</td>
</tr>
</tbody>
</table>

Date completed:  Click or tap to enter a date.

Name of Principal Investigator or Authorized Designee: ________________________