
Chemical Hygiene Plan

UNC Greensboro

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Table of Contents

1.	Introduction.....	1
2.	Laboratory Safety Plan	1
3.	Chemical Hygiene Responsibilities	2
3.1	Department of Environmental Health & Safety.....	2
3.2	Principal Investigator	2
3.3	Laboratory Workers	3
4.	Laboratory Inspection Program	3
5.	Training.....	4
6.	Hazard Communication	5
6.1	Signs.....	5
6.2	Labeling	5
6.3	Inventory	5
6.4	Safety Data Sheets	5
7.	General Laboratory Safety Precautions	6
7.1	Personal Work Practices	6
7.2	Laboratory Equipment and Glassware.....	6
7.3	Housekeeping.....	7
8.	Personal Protective Equipment	7
9.	Chemical Storage and Use	8
9.1	Chemical Procurement.....	8
9.2	Chemical Handling	8
9.3	Chemical Storage	9
9.4	Compressed Gas.....	10
10.	High Hazard Materials	10
10.1	Particularly Hazardous Substances	10
	Select Carcinogens	11
	Reproductive Toxins	11
	Highly Toxic Materials.....	11
10.2	Working with Particularly Hazardous Substances:.....	12
10.3	Working with Animals and Chemicals of High Toxicity (Special Precautions)	12
10.4	Organic Compounds that form Hazardous Peroxides.....	13

Storage and Handling:	13
10.5 Nanomaterials	14
10.6 Chemicals Requiring Initial Monitoring	15
10.7 Department of Homeland Security Chemicals of Interest	15
10.8 Controlled Substances	15
11. Activities Requiring Prior Approval	16
Sole Occupancy and Off-hours Work:	16
Unattended Operations:	16
Children and Unauthorized Personnel in Hazardous Environments:	16
12. Emergency Equipment & Engineering Controls	17
12.1 Emergency Equipment:	17
Fire Extinguishers	17
Emergency Showers and Eyewashes	17
12.2 Engineering Controls	17
Fume Hoods	18
Local Exhaust Ventilation	18
Glove Boxes and Isolation Rooms	19
Cold Rooms and Warm Rooms	19
Chemical Storage Cabinets	19
13. Chemical Spills, Releases, and Incidents	19
14. Medical Consultations	20
15. Laboratory Closure or Relocation	21
15.1 Responsibilities	21
15.2 Researcher Precautions/Procedures Prior to Relocation or Closure	22
Chemicals (Solids, Liquids, Gases)	22
Biological Materials	22
Radioactive Materials	23
16. Recordkeeping	23
Appendix A: Glove Compatibility Table	24
Appendix B: Lab-Specific Training Form	27
Appendix C: SOP Template for Hazardous Materials or Procedures	30
Appendix D: Chemicals Requiring Initial Monitoring	33
Appendix E: Department of Homeland Security Chemicals of Interest	35

1. Introduction

On January 31, 1990 the Occupational Safety and Health Administration (OSHA) promulgated a final rule for occupational exposure to hazardous chemicals in laboratories. Included in the standard, which became effective on May 1, 1990 is a requirement for all employers covered by the standard to develop and carry out the provisions of a Chemical Hygiene Plan (CHP).

A CHP is defined as, "a written program which sets forth procedures, equipment, personal protective equipment and work practices that are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace". Components of the CHP must include standard operating procedures for safety and health, criteria for the implementation of control measures, measures to ensure proper operation of engineering controls, provisions for training and information dissemination, permitting requirements, provisions for medical consultation, designation of responsible personnel, and identification of particularly hazardous substances.

This document is the Chemical Hygiene Plan developed for UNCG. It contains the University policies and procedures for working with hazardous chemicals. This document was developed to comply with paragraph (e) of the referenced OSHA 1910.1450 standard. This CHP will be reviewed, evaluated and updated at least annually by the Environmental Health and Safety Department. The CHP will be readily available to employees, their representatives and any representative of the Assistant Secretary of Labor of OSHA.

In addition, each employee is expected to develop safe personal chemical hygiene habits aimed at the reduction of chemical exposures to themselves and co-workers.

2. Laboratory Safety Plan

A Laboratory Safety Plan (LSP) for individual laboratories is required by the Occupational Safety and Health Administration (OSHA) regulation, "Occupational Exposures to Hazardous Chemicals in Laboratories," commonly referred to as the OSHA Lab Standard. This standard requires a written plan that sets forth procedures, equipment, personal protective equipment and work practices capable of protecting employees from health hazards presented by the chemicals used in the laboratory. To accomplish this, UNCG requires any Principal Investigator who uses chemicals in the laboratory space to complete a LSP and operate in accordance with the University's Chemical Hygiene Plan. The LSP is designed to provide the Principal Investigator the ability to develop such a written plan specific to his or her laboratory. The LSP must be completed by new Principal Investigators and updated on an annual basis or whenever changes occur in the laboratory personnel or hazards.

The Laboratory Safety Plan provides the following:

- Identifies the hazards associated with a particular laboratory space (ie. Hazardous Chemicals, Biological Hazards, Radioactive Materials, X-Rays, Lasers);
- Describes specific procedures and precautions in place to account for the hazards identified;
- Identifies emergency procedures and contacts;
- Identifies personnel who are approved to work in the laboratory;
- Identifies training that has been conducted with approved personnel.

3. Chemical Hygiene Responsibilities

3.1 Department of Environmental Health & Safety

The EH&S Department will:

- Work with administrators and other employees to develop and implement appropriate chemical hygiene policies and practices;
- Monitor procurement, use, storage, and disposal of chemicals at the University;
- Assist Supervisors and Principal Investigators in developing and maintaining adequate facilities and work practices, and determining appropriate training for workers;
- Perform regular, formal chemical hygiene and safety inspections;
- Maintain current knowledge concerning the legal requirements of regulated substances at the University;
- Review the Chemical Hygiene Program on an annual basis.

3.2 Principal Investigator

The Principal Investigator shall:

- Maintain overall responsibility for the laboratory operation;
- Manage procurement, storage, use, and disposal of chemicals in accordance with the CHP
- Develop and maintain an accurate Laboratory Safety Plan (LSP);
- Plan each laboratory operation in accordance with the CHP;
- Ensure that lab workers and visitors know and follow the rules and procedures in the CHP & LSP;
- Determine the proper level of personal protective equipment (PPE) and ensure that such protective equipment is available and used properly by lab members;

- Determine that facilities and training levels are adequate for the chemicals in use;
- Ensure that appropriate training has been provided to employees;
- Ensure that lab facilities and equipment are maintained in good working condition.

3.3 Laboratory Workers

The laboratory workers are individually responsible for:

- Reading and understanding the applicable safety rules and procedures in their Lab Safety Plan (LSP) and Lab SOP's;
- Conducting each laboratory operation in accordance with the CHP & LSP,
- Developing good personal chemical hygiene habits and wearing appropriate PPE;
- Promoting good housekeeping practices in the laboratory area;
- Reporting hazardous conditions and incidents to the PI.

4. Laboratory Inspection Program

There are a myriad of health and safety regulations impacting laboratory operations from training and recordkeeping requirements to safe material handling and storage procedures. The goal of the laboratory inspection program is to maintain safe and compliant laboratory environments through the early detection of regulatory deficiencies and potentially unsafe work practices and to serve as a resource to aide researchers in the development of necessary policies and procedures, as required by the OSHA Laboratory Standard.

Each Principal Investigator's (PI's) laboratory will be inspected semiannually. PI's will be informed of the month of their laboratory inspections, which will otherwise be unannounced. Inspections will assess administrative, procedural, and operational compliance with internal and external regulatory standards in the following areas:

- Laboratory Safety & Protective Procedures
- Chemical Hygiene
- Biological Hazards
- Radiation Safety
- Hazardous Waste

Another primary component of the inspection program is a review of the accuracy of the Laboratory Safety Plan, as it serves to identify hazards to personnel and as a resource for required material handling and storage procedures.

The inspector will review any findings with the PI or lab personnel present during the inspection and will provide guidance on appropriate corrective measures. Items presenting an immediate safety risk shall be corrected immediately or lab operations suspended, as necessary, to mitigate

the hazard until the condition is corrected. A written report detailing any items of noncompliance or other safety concerns will be sent to the PI. For items not corrected during the inspection, a written response from the PI or their designee must be received, detailing corrective actions. If a written response is not received within two weeks, the escalated enforcement process will be initiated.

Escalated Enforcement Process (may be accelerated for items posing an immediate safety risk):

- I. **2 weeks – Reminder.** If an adequate response is not received within two weeks of the initial inspection report, the PI will receive a reminder notice of the safety deficiencies and request for response.
- II. **4 weeks – Second Reminder to Department Head.** If an adequate response is not received within four weeks, a second reminder will be sent to the PI and their Department Head.
- III. **6 weeks – Notification to Dean & SSROC.** If an adequate response is not received by six weeks, the items of non-compliance will be communicated to the PI's Dean and the Safety and Scientific Research Oversight Committee.

5. Training

All lab workers will be apprised of the hazards present in the laboratory. Each worker shall receive training at the time of initial assignment to the laboratory, prior to assignments involving new exposure situations, and annually thereafter. General laboratory safety training can be completed through universal department or university training programs. Lab-specific training topics must be presented by the principal investigator or a senior laboratory supervisor.

Training shall include:

General Laboratory Safety (may be fulfilled by universal safety training):

- Location of UNCG Chemical Hygiene Plan
- Hazard Communication Program Information (signs, labels, symbols)
- Storage, use, and disposal procedures for general chemical classifications
- Physical hazards and signs/symptoms of exposure to general chemical classifications
- Precautions to mitigate hazard exposure
- Response to spills, incidents, and emergencies
- Security considerations

Lab-Specific Topics (presented by PI or Lab Supervisor):

- Location and contents of the Lab Safety Plan and Lab SOP's
- Location of Chemical Inventory & Safety Data Sheets (SDS)
- Identify high hazard and restricted materials, equipment, or areas of the lab

- Information on particularly hazardous substances. Specify personnel and materials (Select Carcinogens, Reproductive Toxins, High Acute Toxicity, Nanomaterials, etc.):

Documentation of departmental safety training sessions shall be maintained by the department and a copy forwarded to the EH&S Department. Lab-specific training provided by the PI or supervisor shall be documented on the form in Appendix B or the equivalent and maintained in the Lab Safety Plan binder.

6. Hazard Communication

6.1 Signs

Signs shall be posted at entryways to areas containing hazardous materials. Entry signs shall include telephone numbers for emergency personnel, supervisors and other workers, as deemed appropriate, and hazard symbols for all hazardous materials present. Location signs for safety and emergency equipment shall be posted inconspicuously.

6.2 Labeling

All containers in the laboratory shall be labeled. Labels shall include, at a minimum, the full product or chemical name(s) and the associated hazards. Hazards can be identified by words, GHS pictograms, or NFPA labels.

- Portable containers shall be labeled by the individual using the container.
- Exemptions for labeling requirements shall be made for chemical transfers from a labeled container which is intended only for the immediate use by the person who performed the transfer.
- The labeling program shall be periodically inspected by laboratory personnel to ensure that labels are accurate and legible.

6.3 Inventory

A list of all chemicals present in the workplace must be readily accessible to personnel at all times.

6.4 Safety Data Sheets

Safety Data Sheets (SDS) for all chemicals present in the workplace must be readily accessible to personnel at all times. SDS can be kept in paper or electronic form.

Electronic SDS can be accessed at MSDS Online via the EH&S website <https://safety.uncg.edu>.

SDS will include information organized into the following sections:

- | | |
|---|-------------------------------------|
| 1. Identification | 9. Physical and Chemical properties |
| 2. Hazard(s) identification | 10. Stability and reactivity |
| 3. Composition/information on ingredients | 11. Toxicological information |
| 4. First-aid measures | 12. Ecological information |
| 5. Firefighting measures | 13. Disposal considerations |
| 6. Accidental release measures | 14. Transport information |
| 7. Handling and storage | 15. Regulatory information |
| 8. Exposure control/personal protection | 16. Other information |

7. General Laboratory Safety Precautions

7.1 Personal Work Practices

- All employees shall remain vigilant to unsafe practices and conditions in the laboratory and shall immediately report such practices and conditions to the laboratory supervisor. The supervisor must correct unsafe practices and conditions promptly.
- Encourage safe work practices in co-workers by setting the proper example. Horseplay is strictly forbidden.
- Seek information and advice from knowledgeable persons, standards, and codes about the hazards present in the laboratory. Plan operations, equipment and protective measures accordingly.
- Long hair and loose-fitting clothing shall be confined close to the body to avoid being caught in moving equipment/parts, or contact with flames or hazardous materials.
- Inspect personal protective equipment prior to use. Wear appropriate protective equipment as procedures dictate and when necessary to avoid exposure.
- Avoid unnecessary exposure to all chemicals by any route.
- Do not smell or taste any chemicals.
- Understand and use engineering controls appropriately.
- Only use chemicals which are compatible with the ventilation system.

7.2 Laboratory Equipment and Glassware

Each employee shall keep the work area clean and uncluttered. All chemicals and equipment shall be properly labeled in accordance with the labeling section of this plan. At the completion of each work day or operation, the work area shall be thoroughly cleaned and all equipment properly cleaned and stored.

In addition, the following procedures shall apply to the use of laboratory equipment:

- All laboratory equipment shall be used only for its intended purpose.

- All glassware will be handled and stored with care to minimize breakage; all broken glassware will be immediately taken out of service.
- All evacuated glass apparatus shall be shielded to contain chemicals and glass fragments should implosion occur.
- All laboratory equipment shall be inspected on a periodic basis and replaced or repaired, as necessary.

7.3 Housekeeping

Each laboratory worker is directly responsible for the cleanliness of his or her work space, and jointly responsible for common areas of the laboratory. The Principal Investigator or supervisor shall insist on the maintenance of housekeeping standards.

The following procedures apply to the housekeeping standards of the laboratory:

- All spills on lab benches or floors shall be immediately cleaned and disposed of properly. The laboratory supervisor must be informed of any large spills (> 1 L) or spills of particularly hazardous substances.
- Lab bench work areas shall be kept clear of equipment and chemicals except those necessary for the work currently being performed.
- The work area shall be cleaned at the end of each operation and each day.
- All apparatus shall be thoroughly cleaned and returned to storage upon completion of usage.
- All floors, aisles, exits, fire extinguishing equipment, eyewashes, showers, electrical panels and other emergency equipment shall remain unobstructed.
- All labels shall face forward.
- Chemical containers shall be clean, properly labeled and returned to storage upon completion of usage.
- All chemical wastes will be disposed of in accordance with UNCG Hazardous Waste Disposal Procedures.

8. Personal Protective Equipment

- **SAFETY GLASSES** meeting ANSI Z87.1 are required for all persons in a laboratory and must be worn at all times, when a splash hazard is present.
- Safety goggles and/or a full face shield shall be worn when working with concentrated corrosives, or there is a hazard from large splashes or flying particles, for example, when transferring large quantities of chemicals or working with glassware under pressure or vacuum.
- Sandals, perforated shoes, and bare feet are prohibited. Safety shoes, per ANSI 47 are required where employees routinely lift heavy objects.

- **LAB COATS** are recommended for use in the laboratory. Laboratory coats will be laundered on a periodic basis, at least monthly. Laboratory coats shall be removed from service immediately upon discovery of significant contamination.
- Short pants may not be worn when working with hazardous materials in a laboratory.
- Appropriate chemical-resistant **GLOVES** based on the table in Appendix A shall be worn at all times when handling corrosive or otherwise hazardous materials and chemicals of unknown toxicity. Used gloves shall be inspected and washed prior to re-use. Damaged or deteriorated gloves will be immediately replaced. Reusable Gloves shall be washed prior to removal from the hands. Disposable, single use gloves shall not be reused.
- Thermal-resistant gloves shall be worn for operations involving the handling of heated materials and exothermic reaction vessels. Thermal-resistant gloves shall be non-asbestos and shall be replaced when damaged or deteriorated.
- **RESPIRATOR** usage shall comply with the OSHA Respiratory Protection Standard, 29 CFR 1910.134, and the UNCG Respiratory Protection Program.

9. Chemical Storage and Use

9.1 Chemical Procurement

The decision to procure a chemical shall be a commitment to handle and use the chemical properly from initial receipt to ultimate disposal. Information on proper handling, storage and disposal shall be known prior to the procurement of the chemical. Chemicals utilized in the laboratory shall be compatible with related lab facilities, such as storage cabinets and ventilation systems. Personnel who receive chemical shipments shall be knowledgeable of the proper procedures for receipt.

9.2 Chemical Handling

Each laboratory employee shall be trained and provided the resources by their supervisor develop and implement work habits consistent with this CHP to minimize personal and co-worker exposure to chemicals in the laboratory. Given that all chemicals inherently present hazards in certain conditions, exposure to all chemicals shall be minimized.

General precautions for the handling and use of all chemicals:

- Skin contact with all chemicals shall be avoided.
- Immediately wash any areas of contaminated skin.
- Mouth suction for pipetting or starting a siphon is prohibited.

- Eating, drinking, smoking, gum chewing, or application of cosmetics in areas where laboratory chemicals are present is prohibited. Hands shall be thoroughly washed prior to performing these activities.
- Storage or handling of food or beverages shall not occur in storage areas or refrigerators also used for laboratory materials or operations.
- Any chemical mixture shall be assumed to be as hazardous as its most hazardous component.
- Substances of unknown toxicity shall be assumed to be toxic.
- Laboratory employees shall be familiar with the symptoms of exposure for the chemicals with which they work and the precautions necessary to prevent exposure.
- In all cases of chemical exposure, neither the Permissible Exposure Limits (PELs) of OSHA or the Threshold Limit Values (TLVs) of the American Conference of Governmental Industrial Hygienists (ACGIH) shall be exceeded.
- Understand and use engineering controls appropriately.
- Implement and adhere to special precautions for particularly hazardous materials, as described in the Highly Hazardous Materials section of this plan.

9.3 Chemical Storage

- Received chemicals shall be immediately moved to their designated storage area. Large glass containers shall be placed in carrying containers or shipping containers during transportation.
- Storage areas shall be well illuminated, with all storage maintained below eye level. Large bottles shall be stored no more than two feet from ground level.
- Chemicals shall be segregated by hazard classification and compatibility in a well identified area, with local exhaust ventilation.
- Mineral acids should be separated from flammable and combustible materials. Separation is defined by NFPA 49 as storage within the same fire area, but separated by as much space as practicable or by intervening storage from incompatible materials.
- Acid-resistant trays shall be placed under bottles of mineral acids.
- Acid-sensitive materials such as cyanides and sulfides, shall be separated from acids or protected from contact with acids.
- Storage areas shall not be used as a preparation or repackaging area.
- Chemicals transported outside of laboratory areas shall be placed in a secondary container, such as a bottle jockey, bucket, or cart capable of containing a spill.
- Storage of chemicals at the lab bench or other work areas shall be limited to those amounts necessary for one operation. The container size shall be the minimum convenient. The amounts of chemicals at the lab bench shall be as small as practical. Chemicals in the workplace shall not be exposed to sunlight or heat.

- Stored chemicals shall be examined at least annually by the Principal Investigator or supervisor for expiration, deterioration, and container integrity. The inspection should determine whether any corrosion, deterioration, or damage has occurred to the storage facility as a result of leaking chemicals.

9.4 Compressed Gas

Cylinders should be stored in an upright position and secured to a wall or laboratory bench through the use of chains or straps. Cylinder caps should remain on the cylinder at all times unless a regulator is in place. Cylinders should be stored in areas where they will not become overheated. Avoid storage near radiators, areas in direct sunlight, steam pipes and heat releasing equipment such as sterilizers. Transport compressed gas cylinders on equipment designed for this function. Never carry or "walk" cylinders by hand.

Hazard assessment for work with compressed gases should assure that all staff understands proper use and handling precautions; that all pressurized equipment is properly shielded; regulators are not interchanged between different gas types; all hose connections are properly secured and are appropriate for the pressure(s) used.

Engineering/Ventilation Controls: Manipulation of compressed gases should typically be carried out in a fume hood if the compressed gas is an irritant, oxidizer, asphyxiant, or has other hazardous properties.

PPE: Lab coats, closed toed shoes and long sleeved clothing should be worn when handling compressed gases. Eye protection in the form of safety glasses must be worn at all times when handling compressed gases.

Emergency Procedures: In the event of a spill of a compressed gas that is an irritant, oxidizer, asphyxiant, or has other hazardous properties all personnel in the area should be alerted. Vacate the laboratory immediately and call the UNCG Police 4-4444 for response.

10. High Hazard Materials

10.1 Particularly Hazardous Substances

Particularly hazardous substances require additional planning and precautions, detailed in written standard operating procedures (SOP). OSHA defines particularly hazardous substances as select carcinogens, reproductive toxins, and substances which have a high degree of acute toxicity. The SOP should include provisions to limit exposure and contamination of personnel and equipment through appropriate containment, personal protective equipment, decontamination procedures, and waste collection. The safety provisions can be documented using the SOP template in Appendix C or written into the lab

Select Carcinogens

OSHA defines select carcinogens as chemicals:

- Regulated by OSHA as a carcinogen; or
- Listed as “known to be carcinogen” in the Annual Report on Carcinogens published by the National Toxicology Program (NTP); or
- Listed as “Group 1” (“carcinogenic to humans”) by the International Agency for Research on Cancer Monographs (IARC); or
- Listed in either Group 2A or 2B by the IARC or as “reasonably anticipated to be carcinogens” by the NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:
 - Inhalation of <10 mg/m³ for 6-7 hours per day for 5 days a week for a significant portion of lifetime
 - Repeated skin application of <300 mg per kg of body weight per week
 - Oral dose of <50 mg per kg of body weight per day

Reproductive Toxins

Reproductive toxins are defined as materials that affect the reproductive capabilities, including adverse effects on sexual function and fertility in males and females, as well as adverse effects on the development of the offspring. Materials that may cause adverse reproductive effects include chemical, biological, and radiological agents.

UNCG is committed to providing additional protection for the conceptus by implementation of specific procedures or accommodations to protect pregnant personnel. Protective considerations for declared pregnancies may include specific PPE, containment equipment, procedure alterations, or work assignment changes, at no cost or loss of job opportunity to the individual. Pregnancy declarations can be made confidentially to the supervisor, department head or UNCG Laboratory Safety Manager.

Highly Toxic Materials

Chemicals with a high acute toxicity have the ability to cause harmful effects, which can be local or systemic, after a single exposure. The parameters for assessing the acute toxicity of a chemical are its LD₅₀ and LC₅₀, the mean lethal dose or concentration causing death in experimental animals. OSHA defines highly toxic substances by the following criteria.

- Oral LD₅₀ for albino rats of <50 mg/kg; or
- Topical LD₅₀ for albino rabbits of <200 mg/kg; or
- Inhalation LC₅₀ in albino rats of <200 ppm or 2 mg/L for one hour.

10.2 Working with Particularly Hazardous Substances:

- Develop and document a written procedure identifying the special precautions for personnel protection and designated areas of use for all particularly hazardous substances used in the lab.
- All storage, transfer and work with these substances shall be in a designated area (cabinet, hood, glove box, benchtop) of a restricted access lab room.
- The designated area(s) will be marked with warning and restricted access signs.
- Containers will be stored in a ventilated, limited access area in labeled, unbreakable, chemically resistant, secondary containment.
- HVAC systems must be configured to maintain negative pressure in the lab room.
- Exhaust air from the work area or primary containment equipment must discharge directly to the outdoors, clear of buildings and air intakes. Exhaust air from the work area must not recirculate.
- Exhaust systems for highly toxic substances must contain engineered fail-safes to prevent loss of containment due to utility outages.
- A laboratory coat and compatible gloves must be worn when working with highly toxic chemicals or select carcinogens. Protective clothing shall not be worn outside of the lab and must be decontaminated prior to laundering.
- Hands and arms will be washed immediately after working with these chemicals.
- The PI or supervisor, and EH&S will be notified of spills and other exposure incidents. A physician will be consulted when appropriate.
- Vacuum systems must have protection via an absorbent or liquid trap and a high efficiency particulate air (HEPA) filters. Use vacuum pumps in an appropriate hood.
- Any contaminated equipment or glassware will be decontaminated in the hood before removing them from the designated area.
- Women of child-bearing age shall only handle embryotoxins in a fume hood.
- Two people will always be present during work with these chemicals.

10.3 Working with Animals and Chemicals of High Toxicity (Special Precautions)

- Hazardous chemical operating procedures and SDS shall be included with IACUC protocols.
- Animals exposed to highly toxic materials will be housed in designated rooms posted for toxic materials.
- Compatible gloves and long lab coats will be worn in the designated animal room.
- The substance will be administered by injection or gavage when possible rather than by diet. When diet is used, a caging system under negative pressure or under laminar air flow directed toward HEPA filters will be used.

- Procedures will be used to minimize contaminated aerosols and dust from food, urine and feces:
 - HEPA filtered vacuum equipment for cleaning.
 - Moisten contaminated bedding before removal from cage.
 - Mix diets in closed containers in hood

10.4 Organic Compounds that form Hazardous Peroxides

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

Examples of organic compounds that form hazardous peroxides:

- aldehydes, ketones, ethers.
- Compounds with allylene ($\text{CH}_2=\text{CHCH}_2\text{R}$) structure.
- Alkali metals, alkoxides, amines.
- Vinyl and vinylidene compounds.
- Compounds with benzylic hydrogen atoms.

Examples of chemicals which form hazardous peroxides during exposure to air:

- cyclohexane
- tetrahydrofuran
- decalin
- ethyl ether
- tetralin
- isopropyl ether
- dioxane (1,4)
- potassium metal
- sodium amide
- divinyl acetylene
- vinyl ethers
- cumene
- diazine
- cyclopentene

Storage and Handling:

- Additional labeling of these compounds must include “PEROXIDE FORMING CHEMICAL”.
- Discard OPENED containers of peroxide forming chemicals after 6 months. Discard UNOPENED containers of peroxide forming chemicals after 12 months. Contact the Office of Safety for disposal.

- Order peroxide-forming chemicals in small amounts and use quickly.
- Include the DATE OF PURCHASE on label.
- After opening, note the DATE OF USE on label.
- Store in cool, dry, well-ventilated area, out of direct sunlight. Protect from extreme temperatures and rapid temperature changes.
- Containers should be tightly sealed. DO NOT use corks or rubber stoppers to cap containers.
- Store in amber glass or inert containers, preferably unbreakable.
- Before opening glass bottles, look for the presence of solids (crystals) or viscous liquid at the bottom of the bottle. These are good indicators of peroxide formation. If either are present – DO NOT OPEN OR HANDLE the container. Call the EH&S Department at 336-334-4357 for assistance and possible deactivation of the material.

10.5 Nanomaterials

Nanomaterials are defined as materials with at least one external dimension in the nanoscale, between 1 and 100 nanometers. A nanofiber has two external dimensions in the nanoscale and a nanoparticle has all three dimensions in the nanoscale. Nanomaterials often exhibit unique properties that differ from their base material, due largely to their high surface to volume ratio and structure. As such, nanotechnology offers scientific advancement in many areas including medicine, consumer products, energy, and materials and manufacturing.

Risk Assessment

The rapid growth of nanotechnology has outpaced the study of the associated safety concerns, thus the potential health effects and safety hazards of nanomaterials are not well understood. To ensure the safety of the UNCG community, **researchers must conduct a risk assessment and document standard operating procedures (Appendix C) prior to use of any nanomaterials.**

Toxicity and Physical Hazards: In general, as particle size decreases into the nanoscale, the chemical and biological reactivity increase significantly. Thus, the chemical, structural, and size-dependent properties must all be considered to assess the potential for toxicity or physical hazards.

Routes of Exposure: Inhalation is primary route of concern, because nanomaterials can reach and affect all areas of the lungs, penetrate into capillaries, and translocate to other organs. Studies have shown conflicting results with regard to skin penetration by nanomaterials.

Use the template in Appendix C to conduct the risk assessment and document standard operating procedures for each nanomaterial to be used in the lab. To complete the risk assessment....

- Review the SDS of the specific nanomaterial (if available)
- Review the SDS of the base material

- Consider the specific operations and manipulations to be performed
- Consider reactivity with other chemicals to be used
- Consider the potential routes of exposure
- Consider the magnifying effect of nanoscale materials on toxicity, reactivity, and physical hazards
- Assign the highest degree of hazards identified or anticipated from the risk assessment
- Assign material use and handling precautions to minimize the potential hazards to lab personnel

10.6 Chemicals Requiring Initial Monitoring

A list of chemicals requiring initial monitoring is found in Appendix D. Sampling for evaluating employee exposure to chemical substances shall be conducted periodically or as specified by specific codes or regulations. The Department is responsible for identifying chemicals that require initial monitoring and arranging to have monitoring conducted through the EH&S Department.

10.7 Department of Homeland Security Chemicals of Interest

On November 20, 2007, the Department of Homeland Security passed 6 CFR Part 27 “Appendix A” to the Chemical Facility Anti-Terrorism Standard Final Rule. This rule requires that any “Chemical Facility” report amounts of “Chemicals of Interest (COI’s)” inventoried at these facilities. Under the rule Universities were established as “Chemical Facilities”. Appendix E contains a list of COI’s and amounts that are required to be reported within 60 days from the time they are received or produced. Because of this reporting requirement, inventories of these chemicals on campus at any time require particular attention.

The Principal Investigator shall be responsible for reporting the amount of these chemicals on an annual basis. Reports should be directed to the EH&S Department, which will keep a master list of COI’s and quantities on file.

10.8 Controlled Substances

Drugs and other substances that are considered controlled substances under the Controlled Substances Act (CSA) are divided into five schedules. An updated and complete list of the schedules is published annually in Title 21 Code of Federal Regulations 1308.11 through 1308.15. Substances are placed in their respective schedules based on whether they have a currently accepted medical use in treatment in the United States, their relative abuse potential, and likelihood of causing dependence when abused. Researchers acquiring these materials will be required to register with NC DHHS and obtain a DEA license. EHS will aid each Principle Investigator (PI) in obtaining his/her licenses for the purchase of controlled drugs if necessary.

For more information, see the Controlled Substance Policy available on the Laboratory Safety webpage <https://safety.uncg.edu/LaboratorySafety.html>.

11. Activities Requiring Prior Approval

Some laboratory activities and situations present an elevated risk to health and safety and may require prior approval and planning. These activities include off-hours work, sole occupancy of building, and unattended operations.

Sole Occupancy and Off-hours Work:

A prior authorization and emergency contact plan shall be implemented for laboratory work involving hazardous chemicals, procedures, or equipment, when the only person in the building is the lab worker. The Principal Investigator shall determine when an authorization and emergency plan are necessary, considering the hazards associated with the activity and the need for emergency assistance. The **emergency contact plan** for sole occupancy hazardous work shall designate a contact person for periodic check-ins during long operations and to whom the worker shall report the safe completion of the operation.

Unattended Operations:

When laboratory operations are performed which will be unattended by laboratory personnel (continuous operations, overnight reactions, etc.), the following procedures will be employed:

- Prior approval - The Principal Investigator or lab supervisor must grant approval, based on the hazards and risks associated with the unattended operation.
- Review of procedure – The PI or lab supervisor shall review the proposed operation procedures to minimize the risk and effects of an accident. Consideration shall be given to a potential interruption of utility service (loss of water pressure, electricity, etc.).
- An individual and backup shall be designated to terminate the process at the planned conclusion of the operation.
- A communication plan shall be implemented to confirm actions taken for processes requiring after-hours mediation or termination which, if not performed, would increase the risk of accident (fire, explosion, chemical release, etc.).
- A sign will be posted at all entrances to the laboratory, indicating an unattended operation is underway and identifying the names and phone numbers of persons familiar with the operation, to be contacted in an emergency.
- The overhead lights in the laboratory will be left on.

Children and Unauthorized Personnel in Hazardous Environments:

Access to areas identified as laboratories where hazardous chemicals and equipment are maintained is limited to authorized University staff and students and other persons on official, related business. This requirement is intended to protect the health and well-being of all

University employees and to avoid exposing unauthorized individuals to a hazardous environment. Measures should be taken to ensure that persons entering these areas be appropriately trained and adequately protected from hazards and informed about the safety and emergency procedures relevant to their activities.

Children under the age of 18 are prohibited from entering laboratory areas or other areas where hazardous materials or conditions may be present unless:

- Such entry is in the context of a scheduled open house or tour;
- The minor is a UNCG student performing the normal duties of a student, student worker or intern who has been deemed competent to handle those risk factors by the lab supervisor;
- There exists written documentation by the department chair or director that approval has been given and appropriate training provided, per the UNCG Policy on Minors in Research Laboratories, available in the University Policy Manual.

12. Emergency Equipment & Engineering Controls

12.1 Emergency Equipment:

Fire Extinguishers

Fire extinguishers are to be used only by university personnel specifically trained to do so. Training can be requested through UNCG Environmental Health and Safety. Attempt to extinguish a fire only if you are certain it is safe to do so.

Emergency Showers and Eyewashes

All employees who might be exposed to chemical splashes shall be instructed in the location and proper usage of emergency showers and eyewashes. The eyewash should be activated weekly and shall be inspected monthly by laboratory personnel. These inspections shall be in accordance with ANSI Z358.1 and manufacturer's specifications. Inspection records shall be maintained on inspection tags or log sheets kept on or adjacent to the equipment.

12.2 Engineering Controls

Intent - The engineering controls installed in the laboratory are intended to minimize worker exposure to chemical and physical hazards. These controls must be maintained in proper working order for this goal to be realized. Equipment must be inspected regularly to ensure proper function.

Modification – Engineering controls are not to be altered unless testing indicates that worker protection will continue to be adequate.

Improper Function - Improper function of engineering controls must be reported to the Principal Investigator or supervisor immediately. The system shall be taken out of service until proper repairs have been executed.

Usage - All employees shall be trained on and adhere to proper work practices when using the engineering controls.

Fume Hoods

Fume hoods shall be utilized for all chemical procedures which might result in release of hazardous chemical vapors or dust.

The following work practices shall apply to the use of hoods:

- Confirm adequate hood ventilation performance prior to opening chemical containers inside the hood. An inward flow of air can be confirmed by holding a piece of paper at the face of the hood and observing the inward movement of the paper.
- Keep the hood sash closed when not in use. When working in the hood, maintain the sash height as low as possible.
- Storage of chemicals and equipment inside the hood shall be kept to a minimum. Stored items or other obstructions can disrupt the airflow and limit the effectiveness of the hood.
- Leave the hood operating when it is not in active use if hazardous chemicals are contained inside the hood or if it is uncertain whether adequate general laboratory ventilation will be maintained when the hood is non-operational.
- The ventilation system shall be inspected annually. The hood face velocity shall be maintained between 75 and 125 feet per minute. The EH&S Department will conduct inspections annually or as necessary following alterations to the system. Face velocity shall be posted on the hood and a record of each inspection shall be maintained by the EH&S Department.
- The hood shall not be used as a means of disposal for volatile chemicals.
- Prior to the introduction of new chemicals, the adequacy of hood ventilation systems shall be determined by the Principal Investigator or supervisor.

Local Exhaust Ventilation

The following procedures shall apply to the use of local exhaust ventilation:

- Openings of hoods shall be placed as close as possible to sources of the air contaminant.
- Clear the screen on the face of the hood prior to usage.
- After using hoods, operate the fan for an additional period of time sufficient to clear residual contaminants from the duct work.
- Prior to a change in chemicals or procedures, the adequacy of the ventilation system shall be determined by the Principal Investigator.

Glove Boxes and Isolation Rooms

The exhaust air from a glove box or isolation room will pass through scrubbers or other treatment before release into the regular exhaust system.

Cold Rooms and Warms Rooms

Prior to the storage of any temperature sensitive materials, emergency procedures must be developed and documented in the Laboratory Safety Plan to ensure the safety and integrity of the materials in the event of a cold room or warm room failure.

Chemical Storage Cabinets

Storage cabinets for flammable and hazardous chemicals will remain closed and latched except when removing or replacing chemicals.

13. Chemical Spills, Releases, and Incidents

In **EMERGENCY** situations requiring POLICE, FIRE DEPARTMENT, or AMBULANCE services, **CALL UNCG POLICE at 336-334-4444.**

In the event of a chemical spill, release or other accident, UNCG employees will adhere to the procedures outlined in the HazMat response procedures on the UNCG Emergency Management website <http://emg.uncg.edu/>.

Small spills (< 1 L) shall be cleaned immediately by laboratory personnel and/or the lab supervisor. EH&S HAZMAT Response personnel are available at any hour for consultation or assistance with spill clean-up. EH&S HAZMAT Response personnel can be reached at 336-334-4357 or after-hours via campus police at 336-334-4444.

Large spills (> 1 L) or spills of particularly hazardous substances must be reported to the lab supervisor immediately. Spills may be cleaned by trained lab personnel or by contacting EH&S HAZMAT Response personnel for assistance. An incident report must be submitted to the EH&S Department upon the conclusion of the event.

Notify the EH&S Department immediately of any release of:

- Chemicals to the sanitary or storm sewer;
- Hazardous chemical fumes or vapors to unrestricted areas of the building;
- Select carcinogens, reproductive toxins, or highly toxic materials to the environment without appropriate filtration.

Reporting

Incident reports for large spills, releases, and incidents resulting in injury or exposure to personnel must be sent to the EH&S Department as soon as feasible. Personnel are also

encouraged to report near misses and other concerns, which can be made anonymously. Reports can be submitted by:

- Calling EH&S at 336-334-4357
- E-mailing the Laboratory Safety Manager (staff directory at <https://safety.uncg.edu/>)
- Submitting a Spartan Safety Concern (link at <https://safety.uncg.edu/>)

14. Medical Consultations

Opportunity for Medical Attention

An opportunity to receive medical attention is available to all employees who work with hazardous chemicals in the laboratory. The opportunity for medical attention will be made available to employees under the following circumstances:

- Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory,
- Medical surveillance programs will be established where exposure monitoring reveals an exposure level above the action level for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements;
- Whenever an event takes place in the laboratory such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure, the employee will be provided an opportunity for medical consultation for the purpose of determining the need for medical examination.

Seeking Medical Attention

For emergency medical services, call 336-334-4444.

For non-emergency medical attention, students and employees shall report to Gove University Health Center for injuries or hazardous material exposures during normal working hours. If immediate medical attention is needed after-hours, individuals should report to the nearest emergency room or call campus police at 336-334-4444.

Cost

These medical consultations and examinations shall be provided without cost to the employees, without loss of pay, and at a reasonable time and place. The cost of any medical surveillance will be the responsibility of the department. Any injury or illness must be reported in accordance with the UNCG Occupational Injury Reporting Procedures.

15. Laboratory Closure or Relocation

Appropriate security and storage of chemicals and other hazardous materials must be maintained during the closure, relocation or renovation of a laboratory. These procedures and responsibilities are designed to facilitate the relocation or closeout process while keeping the safety of employees, students, contractors, as well as the environment in mind. Lab personnel should contact the EH&S Department, if needed, at least four weeks prior to the date of change.

15.1 Responsibilities

Researcher

- Label all hazardous waste with a UNCG Hazardous Waste Label and request a pickup using Chemical Waste Removal Form. Please allow at least four weeks for complete removal of chemicals.
- Move all wanted equipment, glassware, supplies and any chemical or other materials to their new designated location.
- Request a radiation exit-survey (if applicable) from the EH&S Department. EH&S will remove or deface all radiation warning signs and labels following successful completion of the survey.
- Disinfect all lab surfaces or remaining equipment potentially contaminated with biohazardous material. Consult EH&S or commercial vendor for guidance on disinfection of biosafety cabinets. Remove or deface all biohazard warning signs and labels following disinfection.
- Ensure all equipment, benchtops, shelving, storage cabinets, fume hoods, and other accessible surfaces are free of visible chemical residue. Clean (detergent wipe down) surfaces/equipment as necessary and manage cleaning materials as hazardous waste (if applicable).

EH&S Department

- Collect hazardous waste upon request
- Perform contamination survey(s) upon request.
- Provide guidance on appropriate decontamination/disinfection methods.
- Perform a survey to identify hazardous materials or other hazards upon request from project manager.
- May only communicate with construction managers through the University project managers.
- Relocate and amend Laboratory Hazard Warning Signs as needed.

Project Managers

- Request a hazardous materials survey of building from EH&S Department prior to construction activity.

- Notify contractors of all hazardous materials or conditions present in their work area.
- Keep departments, researchers, and EH&S apprised of construction schedule.
- Cease any work that may present hazardous work conditions until corrected.
- Work with EH&S to remove any hazardous materials found after work has commenced.

15.2 Researcher Precautions/Procedures Prior to Relocation or Closure

Chemicals (Solids, Liquids, Gases)

- Ensure that all containers are securely closed to prevent leaks and free of chemical residue on the exterior surface.
- Ensure all chemical containers are properly labeled with complete chemical name and associated hazards.
- Segregate incompatible materials.
- Identify, label, and properly store all hazardous waste and request removal by EH&S
- Contact the EH&S department for assistance with transport to new location, if desired.
- Commercial vendor arrangements, if used, must be coordinated with University project manager and EH&S. The hazardous materials manifest created by hazardous materials transporter may only be signed by EH&S Department personnel.
- Identify usable chemicals which are in like new condition and offer to EH&S Orphan Chemical Program.
- Arrange to have unwanted cylinders returned to the supplier.
- Remove pressure regulators from wanted cylinders and secure cylinder caps. Use a drum dolly fitted with cylinder straps to transport cylinders.
- Researchers who possess DEA License must notify Greensboro DEA Agency to terminate or amend license, as necessary. Contact EH&S to ensure proper disposal of scheduled drugs.

Biological Materials

- Treat and dispose of all biological waste according to UNCG Biological Safety Policy.
- Ensure that all biological material is adequately sealed and labeled prior to transport.
- Refrigerators, freezers, and other equipment used with biohazardous materials should be emptied and cleaned prior to transport.
- Disinfect all unwanted equipment potentially contaminated with biohazards, prior to transfer to surplus or another lab.
- Disinfect all lab surfaces potentially contaminated with biohazards, prior to departure.

Radioactive Materials

- Notify the Radiation Safety Officer of your intention to relocate or terminate authorization.
- Perform a thorough radiation contamination survey of equipment and laboratory surfaces. Decontaminate and repeat survey until all surfaces are free of removable contamination.

16. Recordkeeping

- Accident reports will be retained indefinitely by the EH&S Department.
- Exposure records for hazardous chemicals and harmful physical agents will be maintained for 30 years per 29 CFR 1910.1020. These records will be forwarded to the EH&S Department by the lab supervisor.
- Medical records for employees exposed to hazardous chemicals and harmful physical agents will be maintained for the duration of employment plus 30 years per 29 CFR 1910.1020.
- Upon the completion of training, records shall be forwarded to the EH&S Department for indefinite storage.

Appendix A: Glove Compatibility Table

Chemical	Natural Rubber	Neoprene Rubber	Nitrile	Vinyl
Acetaldehyde	G	G	E	G
Acetic Acid	E	E	E	E
Acetone	G	G	G	F
Acrylonitrile	P	G	--	F
Ammonium Hydroxide (sat)	G	E	E	E
Aniline	F	G	E	G
Benzaldehyde	F	F	E	G
Benzene ^a	P	F	G	F
Benzyl Chloride ^a	F	P	G	P
Bromine	G	G	--	G
Butane	P	E	--	P
Butyraldehyde	P	G	--	G
Calcium Hypochlorite	P	G	G	G
Carbon Disulfide	P	P	G	F
Carbon Tetrachloride ^a	P	F	G	F
Chlorine	G	G	--	G
Chloroacetone	F	E	--	P
Chloroform ^a	P	F	G	P
Chromic Acid	P	F	F	E
Cyclohexane	F	E	--	P
Dibenzyl Ether	F	G	--	P
Dibutyl Phtalate	F	G	--	P
Diethanolamine	F	E	--	E
Diethyl Ether	F	G	E	P
Dimethyl Sulfoxide ^b	--	--	--	--
Ethyl acetate	F	G	G	F
Ethylene Dichloride ^a	P	F	G	P
Ethylene Glycol	G	G	E	E
Ethylene Trichloride ^a	P	P	--	P
Fluorine	G	G	--	G
Formaldehyde	G	E	E	E
Formic Acid	G	E	E	E
Glycerol	G	G	E	E
Hexane	P	E	--	P
Hydrobromic Acid (40%)	G	E	--	E

Chemical	Natural	Neoprene	Nitrile	Vinyl
Hydrochloric acid (conc)	G	G	G	E
Hydrofluoric Acid (30%)	G	G	G	E
Hydrogen peroxide	G	G	G	E
Iodine	G	G	--	G
Methylamine	G	G	E	E
Methyl Cellosolve	F	E	--	P
MethylChloride ^a	P	E	--	P
Methylethylketone	F	G	G	P
MethyleneChloride ^a	F	F	G	F
Monoethanolamine	F	E	--	E
Morpholine	F	E	--	E
Napthalene ^a	G	G	E	G
NitricAcid(conc)	P	P	P	G
PerchloricAcid	F	G	F	E
Phenol	G	E	--	E
PhosphoricAcid	G	E	--	E
PotassiumHydroxide(sat)	G	G	G	E
PropyleneDichloride ^a	P	F	--	P
SodiumHydroxide	G	F	G	E
SodiumHypochlorite	G	P	F	G
SulfuricAcid(conc)	G	G	F	G
Toluene ^a	P	F	G	F
Trichloroethylene ^a	P	F	G	F
TricresylPhosphate	P	F	--	F
Triethanolamine	F	E	E	E
Trinitrotoluene	P	E	--	P

E = excellent G = Good F = Fair P = Poor

- a Aromatic and halogenated hydrocarbons will attack all types of natural and synthetic glovematerials. Should swelling occur, the user should change to fresh gloves and allow the swollen gloves to dry and return to normal.
- b No data on the resistance to dimethyl sulfoxide of natural rubber neoprene, nitrile rubber, or vinyl materials are available; the manufacturer of the substance recommends the use of butyl rubber gloves.

Appendix B: Lab-Specific Training Form

Lab-Specific Training

All lab members must be trained annually on the specific hazards present in their laboratory and the associated safety precautions. General laboratory safety training can be completed through universal department or university presentations. Lab-specific training topics must be presented by the principal investigator or a senior laboratory supervisor.

Training presented by the Principal Investigator (PI) or Lab Supervisor:

General Laboratory Safety (may be fulfilled by universal safety training):

- Location of UNCG Chemical Hygiene Plan (<https://safety.uncg.edu/LaboratorySafety.html>)
- Hazard Communication Program Information (signs, labels, symbols)
- Storage, use, and disposal procedures for general chemical classifications
- Physical hazards and signs/symptoms of exposure to general chemical classifications
- Precautions to mitigate hazard exposure
- Response to spills, incidents, and emergencies
- Security considerations

Lab-Specific Topics (presented by PI or Lab Supervisor):

- Location and contents of the Lab Safety Plan
- Location of Chemical Inventory & Safety Data Sheets (SDS)
- Identify high hazard and restricted materials, equipment, or areas of the lab
- Use of particularly hazardous substances. Specify personnel and materials (Select Carcinogens, Reproductive Toxins, High Acute Toxicity, Nanomaterials, etc.):

- Other lab hazards/procedures, specify: _____

See next page for signatures of trainer and trainees

Lab-Specific Training

By signing below, I confirm that I have received training and understand the hazards and procedures checked on page 1.

Name (Please print)

Signature

Date

_____	_____	_____
_____	_____	_____
_____	_____	_____
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_____	_____	_____
_____	_____	_____

Trainer:

PI / Lab Supervisor

File this form in your Laboratory Safety Plan binder to document training.

Appendix C: SOP Template for Hazardous Materials or Procedures

Standard Operating Procedure

For work with: enter chemical name, category, or process		
PI / Lab Director:		Date:
Building & Room(s):		
Chemical Name(s)	CAS #	Qty

Process Description (Describe the operations, quantities, concentrations, etc.)

Risk Assessment (list physical and health hazards and symptoms):

Designated Use Area(s):

Hazard Control:

Personal Protective Equipment (PPE):

Engineering Controls:

Administrative and Work Practice Controls:

Special Handling / Storage Requirements: Ex.: Always wash hands and arms immediately after working with these materials. Assure that at least 2 people are present at all times if a compound in use is highly toxic or of unknown toxicity. Store breakable containers of these substances in chemically resistant trays; also work and mount apparatus above such trays or cover work and storage surfaces with removable, absorbent, plastic backed paper.

Waste (describe waste collection and disposal procedures):

Emergency Procedures: personnel decontamination, when to seek medical attention, reporting to supervisor or EH&S, cleanup/decon for small or large spills, etc...

Step By Step Operating Procedure (if applicable):

All personnel working with these materials shall read and adhere to this SOP

Appendix D: Chemicals Requiring Initial Monitoring

If your lab uses any of the following chemicals, initial monitoring is required. Contact the UNCG EH&S Department for more information.

Acrylonitrile

Arsenic (Inorganic)

Asbestos

Benzene

Cadmium

Chromium (Inorganic)

Creosote

Crystalline Silica

1, 2 Dibromo- 3- chloropropane

Isocyanates

Ethylene Oxide

Formaldehyde

Lead

Mercury (Inorganic)

4,4'-Methylene bis (2-chloroaniline)

Methylene Dianiline

Methylene Chloride

Vinyl Chloride

Appendix E: Department of Homeland Security Chemicals of Interest

Department of Homeland Security Chemicals of Interest

Chemical	Synonym	CAS#
Acetaldehyde		75-07-0
Acetone cyanohydrin, stabilized		75-86-5
Acetyl bromide		506-96-7
Acetyl chloride		75-36-5
Acetyl iodide		507-02-8
Acetylene	[Ethyne]	74-86-2
Acrolein	[2-Propenal] or Acrylaldehyde	107-02-8
Acrylonitrile	[2-Propenenitrile]	107-13-1
Acrylyl chloride	[2-Propenoyl chloride]	814-68-6
Allyl alcohol	[2-Propen-1-ol]	107-18-6
Allylamine	[2-Propen-1-amine]	107-11-9
Allyltrichlorosilane, stabilized		107-37-9
Aluminum (powder)		7429-90-5
Aluminum bromide, anhydrous		7727-15-3
Aluminum chloride, anhydrous		7446-70-0
Aluminum phosphide		20859-73-8
Ammonia (anhydrous)		7664-41-7
Ammonia (conc. 20% or greater)		7664-41-7
Ammonium nitrate, [with more than 0.2 percent combustible substances, including any organic substance calculated as carbon, to the exclusion of any other added substance]		6484-52-2
Ammonium nitrate, solid [nitrogen concentration of 23% nitrogen or greater]		6484-52-2
Ammonium perchlorate		7790-98-9
Ammonium picrate		131-74-8
Amyltrichlorosilane		107-72-2
Antimony pentafluoride		7783-70-2
Arsenic trichloride	[Arsenous trichloride]	7784-34-1
Arsine		7784-42-1
Barium azide		18810-58-7
1,4-Bis(2-chloroethylthio)-n-butane		142868-93-7
Bis(2-chloroethylthio)methane		63869-13-6
Bis(2-chloroethylthiomethyl)ether		63918-90-1
1,5-Bis(2-chloroethylthio)-n-pentane		142868-94-8
1,3-Bis(2-chloroethylthio)-n-propane		63905-10-2
Boron tribromide		10294-33-4
Boron trichloride	[Borane, trichloro]	10294-34-5
Boron trifluoride	[Borane, trifluoro]	7637-07-2

Boron trifluoride compound with methyl ether(1:1)	[Boron, trifluoro [oxybis (methane)],T-4-]	353-42-4
Bromine		7726-95-6
Bromine chloride		13863-41-7
Bromine pentafluoride		7789-30-2
Bromine trifluoride		7787-71-5
Bromotrifluorethylene	[Ethene, bromotrifluoro-]	598-73-2
1,3-Butadiene		106-99-0
Butane		106-97-8
Butene		25167-67-3
1-Butene		106-98-9
2-Butene		107-01-7
2-Butene-cis		590-18-1
2-Butene-trans	[2-Butene, (E)]	624-64-6
Butyltrichlorosilane		7521-80-4
Calcium hydrosulfite	[Calcium dithionite]	15512-36-4
Calcium phosphide		1305-99-3
Carbon disulfide		75-15-0
Carbon oxysulfide	[Carbon oxide sulfide (COS); carbonyl sulfide]	463-58-1
Carbonyl fluoride		353-50-4
Carbonyl sulfide		463-58-1
Chlorine		7782-50-5
Chlorine dioxide	[Chlorine oxide, (ClO ₂)]	10049-04-4
Chlorine monoxide	[Chlorine oxide]	7791-21-1
Chlorine pentafluoride		13637-63-3
Chlorine trifluoride		7790-91-2
Chloroacetyl chloride		79-04-9
2-Chloroethylchloro-methylsulfide		2625-76-5
Chloroform	[Methane, trichloro-]	67-66-3
Chloromethyl ether	[Methane, oxybis(chloro-)]	542-88-1
Chloromethyl methyl ether	[Methane, chloromethoxy-]	107-30-2
1-Chloropropylene	[1-Propene, 1-chloro-]	590-21-6
2-Chloropropylene	[1-Propene, 2-chloro-]	557-98-2
Chlorosarin	[o-Isopropyl methylphosphonochloridate]	1445-76-7
Chlorosoman	[o-Pinacolyl methylphosphonochloridate]	7040-57-5
Chlorosulfonic acid		7790-94-5
Chromium oxychloride		14977-61-8
Crotonaldehyde	[2-Butenal]	4170-30-3
Crotonaldehyde, (E)-	[2-Butenal], (E)-]	123-73-9
Cyanogen	[Ethanedinitrile]	460-19-5

Cyanogen chloride		506-77-4
Cyclohexylamine	[Cyclohexanamine]	108-91-8
Cyclohexyltrichlorosilane		98-12-4
Cyclopropane		75-19-4
DF	Methyl phosphonyl difluoride	676-99-3
Diazodinitrophenol		87-31-0
Diborane		19287-45-7
Dichlorosilane	[Silane, dichloro-]	4109-96-0
N,N-(2-diethylamino)ethanethiol		100-38-9
Diethyldichlorosilane		1719-53-5
o,o-Diethyl S-[2-(diethylamino)ethyl] phosphorothiolate		78-53-5
Diethyleneglycol dinitrate		693-21-0
Diethyl methylphosphonite		15715-41-0
N,N-Diethyl phosphoramidic dichloride		1498-54-0
N,N-(2-diisopropylamino)ethanethiol	N,N-diisopropyl-(beta)-aminoethane thiol	5842-07-9
Difluoroethane	[Ethane, 1,1-difluoro-]	75-37-6
N,N-Diisopropyl phosphoramidic dichloride		23306-80-1
1,1-Dimethylhydrazine	[Hydrazine, 1, 1-dimethyl-]	57-14-7
Dimethylamine	[Methanamine, N-methyl-]	124-40-3
N,N-(2-dimethylamino)ethanethiol		108-02-1
Dimethyldichlorosilane	[Silane, dichlorodimethyl-]	75-78-5
N,N-Dimethyl phosphoramidic dichloride	[Dimethylphosphoramido-dichloridate]	677-43-0
2,2-Dimethylpropane	[Propane, 2,2-dimethyl-]	463-82-1
Dingu	[Dinitroglycoluril]	55510-04-8
Dinitrogen tetroxide		10544-72-6
Dinitrophenol		25550-58-7
Dinitroresorcinol		519-44-8
Diphenyldichlorosilane		80-10-4
Dipicryl sulfide		2217-06-3
Dipicrylamine [or] Hexyl	[Hexanitrodiphenylamine]	131-73-7
N,N-(2-dipropylamino)ethanethiol		5842-06-8
N,N-Dipropyl phosphoramidic dichloride		40881-98-9
Dodecyltrichlorosilane		4484-72-4
Epichlorohydrin	[Oxirane, (chloromethyl)-]	106-89-8
Ethane		74-84-0
Ethyl acetylene	[1-Butyne]	107-00-6
Ethyl chloride	[Ethane, chloro-]	75-00-3
Ethyl ether	[Ethane, 1,1-oxybis-]	60-29-7
Ethyl mercaptan	[Ethanethiol]	75-08-1

Ethyl nitrite	[Nitrous acid, ethyl ester]	109-95-5
Ethyl phosphonyl difluoride		753-98-0
Ethylamine	[Ethanamine]	75-04-7
Ethyldiethanolamine		139-87-7
Ethylene	[Ethene]	74-85-1
Ethylene oxide	[Oxirane]	75-21-8
Ethylenediamine	[1,2-Ethanediamine]	107-15-3
Ethyleneimine	[Aziridine]	151-56-4
Ethylphosphonothioic dichloride		993-43-1
Ethyltrichlorosilane		115-21-9
Fluorine		7782-41-4
Fluorosulfonic acid		7789-21-1
Formaldehyde (solution)		50-00-0
Furan		110-00-9
Germane		7782-65-2
Germanium tetrafluoride		7783-58-6
Guanyl nitrosaminoguanylidene hydrazine		
Hexaethyl tetraphosphate and compressed gas mixtures		757-58-4
Hexafluoroacetone		684-16-2
Hexanitrostilbene		20062-22-0
Hexolite	[Hexotol]	121-82-4
Hexyltrichlorosilane		928-65-4
HMX	[Cyclotetramethylene-tetranitramine]	2691-41-0
HN1 (nitrogen mustard-1)	[Bis(2-chloroethyl)ethylamine]	538-07-8
HN2 (nitrogen mustard-2)	[Bis(2-chloroethyl)methylamine]	51-75-2
HN3 (nitrogen mustard-3)	[Tris(2-chloroethyl)amine]	555-77-1
Hydrazine		302-01-2
Hydrochloric acid (conc. 37% or greater)		7647-01-0
Hydrocyanic acid		74-90-8
Hydrofluoric acid (conc. 50% or greater)		7664-39-3
Hydrogen		1333-74-0
Hydrogen bromide (anhydrous)		10035-10-6
Hydrogen chloride (anhydrous)		7647-01-0
Hydrogen cyanide	[Hydrocyanic acid]	74-90-8
Hydrogen fluoride (anhydrous)		7664-39-3
Hydrogen iodide, anhydrous		10034-85-2
Hydrogen peroxide (concentration of at least 35%)		7722-84-1
Hydrogen selenide		7783-07-5
Hydrogen sulfide		7783-06-4
Iodine pentafluoride		7783-66-6
Iron, pentacarbonyl-	[Iron carbonyl (Fe (CO) ₅), (TB5-11)-]	13463-40-6

Isobutane	[Propane, 2-methyl]	75-28-5
Isobutyronitrile	[Propanenitrile, 2-methyl-]	78-82-0
Isopentane	[Butane, 2-methyl-]	78-78-4
Isoprene	[1,3-Butadiene, 2-methyl-]	78-79-5
Isopropyl chloride	[Propane, 2-chloro-]	75-29-6
Isopropyl chloroformate	[Carbonochloridic acid, 1-methylethyl ester]	108-23-6
Isopropylamine	[2-Propanamine]	75-31-0
Isopropylphosphonothioic dichloride		1498-60-8
Isopropylphosphonyl difluoride		677-42-9
Lead azide		13424-46-9
Lead styphnate	[Lead trinitroresorcinate]	15245-44-0
Lewisite 1	[2-Chlorovinyl]dichloroarsine]	541-25-3
Lewisite 2	[Bis(2-chlorovinyl)chloroarsine]	40334-69-8
Lewisite 3	[Tris(2-chlorovinyl)arsine]	40334-70-1
Lithium amide		7782-89-0
Lithium nitride		26134-62-3
Magnesium (powder)		7439-95-4
Magnesium diamide		7803-54-5
Magnesium phosphide		12057-74-8
MDEA	[Methyldiethanolamine]	105-59-9
Mercury fulminate		628-86-4
Methacrylonitrile	[2-Propenenitrile, 2-methyl-]	126-98-7
Methane		74-82-8
2-Methyl-1-butene		563-46-2
3-Methyl-1-butene		563-45-1
Methyl chloride	[Methane, chloro-]	74-87-3
Methyl chloroformate	[Carbonochloridic acid, methyl ester]	79-22-1
Methyl ether	[Methane, oxybis-]	115-10-6
Methyl formate	[Formic acid Methyl ester]	107-31-3
Methyl hydrazine	[Hydrazine, methyl-]	60-34-4
Methyl isocyanate	[Methane, isocyanato-]	624-83-9
Methyl mercaptan	[Methanethiol]	74-93-1
Methyl thiocyanate	[Thiocyanic acid, methyl ester]	556-64-9
Methylamine	[Methanamine]	74-89-5
Methylchlorosilane		993-00-0
Methyldichlorosilane		75-54-7
Methylphenyldichlorosilane		149-74-6
Methylphosphonothioic dichloride		676-98-2
2-Methylpropene	[1-Propene, 2-methyl-]	115-11-7
Methyltrichlorosilane	[Silane, trichloromethyl-]	75-79-6
Sulfur mustard (Mustard gas (H))	[Bis(2-chloroethyl)sulfide]	505-60-2
O-Mustard (T)	[Bis(2-chloroethylthioethyl)ether]	63918-89-8

Nickel Carbonyl		13463-39-3
Nitric acid		7697-37-2
Nitric oxide	[Nitrogen oxide (NO)]	10102-43-9
Nitrobenzene		98-95-3
5-Nitrobenzotriazol		2338-12-7
Nitrocellulose		9004-70-0
Nitrogen mustard hydrochloride	[Bis(2-chloroethyl)methylamine hydrochloride]	55-86-7
Nitrogen trioxide		10544-73-7
Nitroglycerine		55-63-0
Nitromannite	[Mannitol hexanitrate, wetted]	15825-70-4
Nitromethane		75-52-5
Nitrostarch		9056-38-6
Nitrosyl chloride		2696-92-6
Nitrotriazolone		932-64-9
Nonyltrichlorosilane		5283-67-0
Octadecyltrichlorosilane		112-04-9
Octolite		57607-37-1
Octonal		78413-87-3
Octyltrichlorosilane		5283-66-9
Oleum (Fuming Sulfuric acid)	[Sulfuric acid, mixture with sulfur trioxide]	8014-95-7
Oxygen difluoride		7783-41-7
1,3-Pentadiene		504-60-9
Pentane		109-66-0
1- Pentene		109-67-1
2-Pentene, (E)-		646-04-8
2-Pentene, (Z)-		627-20-3
Pentolite		8066-33-9
Peracetic acid	[Ethaneperoxic acid]	79-21-0
Perchloromethylmercaptan	[Methanesulfenyl chloride, trichloro-]	594-42-3
Perchloryl fluoride		7616-94-6
PETN	[Pentaerythritol tetranitrate]	78-11-5
Phenyltrichlorosilane		98-13-5
Phosgene	[Carbonic dichloride] or [carbonyldichloride]	75-44-5
Phosphine		7803-51-2
Phosphorus		7723-14-0
Phosphorus oxychloride	[Phosphoryl chloride]	10025-87-3
Phosphorus pentabromide		7789-69-7
Phosphorus pentachloride		10026-13-8
Phosphorus pentasulfide		1314-80-3
Phosphorus trichloride		7719-12-2

Picrite	[Nitroguanidine]	556-88-7
Piperidine		110-89-4
Potassium chlorate		3811-04-9
Potassium cyanide		151-50-8
Potassium nitrate		7757-79-1
Potassium perchlorate		7778-74-7
Potassium permanganate		7722-64-7
Potassium phosphide		20770-41-6
Propadiene	[1,2-Propadiene]	463-49-0
Propane		74-98-6
Propionitrile	[Propanenitrile]	107-12-0
Propyl chloroformate	[Carbonchloridic acid, propylester]	109-61-5
Propylene	[1-Propene]	115-07-1
Propylene oxide	[Oxirane, methyl-]	75-56-9
Propyleneimine	[Aziridine, 2-methyl-]	75-55-8
Propylphosphonothioic dichloride		2524-01-8
Propylphosphonyl difluoride		690-14-2
Propyltrichlorosilane		141-57-1
Propyne	[1-Propyne]	74-99-7
QL	[o-Ethyl-o-2-diisopropylaminoethyl methylphosphonite]	57856-11-8
RDX	[Cyclotrimethylenetrinitramine]	121-82-4
RDX and HMX mixtures		121-82-4
Sarin	[o-Isopropyl methylphosphonofluoridate]	107-44-8
Selenium hexafluoride		7783-79-1
Sesquimustard	[1,2-Bis(2-chloroethylthio)ethane]	3563-36-8
Silane		7803-62-5
Silicon tetrachloride		10026-04-7
Silicon tetrafluoride		7783-61-1
Sodium azide		26628-22-8
Sodium chlorate		7775-09-9
Sodium cyanide		143-33-9
Sodium hydrosulfite	[Sodium dithionite]	7775-14-6
Sodium nitrate		7631-99-4
Sodium phosphide		12058-85-4
Soman	[o-Pinacolyl methylphosphonofluoridate]	96-64-0
Stibine		7803-52-3
Strontium phosphide		12504-16-4
Sulfur dioxide (anhydrous)		7446-09-5
Sulfur tetrafluoride	[Sulfur fluoride (SF ₄), (T-4)-]	7783-60-0
Sulfur trioxide		7446-11-9

Sulfuryl chloride		7791-25-5
Tabun	[o-Ethyl-N,N-dimethylphosphoramido-cyanidate]	77-81-6
Tellurium hexafluoride		7783-80-4
Tetrafluoroethylene	[Ethene, tetrafluoro-]	116-14-3
Tetramethyllead	[Plumbane, tetramethyl-]	75-74-1
Tetramethylsilane	[Silane, tetramethyl-]	75-76-3
Tetranitroaniline		53014-37-2
Tetranitromethane	[Methane, tetranitro-]	509-14-8
Tetrazene	[Guanyl nitrosaminoguanilyltetrazene]	109-27-3
1H-Tetrazole		288-94-8
Thiodiglycol	[Bis(2-hydroxyethyl)sulfide]	111-48-8
Thionyl chloride		7719-09-7
Titanium tetrachloride	[Titanium chloride (TiCl ₄) (T-4)-]	7550-45-0
TNT	[Trinitrotoluene]	118-96-7
Torpex	[Hexotonal]	67713-16-0
Trichlorosilane	[Silane, trichloro-]	10025-78-2
Triethanolamine		102-71-6
Triethanolamine hydrochloride		637-39-8
Triethyl phosphite		122-52-1
Trifluoroacetyl chloride		354-32-5
Trifluorochloroethylene	[Ethene, chlorotrifluoro]	79-38-9
Trimethylamine	[Methanamine, N,N-dimethyl-]	75-50-3
Trimethylchlorosilane	[Silane, chlorotrimethyl-]	75-77-4
Trimethyl phosphite		121-45-9
Trinitroaniline		26952-42-1
Trinitroanisole		606-35-9
Trinitrobenzene		99-35-4
Trinitrobenzenesulfonic acid		2508-19-2
Trinitrobenzoic acid		129-66-8
Trinitrochlorobenzene		88-88-0
Trinitrofluorenone		129-79-3
Trinitro-meta-cresol		602-99-3
Trinitronaphthalene		55810-17-8
Trinitrophenetole		4732-14-3
Trinitrophenol		88-89-1
Trinitroresorcinol		82-71-3
Tritonal		54413-15-9
Tungsten hexafluoride		7783-82-6
Vinyl acetate monomer	[Acetic acid ethenyl ester]	108-05-4
Vinyl acetylene	[1-Buten-3-yne]	689-97-4
Vinyl chloride	[Ethene, chloro-]	75-01-4
Vinyl ethyl ether	[Ethene, ethoxy-]	109-92-2

Vinyl fluoride	[Ethene, fluoro-]	75-02-5
Vinyl methyl ether	[Ethene, methoxy-]	107-25-5
Vinylidene chloride	[Ethene, 1,1-dichloro-]	75-35-4
Vinylidene fluoride	[Ethene, 1,1-difluoro-]	75-38-7
Vinyltrichlorosilane		75-94-5
VX	[o-Ethyl-S-2-diisopropylaminoethyl methyl phosphonothiolate]	50782-69-9
Zinc hydrosulfite	[Zinc dithionite]	7779-86-4