BIOLOGICAL SAFETY
AND
CHEMICAL HYGIENE PLAN

School of Biological Sciences

July 2015

UNIVERSITY OF NORTHERN COLORADO

Please note that the authors of this plan have taken the liberty of using materials from OSHA and the Chemical Hygiene Plans posted by other Universities and Colleges. We appreciate the use of these materials.

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EMERGENCY CONTACTS

Campus Emergency 911

School Director
Dr. Susan M. Keenan 970.351.2510
Main Office 970.351.2921

School Chemical Hygiene Officer (CHO)
Dr. Mark Thomas 970.351.2329

Chemical Stockroom
Mr. Frank Skufca, Lab Manager 970.351.2469

Environmental Health and Safety
Mr. Glenn Adams, Director 970.351.1149

Poison Control Center ..... (800)222.1222

Radiation Safety Officer
Dr. Cynthia Galovich 973.351.2079

Campus Police (non-emergency) 970.351.2245

PREAMBLE

The Culture of Laboratory Safety

As a result of the promulgation of the Occupational Safety and Health Administration (OSHA) Laboratory Standard (29 CFR § 1910.1450), a culture of safety consciousness, accountability, organization, and education has developed in industrial, governmental, and academic laboratories.

Laboratory personnel realize that the welfare and safety of each individual depends on clearly defined attitudes of teamwork and personal responsibility and that laboratory safety is not simply a matter of materials and equipment but also of processes and behaviors. Learning to participate in this culture of habitual risk assessment, experiment planning, and consideration of worst-case possibilities—for oneself and one's fellow workers—is as much part of a scientific education as learning the theoretical background of experiments or the step-by-step protocols for doing them in a professional manner.

A crucial component of biological education at every level is to nurture basic attitudes and habits of prudent behavior so that safety is a valued and inseparable part of all laboratory activities. In this way, a culture of laboratory safety becomes an internalized attitude, not just an external expectation driven by institutional rules. This process must be included in each person's chemical education throughout his or her scientific career.

Responsibility and Accountability for Laboratory Safety

Ensuring a safe laboratory environment is the combined responsibility of laboratory personnel, Environmental Health and Safety (EHS) personnel, and the School Safety Committee, though the primary responsibility lies with the individual performing the work. Of course, federal, state, and local laws and regulations make safety in the laboratory a legal requirement and an economic necessity. Laboratory safety requires mandatory safety rules and programs and an ongoing commitment to them. Direct responsibility for the management, implementation, and operation of the School's laboratory safety program rests with the chemical hygiene officer (CHO) and the safety committee; responsibility for working safely, however, lies with faculty, students and others who actually do the work.

A person from the School's Safety Committee is recommended to the School Director for the role of Chemical Hygiene Officer (CHO). The CHO must serve a minimum of two years in the role in order to learn the duties and responsibilities of the position. No term limits on the position exist and continued service in the role is at the discretion of the School Director. The choice to begin or continue the service of a particular CHO should not be taken lightly as the CHO represents and ensures the maintenance of safety within the School.

Laboratory instructors, coordinators, research mentors and teaching assistants carry direct responsibility for safety of the students in the laboratory. They are responsible for promoting a culture of safety as well as for teaching the requisite skills needed to handle biological hazards and chemicals safely.

Should laboratory instructors, coordinators, research mentors or teaching assistants not adhere to the safety practices outlined in this plan, they will be asked to correct those practices by the CHO and/or School Director. Should that not correct the issue, it is the responsibility of the CHO, School Director and Director of EHS to collectively determine the penalty. That penalty can range from recording the issue in annual reviews (at a minimum) to being banned from the use of laboratory facilities.

INTRODUCTION

This document describes the Biological Safety and Chemical Hygiene Plan for the School of Biological Sciences at the University of Northern Colorado as required by OSHA's Occupational Exposure to Hazardous Chemicals in Laboratories Standard. 29CFR1910.1450.

In order to comply with the Standard the School of Biological Sciences at the University of Northern Colorado has established a plan to ensure our workplace is capable of protecting employees from Health Hazards associated with Hazardous Chemicals in the laboratory, and capable of keeping exposures below the Permissible Exposure Limits (PEL) specified in 29CFR1910 Subpart Z. Questions regarding this plan should be directed to

Susan M. Keenan, PhD
Director and Professor
School of Biological Sciences

Ross Hall 2480, Phone 970.351.2510; email: susan.keenan@unco.edu

This plan is made readily available to the faculty and students of the School of Biological Sciences at the University of Northern Colorado, employee representatives & upon request by the Assistant Secretary for the Occupational Safety & Health Administration.

A review and evaluation of this program is conducted on an annual basis and updated as necessary.

INTRODUCTION TO THE BIOLOGICAL SAFETY AND CHEMICAL HYGIENE PLAN

Safety should always be of the utmost concern for anyone working in the laboratory. The safety policies contained in this Plan are written in accordance with the School of Biological Science's commitment to safety.

For teaching laboratories, the laboratory instructor needs to be cognizant of what is considered to be an unsafe action or whether policy is being adhered to, and he or she has the authority to require a student to leave the laboratory. Each student in a lab is required to complete a basic consent form (see appendix B) which must be kept for a minimum of three (3) years.

If appropriate, the laboratory instructor may pursue further disciplinary action. If there is a dispute on the action taken by the laboratory instructor, the student may appeal the decision to the laboratory coordinator (defined here as the faculty member in charge of all sections of that laboratory course).

A student researcher who does not follow the policies in this manual is subject to disciplinary action by the student researcher's primary advisor. Principal investigator(s) (PIs) for each research laboratory should review the policies in this document and append the specific requirements for the appropriate research laboratory. The PI of each research laboratory should prepare Standard Operating Procedures (SOPs) for all laboratory procedures not covered in this general plan. Copies of the SOPs should be available within each research lab.

It is the responsibility of any person in the laboratory to notify the proper authority in the appropriate hierarchical order, first the laboratory instructor, then the laboratory coordinator or the research advisor, and finally the School Director, Dr. Susan Keenan (susan.keenan@unco.edu; 970.351.251) if unsafe laboratory conditions exist or if a possible safety concern is present. This statement will be inserted into all syllabi with the laboratory coordinator's name.

LABORATORY USE

Laboratories at UNC have two primary functions: teaching and research. Undergraduate students are permitted in teaching laboratories only when there is direct or indirect supervision. When teaching laboratories are not in use, the doors to the laboratory must be locked. When a teaching laboratory is in use, all corridor entrance doors to the laboratory must be unlocked to give full access to the room.

Research laboratories should never be left unlocked when unattended for any period of time. Undergraduate researchers can only work in a research lab when approved to work unsupervised by the lab PI. When students are using a research laboratory, they must let another person know when they are going to be in a research laboratory alone.

GENERAL LAB SAFETY

Basic Rules and Procedures

1. Proper care of equipment and working areas is the first step in safety. A neat and orderly working area promotes safety.
2. Always use common sense in the lab. If you are unsure of yourself or your equipment or if you do not understand something, do not proceed with your experiment. Consult with the instructor or lab supervisor.
3. Eye Protection shall be worn as appropriate by all employees, students & visitors, at all times in laboratory rooms and in the stockroom.
4. No eating, drinking or smoking is permitted in the laboratory areas. No foodstuffs or beverages will be stored in the laboratory area or the laboratory refrigerators or freezers.
5. Lab coats/aprons will be worn when deemed appropriate by supervisors. Laboratory coats should be cleaned immediately upon significant contamination.
6. Appropriate gloves will be available at all times.
7. Long hair must be kept tightly in place. Hair and loose clothing catch fire very easily.
8. Only those biological materials or chemicals for which the ventilation system is adequate shall be used in a laboratory.
9. The use of excess chemicals will be avoided whenever possible.
10. No chemical is to be tasted or inhaled deeply. Any apparatus that may discharge toxic chemicals must be vented into a hood.
11. Laboratory personnel will inspect equipment for cracks, frayed cords, etc. before use in an experiment.
12. Equipment will only be used for designed purpose. If an apparatus should fail, a large warning sign will be placed on the equipment and a repair order submitted.
13. All glassware will be inspected before use. No damaged glassware (internal cracks, stars, blisters) will be used. All chipped and cracked glassware are to be fire-polished before use. Proper safety techniques will be followed for insertion of glass tubing or thermometers through stoppers and corks.
14. Ventilation hoods will be checked at the beginning of each day when the laboratories are in use.
15. All hoods (fume and biosafety) will be checked annually by EHS. Laboratory hoods will remain on whenever chemicals with toxic vapors are present in the hood. Hood doors should be lowered when not being actively used. Do not block vents or airflow with stored material.
16. When exiting laboratory, all areas of exposed skin should be washed, especially the hands and forearms if they were unprotected.
17. No horseplay of any type is allowed in the laboratory.
18. No mouth pipetting is permitted in the laboratory.
19. Gases and vapors presenting fire or health hazards must be vented into a hood.
20. Always add acid to water and not vice versa. When a drop of water is put into some concentrated acids, the heat evolved is sufficient to change the water into steam and spattering occurs. Therefore, never pour water into acids.

Personal Hygiene

Everyone working in a chemical laboratory should be aware of the dangers of ingesting or absorbing chemicals. These common sense precautions will minimize the possibility of such exposure:

a. Do not bring or consume food or beverages in any laboratory.
b. Do not smoke, use smokeless tobacco, or chew gum in any laboratory.
c. Do not apply cosmetics when in the laboratory.
d. Wash hands thoroughly before leaving the laboratory.
e. Wash hands thoroughly after removing gloves.
f. Do not leave a laboratory or use instruments with gloves on. Gloves should always be removed and discarded in the trash can before leaving a laboratory or before using instruments that will be handled by people that will not be wearing gloves.
g. Wash lab coats or jackets separately from personal laundry.
h. Never wear or take lab coats or jackets into areas where food is consumed.
i. Never pipet by mouth; always use a pipet aid, suction bulb or thumb roller

General Laboratory Upkeep

Cleanliness leads to a safer and more efficient work environment. For example, laboratory drawers should be closed when not in use for they can pose a potential hazard for others who enter the lab. All laboratory equipment must be used in accordance to the manufacture's specifications. When finished using a piece of equipment, it should be returned in the same condition in which it was found, making sure that no safety concerns are present. Chemicals must be returned to their appropriate storage location immediately after use.

Cleaning Glassware

Dirty glassware should never be allowed to accumulate in large quantities in any laboratory. It should be cleaned daily at the very least. Glassware should be cleaned with warm water and soap or detergent. Cleaned glassware should be dried on a drying rack, or oven if appropriate for the particular laboratory. Once dried, the glassware should be stored in its proper location; the drying rack is not a storage location.

Broken Glassware

If glassware is broken in a teaching laboratory, the laboratory instructor should be notified immediately. If a chemical spill has occurred as well, see the appropriate section in this manual for handling spills. Once chemicals have been dealt with appropriately, the broken pieces should be collected using a broom and dustpan and disposed of in a broken glass disposal box. DO NOT DISPOSE OF BROKEN GLASS IN THE REGULAR TRASH! When the broken glass disposal box is full, it should be securely taped and labeled as trash for the custodial services to pick up.

Instruments and Equipment

Before using any instrument or equipment in a research laboratory or a teaching laboratory, the student or researcher must be properly trained by a qualified graduate student, faculty

member, or the Lab Manager. Failure to seek proper authorization may result in dismissal from the laboratory and loss of the privilege to use instrumentation and equipment.

Training from Chad Wangeline or Ken Cochran is required **prior to the use of all equipment in the Imaging Suite**, Ross 1680. Please contact Ken or Chad directly at 970.351.2381 or 970.351.1096 respectively. There are no exceptions to this rule and failure to seek proper authorization may result in loss of the privilege to use instrumentation and equipment. The doors to the Imaging Suites are not to be propped open and only the person to whom swipe access has been provided should swipe into a room.

Wiring on electrical equipment should be examined to ensure that no exposed wires or possible dangerous condition exists. Any equipment that has potentially dangerous wiring should not be used. Use equipment only in accordance with manufacturer's specifications. When using equipment that emits heat, be sure no combustible material is near.

Do not leave equipment unattended when in use; the operator or another person should always be in the laboratory. If equipment must be left unattended for a period, check the equipment periodically. If applicable, let another person know that equipment is being left unattended so that he or she can monitor it.

Refrigerators, freezers and microwaves in laboratories are for chemicals, never for food and must be labeled to reflect this policy. Volatile solvents requiring refrigeration must be stored in explosion-proof refrigerators.

Compressed Gases

Compressed gases have the potential to be very dangerous missiles if handled improperly. All cylinders, regardless of size, must be restrained at all times using straps, chains or in the case of lecture bottles, a stand. Protective caps (shipping caps) must be properly installed on compressed gas cylinders at all times when not in use. If a cylinder must be moved, the protective cap must be secured in place over the valve. Transport of that cylinder, unless it is a lecture bottle, requires the appropriate use of a cylinder cart with the cylinder strapped in place.

All cylinder valves must be tightly closed when not in use. Any regulator must not be left under pressure when the gas is not being used. As with all work in the laboratories, appropriate PPE must be worn when working with compressed gases.

Dry Ice and Liquid Nitrogen (LN_2)

Liquid nitrogen is an asphyxiant and a cryogen and must be handled carefully. Persons who use LN_2 must be trained before dispensing and using it. LN_2 can cause tissue damage by contact, and boil-off or a spill can cause asphyxiation. Should LN_2 be needed for an experiment or demonstration off-campus, any person handling it MUST be trained in its safe use and transport. The School Safety Committee will verify all training before any LN_2 is dispensed for use off-campus. Under no circumstances should LN_2 be transported within a closed vehicle.

Although not a cryogen, solid carbon dioxide or dry ice which converts directly to carbon dioxide gas at −78°C (−109°F) is also often used in laboratories. Shipments packed with dry ice, samples preserved with liquid nitrogen, and in some cases, techniques that use cryogenic liquids, such as cryogenic grinding of samples, present potential hazards in the laboratory. Cold contact burns, asphyxiation and pressure or chemical explosion are all potential issues

Whenever handling or transferring cryogenic fluids might result in exposure to the cold liquid, boil-off gas, or surface, protective clothing must be worn, which includes face shield or safety goggles, cryogenic gloves and long-sleeved shirts, lab coats, aprons. Eye protection is required at all times when working with cryogenic fluids. When pouring a cryogen, working with a wide-mouth Dewar flask or around the exhaust of cold boil-off gas, use of a full face shield is recommended. Hand protection is required to guard against the hazard of touching cold surfaces. It is recommended that cryogen safety gloves be used by the worker.

Due to the high expansion ratios for liquid cryogens and ability for solid CO_2 to sublimate, these materials should only be stored in areas with adequate ventilation. Large mobile Dewars or $_{LN2}$ refrigerators (or the trolleys carrying these) used for transporting cryogens within a building or between buildings should be equipped with a braking mechanism. Large mobile Dewars at risk for tipping should be transported on appropriate carts. Wheeled trolleys may not be used if the vessel must pass over elevator thresholds or other slots/crevasses wider than 25% of the wheel width. Use two people to move tall mobile Dewars over door thresholds, if there is the possibility of tipping the container. Smaller vessels of liquid nitrogen or other cryogens transported by hand within or between buildings must have a handle or bail, and must be covered.

Never mix dry ice or liquid nitrogen with water or water ice or pour it down the sink. Ice can solidify around it, trapping the gas at a high pressure. Therefore do not dispose of LN_2 or dry ice in a sink or drain—simply leave it to sublimate.

Vacuum work

Many laboratories employ vacuum apparatus for analytical equipment like mass spectrometers, reactive chemical handling and transfer in Schlenk lines, filtration, and desiccation.

Inspect glassware that will be used for reduced pressure to make sure there are no defects such as chips or cracks that may compromise its integrity. Use only approved glassware for low pressure work. Never use a flat bottom flask (unless it is a heavy-walled filter flask) or other thin-walled flask that is not appropriate to handle desired pressure. Collection flasks for vacuum systems should be plastic or plastic-coated glass. Otherwise, plastic or wire mesh may be used, or the flask may be taped. Glass Dewar flasks, some distillation columns and other apparatus are permanently under vacuum. The same precautions apply to these items. Note that “Thermos” flasks are especially thin and prone to breakage. Wrap them with tape to contain glass shards in the event of an implosion.

Autoclaves/sterilizers

Autoclaves and sterilizers are such a familiar feature within laboratories it is often easy to overlook the hazards which they present. In order to render a material sterile, the autoclave utilizes hot pressurized steam (270°F & 30 lbs/in^2), which presents serious burn hazards. Because the conditions within autoclaves are so extreme, the chance for malfunction is high if not properly operated and maintained.

Each autoclave has unique characteristics, so it is important for users to review and understand the operator's manual or receive training prior to use. Since any unsafe practice could result in injury to laboratory staff, the following safety precautions should be enforced when using autoclaves:

- NEVER attempt to autoclave items which contain hazardous chemicals or other hazardous materials (other than potentially infectious materials).
- Firmly lock autoclave doors prior to operation. Most autoclaves are equipped with an interlock system, which does not allow operation without the door being completely closed. Determine if your autoclave is equipped with an interlock system. If it does not, be sure all users are aware of this feature and advise them to utilize extra caution when operating the autoclave.
- Do not store combustible materials near autoclaves.
- Always utilize the appropriate Personal Protective Equipment (PPE) when handling items being placed into or removed from an autoclave. This includes heat resistant gloves, safety goggles, and if handling large amounts of liquid, rubber boots and rubber apron to protect against splash/spill hazards.
- Be sure autoclave is not operating and pressure is low before opening doors. Open autoclave doors slowly, keeping the head, face, and hands away from the opening to prevent direct contact with steam. Wait at least 30 seconds after opening the door before reaching into the autoclave to remove sterilized items. Wearing appropriate gloves and protective equipment, remove items slowly.
- Before loading the autoclave, check the inside for items left by previous users.
- Load autoclaves as per the manufacturer's recommendations. Not following these recommendations may result in incomplete sterilization of items.
- To prevent bottles from shattering during pressurization, the caps of containers with liquids must be loosened before loading.
- Use a tray with a solid bottom and walls to contain the contents and catch spills, should they occur. Add ¼ to ½ inch of water in the bottom of the tray to ensure bottles heat evenly.
- Check plastic materials to ensure they are compatible with the autoclave.
- For non-liquid loads, allow glassware to cool for at least 15 minutes prior to touching with ungloved hands.
- For liquid loads, allow liquids to stand for at least 1 hour prior to touching with ungloved hands.

- In addition to the above safety precautions, all manufacturer safety recommendation should be in place and effectively enforced. If injury occurs from exposure to autoclave steam or autoclaved materials, follow procedures for treatment of a burn and seek immediate medical attention

Centrifuges

Centrifuges, due to the high speed at which they operate, have great potential for injuring users if not operated properly. Unbalanced/damaged/worn centrifuge rotors can result in injury, even death. The majority of all centrifuge accidents are the result of user error. Follow the manufacturer's recommendations for use.

Pregnancy Policy

A chemical may pose a hazard to both an adult and an unborn fetus. Students who are pregnant or think that they might become pregnant during the course should discuss their enrollment in this course with their physician(s). Student researchers should also discuss potential hazards with their physician. Safety data sheets (SDSs) are available within each laboratory, and the chemical materials used are listed in the lab manual for the course. This includes men or women attempting pregnancy.

Service Animals

The safety of a service animal is the responsibility of the caretaker of that animal. The owner of any service animal must provide leather booties and a blanket for the animal to rest upon. The animal must rest in an area removed from any work on a bench or hood. Failure to provide care for any service animal according to these rules will result in prohibiting admission into the laboratory for the animal and the caretaker.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Laboratories in which chemicals are used must have access to safety showers, eyewashes, fire extinguishers, fume hoods, and sinks. Safety showers and eyewashes must be free of obstructions in order to be accessed easily and quickly.

PPE is the last line of defense against laboratory hazards. In order for PPE to protect the user, it must be stored, maintained, and worn properly. Since PPE can fail, those who wear it should understand its limitations. PPE does not eliminate the hazard. The need for PPE is dependent upon the type of operations and the nature and quantity of the materials in use while performing a specific procedure. Laboratory Supervisors are responsible for determining the appropriate PPE for each lab activity and workers should refer to section eight of relevant SDSs.

Lab Coats

Disposable or cloth lab coats will be made available to all workers in the School using chemicals or biological materials where splashing or contamination of clothes is possible. Students in courses are required to provide their own lab coat if necessary for a course.

- Lab coats must be closed (buttoned) when worn
- Lab coats are not to be worn in or removed to areas outside of the designated lab area, except in cases where a lab related function is being performed elsewhere, the handling and transportation of chemical or biological materials to an adjacent or common equipment area
- Students must supply their own lab coats for courses where the use is required by the course instructor

Gloves

- Appropriate gloves are to be worn by all workers whenever they handle chemicals unless otherwise stated on the SDS.
- Heavy duty chemical resistant gloves such as nitrile, neoprene or vinyl are to be worn when recommended by the Safety Data Sheets for the substances being used and should be used when cleaning refrigerators, centrifuges, hoods, shelves, and other equipment and bench surfaces coming in contact with hazardous materials.
- Information about appropriate glove types can be found on SDSs, but the following general recommendations can be made:
    - neoprene gloves for oils, acids, caustics, alcohols and solvents
    - butyl rubber gloves for ketones and esters.
    - nitrile gloves for formalin and aromatic, halogenated, and petroleum solvents.

Protective Eye and Face wear

- Safety Glasses: to be worn when the task involves a very small volume of hazardous substance. i.e. pipetting solutions.
- Safety goggles: to be worn when tasks involve manipulating volumes of hazardous substances where splashes could occur. i.e. pouring, mixing solutions from 100 ml to 1 liter.
- Face Protection: to be worn when tasks involve dispensing, mixing, pouring volumes greater than one liter.
- Contact lens should be removed prior to working with volatile chemicals including formaldehyde.
- Eye wash stations should be in every lab where hazardous chemicals are used

For assistance in making informed decisions regarding the selection and acquisition of the appropriate PPE, please consult the faculty head of your lab, SDSs or the CHO.

Clothing, Hair, and Jewelry

Appropriate clothing must be worn in laboratories at all times to offer protection against chemical spills and splashes. When working with hazardous chemicals, shirts must cover the entire torso area, from below the neckline to the waist, and have sleeves that cover the shoulders. Appropriate pants or skirts cover the entire lower portion of the body. At all times, shoes worn in the laboratory must completely cover the feet—no woven shoes, sandals, high

heels, or open-toe shoes may be worn in the laboratory. Long hair and loose clothing should be tied back, out of the way of chemicals or fire.

Jewelry should be worn judiciously in the laboratory with the knowledge that chemicals can seep under a ring or bracelet, jewelry can get caught on equipment and/or come into contact with an electrical hazard.

Fume Hood

The fume hood is often the primary control device for protecting laboratory workers when working with flammable and/or toxic chemicals. OSHA's Laboratory standard (29 CFR 1910.1450) requires that fume hoods be maintained and function properly when used.

Before using a fume hood:

- Make sure that you understand how the hood works. You should be trained to use it properly.
- Confirm the fume hood has been certified within the last 12 months
- Know the hazards of the chemical you are working with; refer to the chemical's Safety Data Sheet if you are unsure.
- Ensure that the hood is on.
- Make sure that the sash is open to the proper operating level, which is usually indicated by arrows on the frame.
- Make sure that the air gauge indicates that the air flow is within the required range. In general, a hood's face velocity is recommended to be between 0.3 m/s (60 fpm) and 0.5 m/s (100 fpm).

When using a fume hood:

- Never allow your head to enter the plane of the hood opening. For example, for vertical rising sashes, keep the sash below your face; for horizontal sliding sashes, keep the sash positioned in front of you and work around the side of the sash.
- Work at least 6 inches inside the hood to improve capture of contaminates
- Use appropriate eye protection.
- Be sure that nothing blocks the airflow through the baffles (at the back of the hood) or through the baffle exhaust slots.
- Elevate large equipment (e.g., a centrifuge) at least two inches off the base of the hood interior to maintain air circulation.
- Keep all materials inside the hood at least six inches from the sash opening.
- When not working in the hood, close the sash.
- Do not permanently store any chemicals inside the hood.
- Promptly report any hood that is not functioning properly to your supervisor. The sash should be closed and the hood "tagged" and taken out of service until repairs can be completed.

- When using extremely hazardous chemicals, understand your laboratory's action plan in case an emergency, such as a power failure, occurs.

LABORATORY BIOSAFETY CRITERIA

The essential elements of the first two of four biosafety levels for activities involving infectious microorganisms and laboratory animals are listed below. The levels are designated in ascending order, by degree of protection provided to personnel, the environment, and the community. UNC does not have any material requiring a Biosafety Level 3 (BSL-3) or Biosafety Level 4 (BSL-4) laboratory.

Biosafety Level 1 (BSL-1) Laboratory

Biosafety Level 1 is suitable for work involving well-characterized agents not known to consistently cause disease in healthy adult humans, and of minimal potential hazard to laboratory personnel and the environment. The laboratory is not necessarily separated from the general traffic patterns in the building. Work is generally conducted on open bench tops using standard microbiological practices. Special containment equipment or facility design is neither required nor generally used. Laboratory personnel have specific training in the procedures conducted in the laboratory and are supervised by a scientist with general training in microbiology or a related science.

The following standard and special practices, safety equipment and facilities apply to agents assigned to Biosafety Level 1:

1. Standard Microbiological Practices
    a. Access to the laboratory is limited or restricted at the discretion of the laboratory director when experiments or work with cultures and specimens are in progress.
    b. Persons wash their hands after they handle viable materials, after removing gloves, and before leaving the laboratory.
    c. Eating, drinking, smoking, handling contact lenses, applying cosmetics, and storing food for human use are not permitted in the work areas. Persons who wear contact lenses in laboratories should also wear goggles or a face shield. Food is stored outside the work area in cabinets or refrigerators designated and used for this purpose only.
    d. Mouth pipetting is prohibited; mechanical pipetting devices are used.
    e. Policies for the safe handling of sharps are instituted.
    f. All procedures are performed carefully to minimize the creation of splashes or aerosols.
    g. Work surfaces are decontaminated at least once a day and after any spill of viable material.
    h. All cultures, stocks, and other regulated wastes are decontaminated before disposal by an approved decontamination method such as autoclaving. Materials to be decontaminated outside of the immediate laboratory are to be placed in a durable, leak proof container and closed for transport from the laboratory.

Materials to be decontaminated outside of the immediate laboratory are packaged in accordance with applicable local, state, and federal regulations before removal from the facility.

i. A biohazard sign can be posted at the entrance to the laboratory whenever infectious agents are present. The sign may include the name of the agent(s) in use and the name and phone number of the investigator.
j. An insect and rodent control program is in effect.

2. Special Practices – None

3. Safety Equipment (Primary Barriers)
    a. Special containment devices or equipment such as a biological safety cabinet are generally not required for manipulations of agents assigned to Biosafety Level 1.
    b. It is recommended that laboratory coats, gowns, or uniforms be worn to prevent contamination or soiling of street clothes.
    c. Gloves should be worn if the skin on the hands is broken or if a rash is present. Alternatives to powdered latex gloves should be available.
    d. Protective eyewear should be worn for conduct of procedures in which splashes of microorganisms or other hazardous materials is anticipated.

4. Laboratory Facilities (Secondary Barriers)
    a. Laboratories should have doors for access control.
    b. Each laboratory contains a sink for hand washing.
    c. The laboratory is designed so that it can be easily cleaned. Carpets and rugs in laboratories are not appropriate.
    d. Bench tops are impervious to water and are resistant to moderate heat and the organic solvents, acids, alkalis, and chemicals used to decontaminate the work surface and equipment.
    e. Laboratory furniture is capable of supporting anticipated loading and uses. Spaces between benches, cabinets, and equipment are accessible for cleaning.
    f. If the laboratory has windows that open to the exterior, they are fitted with fly screens.

Biosafety Level 2 (BSL-2)

Biosafety Level 2 is similar to Biosafety Level 1 and is suitable for work involving agents of moderate potential hazard to personnel and the environment. It differs from BSL-1 in that:

- Laboratory personnel have specific training in handling pathogenic agents and are directed by competent scientists;
- Access to the laboratory is limited when work is being conducted;
- Extreme precautions are taken with contaminated sharp items; and
- Certain procedures in which infectious aerosols or splashes may be created are conducted in biological safety cabinets or other physical containment equipment.

The following standard and special practices, safety equipment, and facilities apply to agents assigned to Biosafety Level 2:

1. Standard Microbiological Practices
    a. Access to the laboratory is limited or restricted at the discretion of the laboratory director when experiments are in progress.
    b. Persons wash their hands after they handle viable materials, after removing gloves, and before leaving the laboratory.
    c. Eating, drinking, smoking, handling contact lenses, and applying cosmetics are not permitted in the work areas. Food is stored outside the work area in cabinets or refrigerators designated for this purpose only.
    d. Mouth pipetting is prohibited; mechanical pipetting devices are used.
    e. Policies for the safe handling of sharps are instituted.
    f. All procedures are performed carefully to minimize the creation of splashes or aerosols.
    g. Work surfaces are decontaminated on completion of work or at the end of the day and after any spill or splash of viable material with disinfectants that are effective against the agents of concern.
    h. All cultures, stocks, and other regulated wastes are decontaminated before disposal by an approved decontamination method such as autoclaving. Materials to be decontaminated outside of the immediate laboratory are placed in a durable, leakproof container and closed for transport from the laboratory. Materials to be decontaminated off-site from the facility are packaged in accordance with applicable local, state, and federal regulations, before removal from the facility
    i. An insect and rodent control program is in effect.

2. Special Practices
    a. Access to the laboratory is limited or restricted by the laboratory director when work with infectious agents is in progress. In general, persons who are at increased risk of acquiring infection, or for whom infection may have serious consequences, are not allowed in the laboratory or animal rooms. For example, persons who are immunocompromised or immunosuppressed may be at increased risk of acquiring infections. The laboratory director has the final responsibility for assessing each circumstance and determining who may enter or work in the laboratory or animal room.
    b. The laboratory director establishes policies and procedures whereby only persons who have been advised of the potential hazards and meet specific entry requirements (e.g., immunization) may enter the laboratory.
    c. A biohazard sign must be posted on the entrance to the laboratory when etiologic agents are in use. Appropriate information to be posted includes the agent(s) in use, the biosafety level, the required immunizations, the investigator's name and telephone number, any personal protective equipment

that must be worn in the laboratory, and any procedures required for exiting the laboratory

d. Laboratory personnel receive appropriate immunizations or tests for the agents handled or potentially present in the laboratory (e.g., hepatitis B vaccine or TB skin testing).
e. When appropriate, considering the agent(s) handled, baseline serum samples for laboratory and other at-risk personnel are collected and stored. Additional serum specimens may be collected periodically, depending on the agents handled or the function of the facility.
f. Biosafety procedures are incorporated into standard operating procedures or in a biosafety manual adopted or prepared specifically for the laboratory by the laboratory director. Personnel are advised of special hazards and are required to read and follow instructions on practices and procedures.
g. The laboratory director ensures that laboratory and support personnel receive appropriate training on the potential hazards associated with the work involved, the necessary precautions to prevent exposures, and the exposure evaluation procedures. Personnel receive annual updates or additional training as necessary for procedural or policy changes.
h. A high degree of precaution must always be taken with any contaminated sharp items, including needles and syringes, slides, pipettes, capillary tubes, and scalpels.
    i. Needles and syringes or other sharp instruments should be restricted in the laboratory for use only when there is no alternative, such as parenteral injection, phlebotomy, or aspiration of fluids from laboratory animals and diaphragm bottles. Plastic ware should be substituted for glassware whenever possible.
    ii. Only needle-locking syringes or disposable syringe-needle units (i.e., needle is integral to the syringe) are used for injection or aspiration of infectious materials. Used disposable needles must not be bent, sheared, broken, recapped, removed from disposable syringes, or otherwise manipulated by hand before disposal; rather, they must be carefully placed in conveniently located puncture-resistant containers used for sharps disposal. Non-disposable sharps must be placed in a hard-walled container for transport to a processing area for decontamination, preferably by autoclaving.
    iii. Syringes which re-sheathe the needle, needleless systems, and other safety devices are used when appropriate.
    iv. Broken glassware must not be handled directly by hand, but must be removed by mechanical means such as a brush and dustpan, tongs, or forceps. Containers of contaminated needles, sharp equipment, and broken glass are decontaminated before disposal, according to any local, state, or federal regulations.

i. Cultures, tissues, specimens of body fluids, or potentially infectious wastes are placed in a container with a cover that prevents leakage during collection, handling, processing, storage, transport, or shipping.
j. Laboratory equipment and work surfaces should be decontaminated with an effective disinfectant on a routine basis, after work with infectious materials is finished, and especially after overt spills, splashes, or other contamination by infectious materials. Contaminated equipment must be decontaminated according to any local, state, or federal regulations before it is sent for repair or maintenance or packaged for transport in accordance with applicable local, state, or federal regulations, before removal from the facility.
k. Spills and accidents that result in overt exposures to infectious materials are immediately reported to the laboratory director. Medical evaluation, surveillance, and treatment are provided as appropriate and written records are maintained.
l. Animals not involved in the work being performed are not permitted in the lab.

3. Safety Equipment (Primary Barriers)
    a. Properly maintained biological safety cabinets, preferably Class II, or other appropriate personal protective equipment or physical containment devices are used whenever:
    b. Procedures with a potential for creating infectious aerosols or splashes are conducted. These may include centrifuging, grinding, blending, vigorous shaking or mixing, sonic disruption, opening containers of infectious materials whose internal pressures may be different from ambient pressures, inoculating animals intranasally, and harvesting infected tissues from animals or embryonate eggs.
    c. High concentrations or large volumes of infectious agents are used. Such materials may be centrifuged in the open laboratory if sealed rotor heads or centrifuge safety cups are used, and if these rotors or safety cups are opened only in a biological safety cabinet.
    d. Face protection (goggles, mask, face shield or other splatter guard) is used for anticipated splashes or sprays of infectious or other hazardous materials to the face when the microorganisms must be manipulated outside the BSC
    e. Protective laboratory coats, gowns, smocks, or uniforms designated for lab use are worn while in the laboratory. This protective clothing is removed and left in the laboratory before leaving for non-laboratory areas (e.g., cafeteria, library, administrative offices). All protective clothing is either disposed of in the laboratory or laundered by the institution; it should never be taken home by personnel.
    f. Gloves are worn when hands may contact potentially infectious materials, contaminated surfaces or equipment. Wearing two pairs of gloves may be appropriate. Gloves are disposed of when overtly contaminated, and removed when work with infectious materials is completed or when the integrity of the glove is compromised. Disposable gloves are not washed, reused, or used for touching "clean" surfaces (keyboards, telephones, etc.), and they should not be

worn outside the lab. Alternatives to powdered latex gloves should be available. Hands are washed following removal of gloves
.

4. Laboratory Facilities (Secondary Barriers)
    a. Provide lockable doors for facilities that house restricted agents (as defined in 42CFR 72.6).
    b. Consider locating new laboratories away from public areas.
    c. Each laboratory contains a sink for hand washing.
    d. The laboratory is designed so that it can be easily cleaned. Carpets and rugs in laboratories are inappropriate.
    e. Bench tops are impervious to water and are resistant to moderate heat and the organic solvents, acids, alkalis, and chemicals used to decontaminate the work surfaces and equipment.
    f. Laboratory furniture is capable of supporting anticipated loading and uses. Spaces between benches, cabinets, and equipment are accessible for cleaning. Chairs and other furniture used in laboratory work should be covered with a non-fabric material that can be easily decontaminated.
    g. Install biological safety cabinets in such a manner that fluctuations of the room supply and exhaust air do not cause the biological safety cabinets to operate outside their parameters for containment. Locate biological safety cabinets away from doors, from windows that can be opened, from heavily traveled laboratory areas, and from other potentially disruptive equipment so as to maintain the biological safety cabinets' air flow parameters for containment.
    h. An eyewash station is readily available.
    i. Illumination is adequate for all activities, avoiding reflections and glare that could impede vision.
    j. There are no specific ventilation requirements. However, planning of new facilities should consider mechanical ventilation systems that provide an inward flow of air without recirculation to spaces outside of the laboratory. If the laboratory has windows that open to the exterior, they are fitted with fly screens.

Proper use of Biosafety Cabinets (BSCs)

Properly maintained Biosafety Cabinets (BSCs), when used in conjunction with good microbiological techniques, provide an effective containment system for safe manipulation of moderate- and high-risk infectious agents [Biosafety Level 2 (BSL-2) and 3 (BSL-3) agents]. BSCs protect laboratory workers and the immediate lab environment from infectious aerosols generated within the cabinet. BSCs must be certified when installed, whenever they are moved and at least annually [29 CFR 1910.1030(e)(2) (iii)(B)]. Employers should ensure that a risk assessment has been completed and approved for the work to be conducted and to identify the class and type of BSC needed for the operation or procedure.

Before using the BSC

- Prepare a written checklist of materials necessary for a particular activity and place only necessary materials in the BSC before beginning work.
- Turn off any overhead room germicidal ultraviolet light (UV) and any BSC UV lights. A general rule of thumb is to run the UV lights for 10-20 minutes prior to BSC use.
- Confirm that the BSC is currently certified for use.
- Confirm that the BSC is operating properly prior to beginning work by checking airflow gauges.
- Adjust the stool height so that armpits are level with the bottom of the view screen or sash.

Working inside the BSC

- Store extra supplies outside the BSC. Only materials and equipment needed for the immediate work should be placed in the BSC.
- Do not use equipment or store supplies inside the BSC that may disrupt the protective BSC airflow pattern.
- If large equipment must be placed inside the BSC, place it as far back in the BSC as practical.
- Do not work with open containers of infectious or hazardous materials in front of the large equipment.
- Move arms in and out of the cabinet slowly, perpendicular to the face opening, to limit disruption of the air curtain.
- Wear appropriate personal protective equipment. Lab coats must be buttoned and back closing laboratory gowns tied, if utilized, for greater protection. Gloves should be pulled over the wrists of lab coats, not worn inside the sleeve.
- Manipulation of materials inside the cabinet should be delayed for 1 minute after placing hands/arms inside the cabinet to allow the air to stabilize and to “air sweep” arms.
- Do not rest arms on front grille (unless the BSC is specifically equipped with features that permit this action) because doing so allows room air to flow directly into the work area rather than being drawn through the front grille. Instead, work with both arms raised slightly.
- Do not block the front grille with papers or other materials.
- Perform all operations on the work surface and at least 4 inches from the front grille.
- Allow cabinet blowers to operate for at least 3 to 5 minutes before beginning work to allow the BSC to “purge” particulates.
- Make sure that active work flows from the clean to contaminated area across the work surface.
- To minimize frequent in/out arm movement and maintain the air barrier, do not tape autoclavable biohazard collection bags to the outside of the BSC; upright pipette collection containers should not be used in the BSC and/or placed on the floor outside the BSC. (Instead, horizontal discard trays containing an appropriate chemical disinfectant should be used).

- Use the aseptic techniques below to reduce splatter and aerosol generation:
    - Opened bottles or tubes should not be held in a vertical position.
    - Hold the lid above open sterile surfaces to minimize direct impact of downward air.
    - Open flames should not be used because they create turbulence that disrupts the pattern of air supplied to the work surface.
        - If absolutely necessary to do so, touch plate microburners that provide a flame on demand or electric furnaces are available and should be placed in the back third of the BSC. All flames must be turned off before disinfectants are used.
- Aspirator bottles or suction flasks should be connected to an overflow collection plastic flask containing an appropriate disinfectant, and to an in-line HEPA filter and located in the back corner of the BSC.
- If spilled liquid enters through the front or rear grilles, close the drain valves and pour decontaminating solution into the drain pans. Use the appropriate decontamination solution and contact time for the pathogens used in the BSC.
- Carefully handle the paper towels used for cleanup, as any materials present in the catch basin that are caught in the exhaust plenum may require BSC decontamination and the cabinet body being opened to remove the object.
- Immediately following the manipulation of infectious agents in the BSC, decontaminate surfaces and the BSC contents with the appropriate solution and contact time necessary for the infectious agents being used. Do not allow any potential contamination on the interior surfaces to remain until the end of the work shift as this will reduce the efficiency of decontamination procedures.
- When work is finished, surface decontaminate all items that are to be brought out of the BSC prior to their removal.
- After removal of these items, the interior walls and the interior surface of the window should be wiped with 70 percent ethanol or other appropriate disinfectant.
- At the end of the workday, surface decontaminate the BSC with 70 percent ethanol or dilute bleach.

SDS AND CHEMICAL CLASSIFICATION

Systems for labeling chemical and for identifying the potential threat or hazard of a chemical.

Globally Harmonized System (GHS) of the Classification and Labelling of Chemical.

GHS is a set of guidelines for ensuring the safe production, transport, handling, use and disposal of hazardous materials. The system was developed by the United Nations, as a way to bring into agreement the chemical regulations and standards of different countries. In short, it is an international attempt to get everyone on the same page. The hope is that every country will incorporate the tenets of the GHS into their own chemical management systems with the goal of making the international sale and transportation of hazardous chemicals easier, as well as,

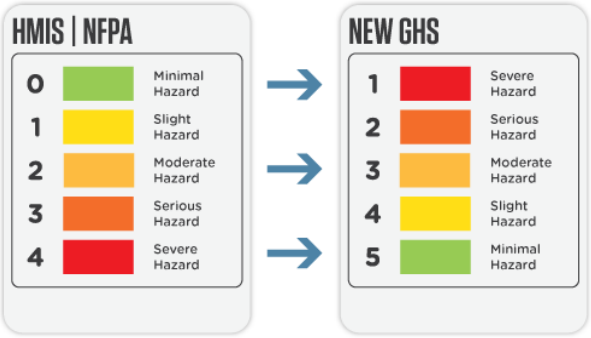
making workplace conditions safer for all employees exposed to chemical hazards. The U.S. officially adopted the GHS on March 26, 2012. OSHA adopted a revision of the Hazard Communication Standard to align with the GHS. OSHA calls this revision, HazCom 2012. GHS is not a global law or regulation– a common misconception – it is a system. Think of it as a set of recommendations or collection of best practices.

The two major elements of GHS are:
Classification of the hazards of chemicals according to the GHS rules: GHS provides guidance on classifying pure chemicals and mixtures according to its criteria or rules.
Communication of the hazards and precautionary information using Safety Data Sheets and labels

Hazardous Materials Identification System (HMIS) and the National Fire Protection Association (NFPA) NFPA 704 system.
At first glance, the HMIS and NFPA labeling systems appear quite similar; both have four sections colored blue, red, yellow and white. Despite their similarities, the two systems are not identical and each system serves a specific purposes;

- HMIS is a complete system designed to aid employers and their employees in day-to-day compliance with OSHA's Hazard Communication Standard. It includes hazard evaluations; a rating system for acute and chronic health, flammability and physical hazards; labels providing at-a-glance information on the hazards and PPE; employee training; and a written compliance program. HMIS was developed by the National Paint and Coatings Association (NPCA).
- NFPA is a fire protection hazard warning system designed to provide rapid, clear information to emergency responders on materials under conditions of fire, chemical spill, or other emergency situations. This labeling system was developed by National Fire Protection Association. Like HMIS, it includes labels and a numerical rating system, but the basic purpose of the label information is different.

An important difference between NFPA/HMIS systems and GHS/HazCom 2012 is the way they use numbers. The numbers in the GHS system, as adopted by OSHA, do not show up on the label, instead they are used to determine what goes on the label. The numbers do appear on GHS formatted safety data sheets, in Section 2, but OSHA believes the use of numbers there will be less confusing since there is much more contextual information available to help the reader understand the hazard information. In the NFPA and HMIS systems, the numbers themselves appear on the label and are used to communicate information about the hazard.



Use of Hazard System in Biological Science Laboratories at the University of Northern Colorado.

In all teaching and research laboratories the Hazardous Materials Identification Guide (HMIG/NFPA) system is used to communicate hazards This system uses blue for Health, red for Flammability, and Yellow for chemical Reactivity and a rating system for each category from 0 = minimal to 4 = extreme. Personal protective equipment (PPE) is specified by a code (see below). Labels on secondary chemical bottles must reflect the same categories.

The user will keep in mind that:

- The absence of a warning label does not imply that no hazard exists.
- Chemicals with different hazard classes are to be stored separately.
- Chemicals are hazardous depending upon usage and concentration.
- Not all possible hazards can be covered with labels.
- Label warnings are no substitute for reading the Material Safety Data Sheet.

Safety Data Sheet (SDS)

Each teaching laboratory and the stock room have an electronic depository containing Safety Data Sheets (SDS) for every chemical stored. Additionally, a hard copy of the SDS sheets for hazardous chemicals used in teaching laboratories will be made available to students and laboratory personnel. It is the responsibility of each research laboratory supervisor to maintain a similar SDS file for those compounds stored or used in their own research spaces. The SDS file should be available electronically. If additional paper copies are provided, they should be easily accessible and stored alphabetically. SDSs should be updated as often as possible to ensure that the most current safety and health information is available in the case of an accident.

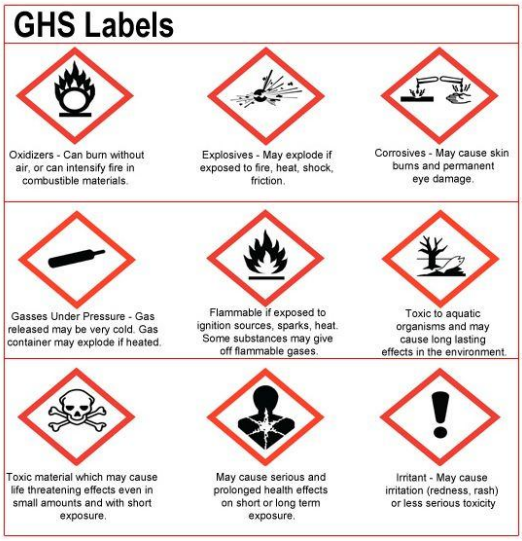
SDS sheets, irrespective of their source, generally contain the following information:

1. Product and Company Identification
    a. Product name
    b. Product use
    c. Supplier
    d. Manufacturer

2. Hazard Identification

a. Globally Harmonized System (GHS) classification including pictograms. It is important to realize that this is not the system that we use to label laboratory risk or secondary chemical containers—we use NFPA and HMIS systems respectively. In terms of threat, the numbering system for GHS is the opposite to NPFA/HMIS

b. Pictograms are used in the GHS system to identify threat and these can be used to augment our HMIS secondary labeling. For example:



c. A signal word is used to indicate the relative level of severity of hazard and alert the reader to a potential hazard on the label. The GHS uses 'Danger' and 'Warning' as signal words. The appropriate signal word to use is set out by the classification system. For example, the signal word for Self-heating substances and mixtures, Category 1 is *Danger* while *Warning* is used for the less serious Category 2. There are categories where no signal word is used. *We are augmenting our HMIS secondary labeling with this information*

3. Composition/Information on Ingredients
4. First Aid Measures
5. Fire Fighting Measures
6. Accidental Release Measures
7. Handling and Storage.
8. Precautions to control exposure/personal protection. Exposure limits, monitoring information and PPE information (required for our HMIS labeling) provided.
9. Physical and Chemical Properties. Appearance, odor, solubility, pH, boiling point, melting point, vapor density, vapor pressure and evaporation rate
10. Stability and Reactivity. Stability information and reactivity profile required for HMIS labeling provided here
11. Toxicological Information possible routes of exposure, acute and long term symptoms and side effects and toxicity provided
12. Ecological Information including ecotoxicity, mobility, degradability and bioaccumulation.

13. Disposal Considerations. Recommended disposal methods
14. Transport Information. Shipping name, hazard class (GHS) and secondary risk, labeling requirements
15. Regulatory Information. Federal, state, and international regulations, risk phrases and safety phrases.
16. Other Information including the department issuing the data sheet, product use and training information. *Keep in mind of a chemical has specific training suggested this should become part of the PI training for his/her research laboratory and the lab manual/training for teaching laboratories.*

Identifying Hazardous Materials

Hazardous materials are those substances with the Hazardous Material Identification System's or the National Fire Protection Association's diamond placard hazard code of four for health, reactivity, and/or flammability depicted on a container or structure (see page 24). Additionally the GHS system identifies hazards in section 2 of the SDS (above). Hazards can also include carcinogens, cancer suspect agents, reproductive toxins, any chemical rated as highly toxic (acute or chronic), any explosive chemical and any chemical deemed particularly hazardous by the professor.

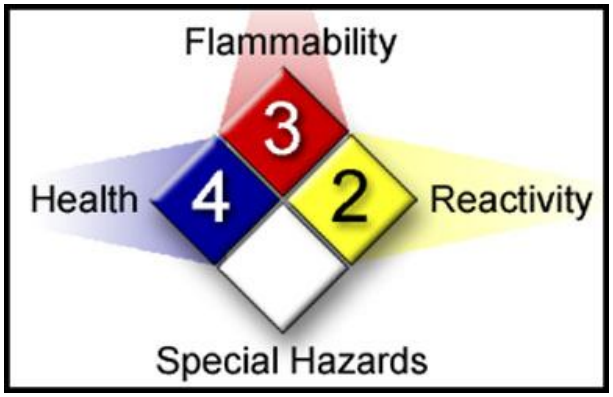
A chemical may also be considered a hazardous waste if exhibits one of the following characteristics defined in 40 CFR Part 261 Subpart C: ignitability, corrosively, reactivity and toxicity. Brief descriptions of these characteristics are included below:

- Ignitable wastes can create fires under certain conditions, are spontaneously combustible, or have a flash point less than 60 °C (140 °F). Examples include waste oils and used solvents. Test methods that may be used to determine ignitability include the Pensky-Martens Closed-Cup Method for Determining Ignitability.
- Corrosive wastes are acids or bases (pH < 2, or > 12.5) capable of corroding metal containers.
- Reactive wastes are unstable and can cause explosions, toxic fumes, gases, or vapors when heated, compressed, or mixed with water.
- Carcinogens are substances regulated by OSHA as carcinogenic, listed under the category "known carcinogen," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP), listed under Group one ("carcinogenic to humans") by the International Agency for Research on Cancer (IARC), or "reasonably anticipated to be carcinogens."
- Reproductive toxins are chemicals which can cause chromosomal mutations and/or teratogenesis in gametes. Embryotoxins, which are substances that act during pregnancy to cause adverse effects on the fetus, are also included in this category. Faculty shall attempt to avoid need for these chemicals, and pre-approve and supervise the laboratory operation, procedure or activity involving these chemicals when they are unavoidable.

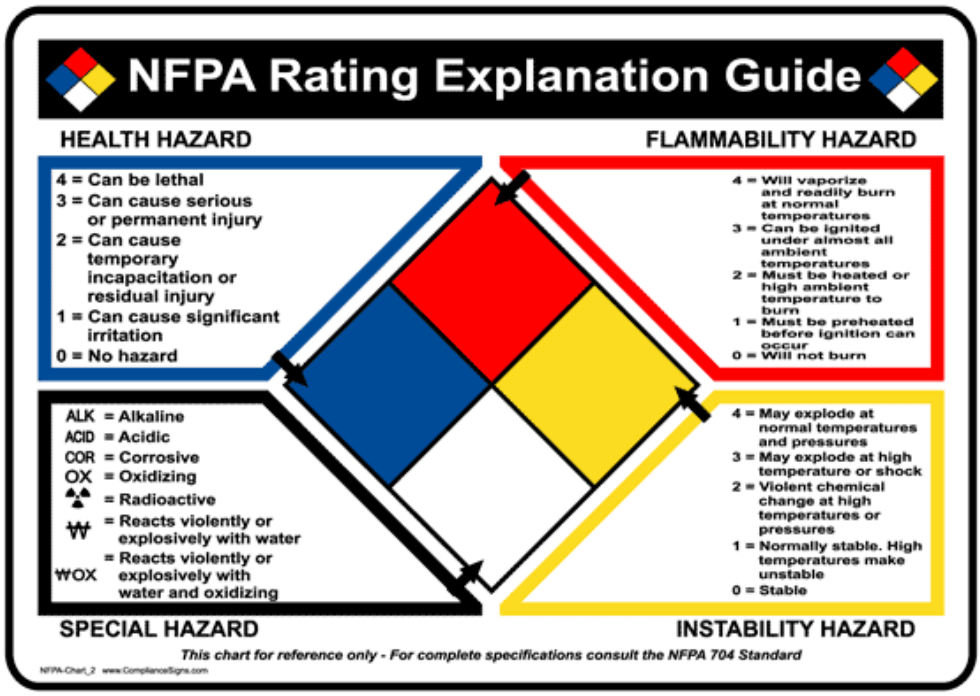
If the composition of the chemical substance produced exclusively for the laboratory's use is known, the professor in charge of the laboratory shall determine if it is a hazardous chemical as defined by the OSHA Hazard Communication Standard 29 CFR 1910.1200. If the chemical is determined to be hazardous, the professor shall provide appropriate handling procedures. Proper labeling is the responsibility of the professor in whose lab the substance is stored, used, or generated. All laboratories will have a sign posted indicating the person responsible for the area.

Laboratory Door Signage

NFPA Hazard Identification Placards. The National Fire Protection Association has developed a system for indicating the toxicity (Health), ignitability (Flammability), Instability (formerly "reactivity), and Special (corrosively, chemical reactivity) hazards of a chemical. Following NFPA standards, UNC's Environmental Health and Safety office places NFPA signs by the entrance doors to the laboratories.



The NFPA hazards are rated with 0 as the least, and 4 as a significant hazard. Additional information is provided below:



Labeling of Chemicals within the laboratory

Primary Container: From the manufacturer, the bottle that the chemical was shipped in. Has all relevant labeling

Secondary Container: Is defined as any container being used beyond the original manufacturer's bottle that the chemical was shipped in. This may include, but is not limited to:

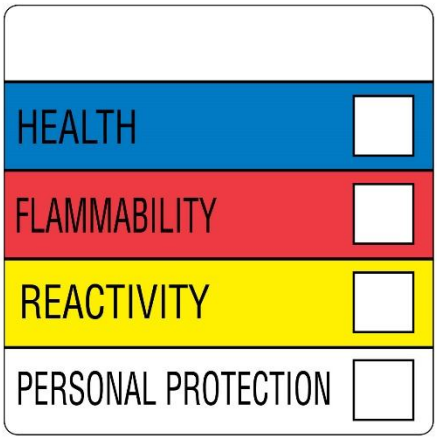
- Portable or working containers, such as flasks, beakers or small storage bottles in "immediate" use.
- Storage bottles that are created for distribution of smaller amounts of the chemical to students or colleagues.
- Storage bottles that are created for **solutions of the original chemical**.
- Sample vials or sealable tubes.

Mixtures

Mixtures are considered primary and should be labeled accordingly. If a substance or mixture has more than one hazard the following should be used on the label HMIG: For Physical Hazards (flammability and reactivity) the highest level of hazard should be indicated. For health, all hazardous should be listed. For PPE, the most protective PPE should be indicated.

Labeling Secondary Containers

Labeling requirements are regulated by the Occupational Safety and Health Administration (OSHA).



- Portable or working containers are exempt from the labeling regulations as long as the portable/working container remains in the direct control and supervision of the employee, and *only over the duration of a standard working day.*

- Storage bottles that are created for distribution of smaller amounts of the chemical are regulated and require at minimum:
    - Chemical name
    - Concentration
    - HMIS label will be filled out
    - Date prepared
    - Who prepared the chemical

- Storage bottles that are created for solutions of the original chemical. These bottles require the same minimum requirements as the storage bottles created for distribution, but
    - MUST also include concentration of the solution and in what solvent system.
    - SHOULD include the date the solution was created for future reference.

- Sample vials or sealable tubes. "Batch" labeling can be done where containers are difficult to label because of their size or if labeling with the actual contents is a problem pedagogically ("unknowns" for a teaching laboratory procedure). These containers should be clearly grouped together in a drawer, box or other larger container, and the larger container can be labeled as described previously. Remember that once the container is removed from this labeled area, it must be treated as a portable/working container (under the direct control of the user) or it will be subject to the labeling regulations.

Notes about Labeling

It is very common in academic labs to use symbols and abbreviations to label bottles. In the past, this has been acceptable to OSHA as long as there is a complete list of the translation of any symbols and immediate reference to the hazards associated with the chemical(s). This list must be readily available to employees as well as emergency responders.

Defacing a manufacturer's label is prohibited. That is to say don't just write over or cover up a manufacturer's label! Scrape it off before re-labeling to avoid any confusion about the contents of the bottle.

CHEMICAL HANDLING

Stockroom Procedures

1. All chemicals purchased for the teaching laboratories will be initially checked and documented through the stockroom.
2. All chemicals will have legible labels with chemical name, formula, CAS number, hazard class and date of receipt (for all new incoming chemicals).
3. Chemicals which are highly toxic (see below) or whose containers have been damaged should be in a secondary container.
4. Chemicals will be stored by compatibility groupings within the storeroom
5. All chemicals will be added to the Chemical Inventory Management System
6. Stored chemicals will be checked at least monthly for signs of deterioration, package breakage or leakage.

7. SDSs for all chemicals used in the Biology laboratories are available on MSDS online https://msdsmanagement.msdsonline.com/63823649-8784-473c-b01a-785b4e981fa1/ebinder/?nas=True

8. Toxicity Values to be used for determining relative hazards are as follows: (per 29 CFR 1910.1200)
    a. Highly toxic: LD_{50} (oral) <= 50 mg/kg
    b. LC_{50} (inhalation) <= 200 ppm gas or vapor<=[2 mg/1 dust or mist]
    c. LD_{50} (dermal) <= 50 mg/kg
    d. Toxic: $_{LD50}$ (oral) > 50 <500 mg/kg
    e. LD_{50} (dermal) >50 <500 mg/kg
    f. LC_{50} (inhalation) > 200 < 2000 ppm gas [>2 <20 mg/l dust or mist]
    g. Corrosive: A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.
    h. Irritant: A chemical, which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact.
    i. Sensitizer: A chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.
    j. LD_{50} Lethal dose at which 50% of test animals died when either given chemical orally or applied dermally.
    k. LC_{50} Lethal air concentration at which point 50% of test animals died when breathing chemical gas or vapor (in ppm), or mist, dust or fumes (in mg/l)

Using Chemicals

The SDS should be consulted before using any chemical, and all necessary precautions and safety equipment must be utilized when handling chemicals. A spill must be cleaned up immediately to avoid possible exposure to others, see the section on chemical spills. After a chemical is used, the bottle should be returned to its storage location. When the bottle is fully depleted, the bottle should be cleaned and removed from the appropriate electronic Chemical Inventory. If the empty bottles from the Stockroom, it should be delivered to the stockroom, so that the chemical can be removed from the Stockroom inventory.

Storage of Hazardous Materials

There are numerous physical hazards which may be present in the laboratory. While not as exotic as chemical and biological hazards, physical hazards are responsible for the majority of

workplace injuries. It is important to be aware of these hazards, preplan, use personal protective equipment and follow basic safety rules in order to prevent accidents involving physical hazards.

Certain chemicals cannot be safely mixed or stored with other chemicals because a severe reaction can take place or an extremely toxic reaction product can result. The following are examples of physical hazards affiliated with chemicals

Flammables and combustibles:

1. Flammable materials can generate sufficient vapors at temperatures below 100°F (38°C); combustibles, at temperatures at or above 100°F (38°C) and below 140°F (60°C). The vapors of these materials are invisible, and a vapor trail to an ignition source away from the immediate area can result in a flashback.
2. Flammables are more hazardous at elevated temperatures due to more rapid vaporization. In addition, flammable and combustible materials react with oxidizers which can result in a fire.
3. Eliminate ignition sources such as open flames, hot surfaces, sparks from welding or cutting, operation of electrical equipment, and static electricity.
4. Minimize the quantity kept in the work area and store in approved flammable liquid containers (safety cans) and storage cabinets, or in a special storage room designed for that purpose.
5. Store away from oxidizing materials.
6. Refrigerators and freezers used for the storage of flammable or combustible liquids must have no internal sources of ignition, such as a flammables refrigerator or explosion proof refrigerator.
7. Ensure that appropriate fire control systems or extinguishers are available.

Corrosives:

1. Corrosives are materials which can react with the skin causing burns similar to thermal burns, and/or which can react with metal causing deterioration of the metal surface. A corrosive material can be either an acid or base.
2. Containers and equipment used for storage and processing of corrosive materials should be corrosion resistant.
3. Eye protection and rubber gloves should always be used when handling corrosive materials. A face shield, rubber apron, and rubber boots may also be appropriate, depending on the work performed.
4. When mixing concentrated acids (caustics) with water, add the acid (caustic) slowly to water. NEVER add water to acid (caustic).
5. Acids and bases should be stored separately from each other. Organic acids should be stored separate from oxidizing acids. If acids and bases are stored in the same cabinet, then the materials should be physically separated from one another through the use of containment items, such as a plastic autoclave pan

Oxidizers:

1. Oxidizers are materials which readily yield oxygen or another oxidizing gas, or that readily react to promote or initiate combustion of flammable/combustible materials.
2. Uncontrolled/unknown oxidation reactions are a frequent cause of chemical accidents.
3. Know the reactivity of the materials involved in the experiment or process.
4. Make sure that there are no extraneous materials in the area which could become involved in a reaction.
5. If the reaction can be violent or explosive, use shields or other methods for isolating the materials or the process.
6. Use the minimum amounts necessary for the procedure. Do not keep excessive amounts of the material in the vicinity of the process.
7. Oxidizers should be stored away from organic materials, flammable materials and other reducing agents.
8. Perchloric acid should be used only in specially-designed perchloric acid fume hoods equipped with wash-down systems to prevent deposition of shock-sensitive perchlorates in the ductwork and machinery. Before purchasing perchloric acid, the laboratory supervisor should arrange for use of an approved perchloric acid hood.

Pyrophoric/water-reactive materials:

1. Materials which react with water to produce a flammable or toxic gas, or other hazardous condition are said to be water-reactive. Pyrophoric materials ignite spontaneously upon contact with air. The flame may or may not be visible. Store and use all pyrophoric in an inert atmospheres
2. Examples of water-reactives include alkali and alkaline earth metals (e.g. Li, Na, K, Ca, Mg), metal hydrides, some metal and nonmetal chlorides (e.g. $SiCl_4$, PCl_3, $AlCl_3$), calcium carbide, acid halides and acidanhydrides. Examples include butyllithium, silane, and yellow phosphorous.
3. Fire and explosion are serious concerns when working with these materials.
4. Special precautions for safe handling of water-reactive materials will depend on the specific material, and the conditions of use and storage. Review SDS for information on the safe use and storage of a specific material.
5. The policy and guidelines for safe handling of these materials, as well as a list of some pyrophoric/water-reactive materials can be found on the EHS website.

Peroxide forming materials:

1. Peroxidizables are substances or mixtures which react with oxygen, light, or heat to form unstable peroxides.
2. Some peroxides can explode with impact, heat, or friction such as that caused by removing a lid.
3. Peroxides form inside the containers of some materials even if they have not been opened.
4. Review SDS for information on the safe use and storage of a specific material.
5. All materials must be dated when received, dated when opened and appropriately managed according to schedule.

6. The schedule and guidelines for safe handling of these materials, as well as a list of some potential peroxide forming materials can be found on the EHS website.

Light-sensitive materials:

1. Light-sensitive materials are unstable with respect to light energy.
2. They tend to degrade in the presence of light, forming new compounds which can be hazardous, or resulting in conditions such as pressure buildup inside a container which may be hazardous.
3. Store light-sensitive materials in a cool, dark place in amber colored bottles or other containers which reduce or eliminate penetration of light.
4. Review SDS for information on the safe use and storage of a specific material.

Shock-sensitive or explosive materials:

1. Shock-sensitive/explosive materials are substances or mixtures which can spontaneously release large amounts of energy under normal conditions, or when struck, vibrated, or otherwise agitated.
2. Some materials become increasingly shock-sensitive with age and/or loss of moisture.
3. The inadvertent formation of shock-sensitive/explosive materials such as peroxides, perchlorates, picrates and azides is of great concern in the laboratory.
4. Review SDS for information on the safe use and storage of a specific material.

All chemicals must be stored according to their chemical reactivity; oxidizers are stored with oxidizers, reducers are stored with reducers, etc. All attempts will be made to ensure that classifications of compounds dictate storage procedures (for example, the Fisher Chemical Storage method). In no case should incompatible compounds be stored within the same location. A list of incompatibilities in Figure 3 is below:

Incompatibilities by Hazard Class

	Acids, Inorganic	Acids, Oxidizing	Acids, Organic	Alkalis (Bases)	Oxidizers	Poisons, Inorganic	Poisons, Organic	Water-Reactives	Organic Solvents
Acids, Inorganic			X	X		X	X	X	X
Acids, Oxidizing			X	X		X	X	X	X
Acids, Organic	X	X		X	X	X	X	X	
Alkalis (Bases)	X	X	X				X	X	X
Oxidizers			X				X	X	X

	Acids, Inorganic	Acids, Oxidizing	Acids, Organic	Alkalis (Bases)	Oxidizers	Poisons, Inorganic	Poisons, Organic	Water-Reactives	Organic Solvents
Poisons, Inorganic	X	X	X				X	X	X
Poisons, Organic	X	X	X	X	X	X			
Water Reactives	X	X	X	X	X	X			
Organic Solvents	X	X		X	X	X			

X Indicates incompatibility between two chemical product groups. Incompatible products should not be stored in close proximity.

SPECIFIC SAFETY PROCEDURES

Toxic Chemicals

When working with any chemical that is listed on the SDS as being highly toxic or toxic, the material should be handled in a fume hood, glove box or area with local exhaust ventilation in order to assure that the PEL (permissible exposure level – OSHA mandated) or TLV-TWA (threshold limit value-time weighted average, suggested by ACGIH) are not exceeded.

Flammable Chemicals

Chemicals with a flash point below 94 C are regarded as fire-hazard chemicals. All such chemicals will be stored in a flammable-solvent storage area or in storage cabinets designed for flammable materials. All such materials will be stored in the laboratories in the fume hood when they are being dispensed. The amount of flammable material used at any one time will be kept to the minimum amount needed to perform the experiment. No open flames will be used around any flammable materials.

Reactive Chemicals

Reactive chemicals such as oxidizers, explosives and water-reactives will be segregated in storage. The mixing of these chemicals with other chemicals, even in small quantities, is forbidden without prior approval of the supervising faculty member and appropriate personal protective equipment must be used.

Corrosive Chemicals

Corrosive chemicals will be segregated from other chemicals in the storage area. When using any corrosive or contact-hazard chemical, the appropriate protective equipment must be used.

WASTES

General Chemical Waste Handling Procedures

1. All acidic/basic solutions containing NO heavy metal ions or organic compounds should be neutralized and then disposed of down the drain.
2. NO organic compounds will be sink-disposed unless approved by laboratory instructor (with concurrence of EHS).
3. Experiments utilizing heavy metals (chromium, nickel, copper, lead, barium, silver, arsenic), sulfides, cyanides, oxidizers, and peroxides will be minimized.
4. Whenever possible, any leftover chemical (that is not contaminated) should be recycled into the laboratory experiments, possibly as an unknown.
5. All other wastes will be collected with a minimum amount of handling. If consolidation of waste must be done, the chemicals must be compatible. If a volume greater than 4 liters of waste is anticipated (such as non-halogenated solvents), a larger container (20 liter can/carboy) should be used for collection.

Biological Wastes Handling and Disposal Procedures

There are four designated containers for refuse disposal in Biology laboratories.

1. Uncontaminated soft materials are disposed of in trash cans.
2. Uncontaminated sharps (scalpel blades, broken glass, etc.) are disposed of in sharps/broken glass containers. Place only uncontaminated sharps in the sharps box (The sharps box is not a trash can.) The uncontaminated sharps box will be a pasteboard box with a plastic liner.
3. Contaminated (body fluids, blood, etc.) sharps are disposed of in biowaste sharps containers. Place only contaminated sharps in the sharps box (The sharps box is not a trash can). The contaminated sharps box will be a hard plastic box usually red in color.
4. Contaminated items (non-sharps) are disposed of in the biohazard waste container with a lid and must be autoclaved at 121°C for at least 60 minutes.

Disposing of Hazardous Chemicals

If a chemical is classified as hazardous material, i.e., material that cannot be disposed of in the sewer system or landfill, the compounds are to be placed in a labeled container with a lid. The label must include the following:

- The term “Hazardous Chemical Waste”
- Name of the waste
- Component chemicals that make up the waste (along with the % of each)
- The date that chemicals were added to the waste container

Similar products that pose no safety hazard if mixed, and do not cost more for disposal when mixed may be placed in a single container (refer to the SDS to verify compatibility and consult with the Safety Committee if appropriate).

Hazardous Material Disposal tags
When a hazardous waste container is full, a Hazardous Material/Waste tag must be completed before pick up. Contact the Lab Coordinator, Frank Skufca for tags and to arrange for waste pickup. The tag must be affixed to a container as soon as it is full or no additional material is to be added to the container.

Use and Disposal of Radioactive Materials
Radioactive materials are no longer used within labs associated with the School of Biological Sciences. Existing sources should be made known to the University's Radiation Safety Officer (see contact information) who will coordinate storage or removal.

DECONTAMINATION PROCEDURES

Eyewashes and Showers
Eyewashes and showers must be activated at least once every one (1) and three (3) months respectively with the date of operation indicated on an inspection tag. When required, both eyewash and shower should be used for a minimum of 10 minutes.

Eye Contact
If chemical is splashed into the eyes, flush with water for a minimum of 15 minutes and transport to the nearest emergency room.

Ingestion of Chemical
Refer to specific SDS for appropriate action.

Skin Contact
Flush affected area with water for 15 minutes while removing contaminated clothing. If symptoms persist after flushing, seek medical attention. If spilled chemical was hydrofluoric acid or another fluoride compound, prompt medical attention is required.

SPILL RESPONSE

Spill kits are available as outlined below:

Spill Kit Locations	For use in:
1650	1691, 1681, 1671, 1660, 1640
1621	1611, 1631, 1641
1360	1330, 1331, 1380, Herbarium, Museum
2360	2320, 2385, 2335, 2380
2551	2615, 2621, 2640, 2545, 2551
Head house	Greenhouse, 0402

The following should provide guidelines for the response to various types if chemical spill. In each event, an accident/incident report (Appendix A) must be completed

Minor Spills

Non-flammable, 500 ml to four (4) liters

1. Move students out of affected area.
2. If corrosive, neutralize with appropriate agent from a spill kit.
3. Soak up material with absorbent from lab Spill Station
4. Place contaminated materials in appropriate disposal bag.
5. Wash area with water.
6. Fill out spill report.

Flammable, under one (1) liter but greater than 100 ml

1. Move students out of affected area.
2. Turn off ignition sources.
3. Open hood sash doors
4. Notify emergency Coordinators
5. Soak up material with absorbent from lab Spill Station
6. Place contaminated materials in appropriate disposal bag.
7. Wash area with water.
8. Fill out spill report.

Flammable, one (1) liter to four (4) liters

1. Move students out of room.
2. Turn off ignition sources.
3. Open hood sash doors.
4. Leave room and notify Chemical Hygiene Officer and/or Emergency Coordinator. After hours, notify Campus Police at 1-2445.
5. DO NOT RE-ENTER UNTIL HELP IS AVAILABLE. (Minimum of two people for cleanup).
6. If chemical vapor is a problem, do not enter without respirator
7. Soak up material with absorbent from lab Spill Station
8. Place contaminated materials in appropriate disposal bag.
9. Wash area with water
10. Fill out spill report.

Major Spills

Cyanide or sulfide solutions/gas (any amount)

1. Evacuate ALL PERSONS from all connecting laboratory areas.
2. Open Hood Sashes if possible, and make sure to close doors.
3. Notify Campus Police at 970.351-2445.
4. DO NOT enter until help is on-site
5. DO NOT enter without a respirator.
6. Make sure spill area is basic.
7. Use Spill material to surround and absorb spill.

8. Place contaminated materials in disposal bags.
9. Wash area with basic solution. Repeat washing area with water.
10. Fill out Spill Report.

Non-flammable (greater than four liters)

1. Evacuate the area.
2. Notify Chemical Hygiene Officer and/or Emergency Coordinator. After normal hours, notify Campus Police at 970.351-2445.
3. Neutralize corrosives, if possible.
4. Soak up material with absorbent from lab Spill Station
5. Place contaminated materials in appropriate disposal bag.
6. Wash area with water.
7. Fill out spill report.

Flammable Liquids (greater than four liters)

1. Evacuate the laboratory
2. Evacuate surrounding areas if low flashpoint or greater than eight (8) liters have spilled.
3. Turn off ignition sources
4. Open hood sash doors
5. Leave room and notify Chemical Hygiene Officer and/or the School Director. After normal hours, notify Campus Police at 970.351.244.
6. If greater than five (5) gallons or if material has a very low flash point, notify fire department. (911)
7. DO NOT RE-ENTER UNTIL HELP IS AVAILABLE.
8. DO NOT ENTER WITHOUT RESPIRATOR IF AIR ISSATURATED WITH VAPOR.
9. Use Spill material to surround and absorb spill.
10. Use non-sparking tools and have a fire extinguisher ready.
11. Place contaminated materials in disposal bags.
12. Wash area with basic solution. Repeat washing area with water.
13. Fill out Spill Report.

FIRES AND FIRE PREVENTION

General housekeeping and safety-minded decisions may prevent fires from occurring. Some common fire preventative housekeeping measures include the following: making sure that all aisles and exits are clear, checking electrical cords before use, using open flames or pyrophoric chemicals appropriately, keeping combustibles, e.g., paper towels, away from hot surfaces and unneeded chemicals away from heat sources.

Types of Fire Extinguishers and Proper Usage

The National Safety Council has estimated that nearly all fires that occur in the United States are easily contained with a single fire extinguisher if the fire is caught soon after ignition. In many cases the fire can be extinguished quickly without the use of a fire extinguisher. Should

one be needed, the information contained below is important to know. There are several types of extinguishers that can be used to fight small fires.

TYPE A extinguishers fight ordinary combustibles such as burning wood, cloth, paper, rubber, upholstery, and plastics

TYPE B extinguishers fight flammable liquids, gases and greases such as oils, paints, and gasoline.

TYPE C extinguishers fight energized electrical fires such as burning wires, circuit breakers, machinery, and appliances.

TYPE D extinguishers are used on fires involving combustible metals. These extinguishers are made for this specific type of material. (Adapted from http://ccfd6.org)

The typical fire extinguisher located throughout the building is an ABC extinguishers. These extinguishers are suitable for use on Type A, B, and C fires. Fire Extinguishers will be evaluated for safety by the Fire Department not less than one per year.

It is easy to underestimate a fire. Only personnel trained in the use of a fire extinguisher are allowed to use them to fight the fire. If a fire extinguisher is used, it is important to remember to stand between the fire and the nearest escape. Otherwise follow the emergency response protocol

ACCIDENT REPORTS

An accident report should be completed in the event of any accident or incident that causes injury or unwanted exposure to a chemical. In teaching laboratories, any accident, no matter how small, requires the completion *the Injury Report (available on the NHS website).* The completed form is to be filed with the Laboratory Coordinator, Chemical Hygiene Officer, and the School of Biological Sciences administrative assistant. The Safety Committee reviews all report forms periodically to determine if changes to operating procedures are needed.

Reporting procedures for incidents

Employees (non-students)

All injuries must be reported to the Office of Human Resources by way of an injury/illness report (available on the HR website)

UNC Students

All accidents and/or injuries must be reported to the NHS Dean's office by way of the Injury Report (available on the NHS website). The course instructor (or comparable) must complete the report and sign. After the student, any witnesses and the School Director signs, the original should be taken to Gunter 1000. The student and the School should keep a copy.

EMPLOYEE HEALTH MONITORING

Any employee or students who is subject to an exposure that is above the listed OSHA limit shall undergo a medical evaluation as prescribed via standards indicated by the Code of Federal Regulations (20 CFR Part 1910)

The Policy for the School of Biological Sciences at UNC is to promptly investigate incidents in which even a remote possibility of over exposure to a toxic substance. The following list includes events or circumstances that might reasonably constitute an over exposure:

- A biological material or hazardous chemical leaked, was spilled or otherwise rapidly releases in an uncontrolled manner outside of a working fume hood
- A laboratory employee had direct eye or skin contact with a biological material or hazardous chemical
- A laboratory employee shows signs of overexposure such as headache, tearing, coughing, irritation or redness of eyes, rash, irritation of the nose or throat, nausea, dizziness, loss of coordination or judgment.
- Two or more people in the same general area of a laboratory have similar symptoms
- Symptoms disappear when the employee leaves exposure area and reappear when employee re-enters the exposure area.

All complaints must be documented with memos, notes and reports related to the complaint of actual or possible exposure maintained as part of the record. The incident will be reported to the Director of EHS who will determine whether further investigation is necessary.

RECORD KEEPING

Records of exposures to hazardous chemicals that result in exposure assessments, medical consultations and medical examinations must be kept for a minimum of three years. The OSHA Laboratory Standard recommends that documents related to employee training, significant employee suggestions, exposure complaints and suspected exposures (whatever the outcome), complaints from employees (or graduate students), and investigation outcomes be documented for future reference.

TRAINING

A mandatory annual training program will be provided to undergraduate and graduate student researchers, and faculty in the School annually. Record of completion will be kept on file with the training documents for that year for a minimum of three years. Personnel that do not attend the annual training will not be allowed to enter any laboratory within the School (teaching or research) for ANY purpose. This will be noted in annual and comprehensive

reviews for faculty, and could affect the ability of the graduate student or researcher to receive an assistantship, pay, or employment.

Students in undergraduate laboratories will participate in safety training as part of the first laboratory of each semester. The training requirements for each group are different, and training is customized to address issues each group faces. All students, whether they join the course at the start of the semester or are a late admission, MUST receive the safety training. Records are to be kept of all students and the specific training each received for a minimum of three years. In all cases, the specific training will address the requirements of the OSHA Laboratory Standard.

Each student working in a research laboratory must complete Hazard Training (and the associated EHS test) each year. Completion records will be kept in the Biology Office. Students will be notified by PIs when new chemicals that are potentially hazardous are introduced into the work place. All student will additionally be trained on spill response procedures. When students are required to perform hazardous non-routine tasks a special training session will be conducted as deemed appropriate by the lab PI to inform students of possible exposure and appropriate precautions.

The following information needs to be conveyed to employees:

- The contents of the Occupational Exposure to Hazardous Chemicals in Laboratories Standard 29CFR1910.1450 and its appendices;
- The location and availability of the Chemical Hygiene Plan
- Location and availability of known reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not limited to, Safety Data Sheets (SDS) received from chemical suppliers.

STANDARD OPERATING PROCEDURES (SOPs)

The guidelines of this document focus on the standard operating procedures for the research and teaching laboratories. Should a teaching or research laboratory require SOPs beyond what is recorded in this document, the laboratory coordinator for the specific laboratory should complete a separate document on the safety requirements of that laboratory. Moreover, standard operating procedures should be prepared for ALL research laboratories by the supervisor of that laboratory, whether those procedures differ from this document or not.

All SOPs should include procedures for handling every hazardous chemical as part of any experiment performed in the laboratory. The SOP documents should also contain safety procedures for the use of instrumentation, disposal of unwanted materials, and other hazards common to the specific laboratory. The SOP should then be used to train all personnel using the specified laboratory or conducting the specified experiments in another laboratory. The training of all researchers and teaching assistants is the responsibility of the supervisor of that laboratory.

The SOP for each laboratory should be stored so that anyone has easy access. Any SOP beyond this document should be consistent with OSHA intent and the department-approved CHP. For help in creating a laboratory-specific SOP, see Young, Kingsley, and Wahl, *Developing a Chemical Hygiene Plan.*

EMERGENCY RESPONSE PLAN

In the event of an emergency, clear and concise communication procedures are essential to save lives, warn the public and protect property. For campus wide emergencies the UNC Police Center will activate the emergency alert system.

Severe Weather

During tornadoes and certain flood situations, the Police Communications Center will have to be evacuated. Once the warning has been issued, proceed with the following steps:

- Move quickly (but do not run) to the interior hall way on the first floor of Ross Hall, making sure to close the doors at both ends of the hallway and the faculty office doors. The bathrooms on the first floor of Ross can also be used.
- Bring personal belongings including cell phones
- Stay out of rooms with windows
- Do not use elevators except to assist people with disabilities
- Crouch down on the floor and cover your head with your arms
- *Do not leave the building. Await further instructions.*

Elevators

In the event that an elevator stops because of power, remain calm. Do not attempt to operate the elevator or open the doors. Use the emergency call box located inside the elevator and advise the University Police of the location and your name. Assigned personnel will respond to the elevator to assist with safe evacuation as quickly as possible. *DO NOT use elevators if the fire alarm is activated. Elevators may not be safe during a fire.*

Equipment Explosion/Chemical Spill

Call the University Police (970.351.2245). The University Police will make the appropriate response. Follow the evacuation procedures (below).

Fire Alarm Pull Station Locations/Fire Extinguishers

Ross Hall has multiple alarms and fire extinguishers located along hallways on each floor. Fire stations are generally located near exits. Please make yourself aware of where the nearest fire alarms and extinguishers are in location to your office, teaching rooms and research and teaching labs.

Health incident/Personal Injury
Emergency: Call the University Police at 911 or use an emergency phone
Non-Emergency*:* University Police: 970.351.2245; Environmental Health and Safety: 970.351.1149; Facilities Management: 970.351.2446

Keep calm and give the following information:

- Where you are
- Nature of the problem
- Who you are and the phone number from which you are calling
- What type of assistance is needed (ambulance, fire department, police, plumbers, electricians)
- If the situation of location changes, re contact the appropriate number

What to do until help arrives:

- Do not move the victim unless he/she is in further risk of injury
- If you or someone is trained in first aid, remember the ABCs
    - Airway open and maintained
    - Bleeding, control with direct pressure
    - Circulation, cardiac pulmonary resuscitation
- Keep the victim calm and reassure them that help is on the way
- If possible have someone meet the emergency responders outside the building to guide them to the exact location
- DO NOT put yourself or others in jeopardy to assist or rescue a victim of injury if a hazard still exists

Evacuation, Fire and Other.
Emergency procedures are in effect whenever the fire alarm system is activated. *Never assume that it is a false alarm.* A safe evacuation is the first priority. All personnel are responsible for evacuating the building when the fire alarm sounds. Faculty and TAs are responsible to communicate to students to evacuate the building. Upon hearing the alarm, evacuate quickly and orderly by way of the nearest exit to a safe distance (approximately 500 feet). Keep clear of emergency vehicles.

Do not use the elevators. If a door knob feels warm or hot to the touch DO NOT open the door. If there is heavy smoke stay as close to the floor as possible and breathe through a piece of clothing.

Stay with the group from your area. DO NOT re-enter the building until the all clear signal has been given. The predetermined meeting place for Biology is on the north side of parking lot E, to the north of Ross Hall.

Power Outages
All power outages (longer than a few minutes) should be reported to UNC Police 970.351.2445 and instructions that they provide should be followed.

RESOURCES

American National Standards Institute (ANSI), Standards Z87.1-2003 (Occupational and Educational Personal Eye and Face Protection Devices) and Z358.1-2004 (Emergency Eyewash and Shower Equipment).

Flinn Chemical and Biological Catalog, Flinn Scientific Inc. www.flinnsci.com

National Research Council, *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals,* National Academy Press, Washington, D.C., 2011.

National Fire Protection Association (NFPA), Standard 45 (Fire Protection for Laboratories Using Chemicals, 2004)

Occupational Safety and Health Administration (OSHA), Occupational Exposure to Hazardous Chemicals in Laboratories, the "Lab Standard," CFR 1910.1450

OSHA Hazard Communication Standard, CFR 1910.1200

Safety Audit/Inspection Manual. American Chemical Society, 2000.

Safety in Academic Laboratories. American Chemical Society, 7th ed. vols 1 (student) and 2 (faculty), 2003. (One copy of each vol FREE—call 800-227-5558.)

Young, Kingsley, Wahl. *Developing a Chemical Hygiene Plan.* American Chemical Society, 1990.

APPENDIX A

Laboratory Incident/Spill Report

DATE:

LABORATORY:

TIME:

INSTRUCTOR:

CHEMICAL AMOUNT SPILLED:

SPILL CLEANUP METHODS:

Chemical Hygiene Officer Notified? YES ___ NO ___

WAS AN INJURY SUSTAINED IN THE INCIDENT? YES ___ NO ___

IF YES, WAS AN ACCIDENT REPORT FILED? YES ___ NO ___

INCIDENT DESCRIPTION/COMMENTS:

Send Copies of this report to EHS and NHS Dean's office

APPENDIX B

School of Biological Sciences
Laboratory Safety Policies Bio XXX

Please read the following safety rules carefully. Enrollment in this course requires that you observe these policies throughout the course. Sign both copies. Leave one copy in your lab manual and turn the other copy in to your instructor.

Note: The School has a Chemical Hygiene Plan. A copy of this plan is available to you and is located XXX

1. ***ABSOLUTELY NO FOOD OR DRINK WILL BE STORED OR CONSUMED IN LAB***.
2. At all times, wear close-toe shoes and wear personal protective equipment (PPE—such as gloves and lab coats) when appropriate. For example, wear gloves whenever handling potentially hazardous materials, such as strong acids, strong bases, biological hazards, and toxicants.
3. Chemical glasses will be worn in the lab whenever working with hazardous substances.
4. Mouth pipetting is ***absolutely prohibited***.
5. Use extreme caution when using sharp instruments, such as razor blades.
6. Read labels before handling any chemicals.
7. Check with your instructors for proper discard procedures for any solutions or materials.
8. Wash your hands before you leave the lab at ***any*** time.
9. Locate the nearest fire extinguishers, fire alarms, emergency eye washes, and emergency showers. If necessary to use an eyewash or chemical shower, do so for a minimum of 15 minutes.
10. Keep your lab area clean and well-organized. Coats and unnecessary books should be stored in the drawers.
11. Broken glass should be carefully discarded into the broken glass container in the lab. Sweep up small pieces with a broom and dustpan and discard them into the broken glass container.
12. Assume that any chemicals other than distilled water are toxic and hazardous. Handle them accordingly. Any spills should be ***immediately*** covered with paper towels. Then ask your lab instructor for proper cleanup/discard procedures.
13. Children and pets are ***not*** allowed in the lab due to potential hazards to them and others working in the lab. For service animals please see the school Chemical Hygiene Plan.
14. In the event that additional emergency assistance is needed, see your instructor and/or dial 911

I (print name:_____) have read the safety rules for the lab and I understand all of the guidelines. I agree to follow these guidelines to help reduce the risks to myself and fellow classmates.

Signature_____ Date_____