College of Natural Science and Physical Education

Laboratory Handbook for Faculty, Staff and Students

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This Hand book and all its contents has been approved by

Dr. Renva Watterson- Vice president for academic affairs

Ginni Siler- Vice president/ chief human resources officer

Dr. Greg Ford- Dean of Natural Science and Physical Education

David Horace- Chief of Police GHC

Phillip Kimsey- Director of Physical Plant and Environmental Safety Officer

Jason Christian- Lab Safety Officer

Preface

This handbook is presented as an information and reference source to be used, along with other materials, as a guide to proper and safe practices in the laboratories of the College of Natural Science and Physical Education at Georgia Highlands College.

The productive and safe operation of our laboratory space is a team effort. We have a collegial community of undergraduate students, visiting k-12 students, staff and faculty all working towards the same goal; the fostering of a safe and supportive working environment. No person is exempt from laboratory policy and regulations. Everyone using or visiting the laboratories must comply with the policies regarding lab safety, equipment use and lab etiquette.

9.12.4 Environmental and Occupational Safety

The Board of Regents is committed to achieving excellence in providing a safe working and learning environment, and supporting environmentally sound practices in the conduct of institutional activities. Each institution shall, at a minimum, comply with applicable environmental and occupational safety laws and regulations, and shall designate a key member of its administrative leadership team to oversee compliance. In the absence of specific laws or regulations, each institution will follow industry standards and good management practices.

Each institution shall maintain policies and procedures to govern activities to meet the goal of comprehensively integrating occupational safety and environmental considerations, and will periodically review and update such policies and procedures.

The USG chief facilities officer is responsible for developing standards, guidelines, and processes to promote, support, and access the implementation of environmental and occupational safety management programs and initiatives.

The USG chief facilities officer shall require institutions to provide reports related to environmental and occupational safety performance and shall report such data to the Board on an annual basis (BoR Minutes, June 2009).

Remember that **you** are responsible for:

- Your own health and safety.
- The health and safety of those around you.
- The security and the safe use of equipment and facilities that you have been authorized to use.
- Understanding and complying with all laboratory policies

Safe and proper participation in the laboratories is a requirement whether as an employee or student. **Failure to do so may result in loss of laboratory privileges or termination of employment.**

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Definitions

The term “lab” has been used for several different meanings. For the purpose of our safety information, the following definitions will be used:

- Lab or Laboratory: A room where scientific scholarship activity takes place using hazardous chemicals or materials.
- Prep room or prep lab: A room where materials are prepared, stored and staged for instructional laboratory activities.
- Instructional Lab or Instructional laboratory: A room used for instructional activities.
- Instructional Laboratory Activity. Procedure performed for the purpose of instruction.
- Field Research or Study: Scientific scholarly activity conducted in an outdoor setting, on or off campus.
- Standard Operating Procedure (SOP): the protocol being used in the lab to conduct the experiment.

Emergency Procedures

This section is to provide instructions for some common occurrences. Refer to the GHC's campus safety web page for specifics on emergencies responses. http://www.highlands.edu/site/campus-safety-emergency-response-guide

Fire Alarms

Become Familiar with emergency evacuation plans for your building. When the fire alarm sounds, you must evacuate the building. Remind all in the room to take their Personal belongings (coat, keys, books, etc.) with them. You may be out of the building for a prolonged period of time.

Treat every alarm as a serious matter. You may only have seconds to evacuate.

Outdoor Sirens

The sirens outside are warnings to seek shelter indoors. In those types of situations, such as a tornado warning, other methods of notification such as automatic cell phone, text and computer pop-up will occur for those indoors.

Severe Weather

There are two types of tornado alerts issued by the National Weather Service:

TORNADO WATCH- *The formation of tornadoes is possible within and near the watch area*

TORNADO WARNING- *A tornado has been spotted on the ground or by Doppler radar. If you are in the warning area, should take action immediately to protect your life and the lives of others.*

If a **TORNADO WARNING** is issued, you may receive that information through the campus alert system. The sirens outside are to warn people outdoors and may not be heard indoors. In addition, there is no sure way to always predict and notify in the event of a tornado. It is in your best interest to stay informed of changing weather conditions and be prepared to take action.

During a Tornado Warning you may need to direct your students or others to safety during a storm warning. In general, you want to be away from windows and on the lowest floor possible.

While taking shelter for a few minutes during a tornado warning may be an inconvenience in your classes or work, the goal is to make sure we all are safe.

Injury or Illness

For any serious injury or illness, call 911, then notify campus safety, the lab safety officer or the department office and administer first aid if necessary.

Minor illness and injury can be handled by contacting the lab safety officer, lab coordinator, or campus safety.

Any injury or illness no matter how small, requires an incident report to be filled out for our records (see Appendix B)

Laboratory Accidents not Resulting in Injury

Contact the lab safety officer or lab coordinator immediately in the case of other accidents. Those will be handled as needed.

Power Failure

Remain calm. Power failure is often short term. However, if a power failure lasts for more than 15 minutes, the building must be evacuated. Emergency lighting is only for the purpose of providing light to assist evacuation, not for continuity of activities. In addition, laboratory ventilation will not be functioning in a power failure.

Whenever there is a loss of laboratory ventilation for any reason, all laboratory activities involving hazardous chemicals, chemically preserved specimens or open flame must cease as well.

Laboratory Safety Guidelines

The College of Natural Science and Physical Education is committed to providing a safe environment for all. However, laboratory safety is a mutual responsibility and requires full participation and cooperation of all involved persons - students, faculty and staff. The following Lab Safety Guidelines have been established for your protection as Faculty, staff, student or visitor. These guidelines are a part of the BOR plans, state/ federal laws and will be rigidly and impartially enforced. Noncompliance may result in a dismissal from lab, or termination of employment.

Personal Protection

1. Safety glasses must be worn in the lab when safety precautions for the activity require it. In general, if anyone using glassware, heat, sharps, projectiles and/or hazardous materials, or any other activity that may cause injury to the eye, everyone in the room is required to where safety glasses. The glasses must be of the impact protection type with splash guards and must meet ANSI Z87.1 specifications. Other eye/face protection may be required with specific procedures. All students will be provided with their first pair for free out of their student fees, after that they will need to purchase their own, as extras may or may not be available in the lab.
2. Contact lenses are discouraged. The safety of wearing contact lenses in laboratories has been hotly debated over the last several years. Both the ACS and OSHA have issued statements indicating that contact lenses can be worn if and only if proper protective eyewear is also worn. In addition, they cannot be worn when working with specific chemicals or situations. The College of Natural Science and Physical recognizes that some eye conditions require contacts for certain vision correction therapies. However, students who choose to wear contacts must recognize the inherent increased risks - they are difficult to remove if chemicals get in the eye, they have a tendency to prevent natural eye fluids from removing contaminants, and sudden displacement can cause visual problems that create additional hazards. Soft contact lenses are especially problematic because they can discolor and also absorb chemical vapors causing damage before the wearer is alerted to the problem. If you choose to wear contacts, please tell your lab instructor or PI and check the procedure you are doing.
3. Appropriate gloves will be provided when needed. Use of gloves is required for handling chemicals, microorganisms and chemically preserved specimens.
4. Remove your gloves and wash your hands before exiting a lab room. Do not wear your gloves in the hallway. Use the “one glove rule” when transporting materials in the hall.
5. Appropriate clothing is required. Your clothing is a barrier between your skin and chemicals. No bare midriffs. You must be covered to the ankle to protect your legs. Knee length shorts and dresses are only acceptable in labs where chemicals are not being

used, but not recommended. Lab coats are recommended and are available in each appropriate lab.
6. Shoes must be worn. No sandals open toed or open heeled shoes. Shoes must cover the entire foot.
7. Secure loose clothing and long hair when working with equipment, open flame, any chemicals or biological substances.
8. Do not eat, drink (including coffee cups, sport bottles and water bottles). Do not store food in the labs.
9. Do not apply cosmetics in the lab. You should avoid touching your eyes and mouth in the lab.
10. Smoking or use of other tobacco products is prohibited.
11. Wash hands after working with chemicals and biological agents.
12. It is the recommendation of this department that all students of reproductive age, especially women who have recently conceived or are anticipating conception during the semester, discuss the course content and reagents with their physician if they have any concerns.

General Lab Rules

1. Conduct yourself in a responsible manner at all times in the laboratory.
2. Avoid working in the lab alone.
3. Learn where the safety and first-aid equipment is located. This includes fire extinguishers, fire blankets, and eyewash stations.
4. Read all instructions carefully and plan your work. Understand the experiment and if in doubt, ask.
5. When first entering a lab room, do not touch any equipment, chemicals, or other materials in the laboratory area until you are instructed to do so.
6. Follow the Standard Operating Procedure (SOP) or lab instructions – Any deviation from this must be in writing and approved beforehand.
7. Treat any equipment with care and respect. Be aware of any related hazard. Do not operate any equipment without proper permission and instruction. Follow the SOP for that equipment.
8. Lab tables should be as uncluttered as possible to allow work space and avoid accidents. Also, keep the aisles clear to prevent tripping over your gear, and so that other people can pass unhampered. Place book bags, pocketbooks, etc. under the lab tables. In some labs, seats or stools are not to be used during labs – individuals need to be mobile to avoid possible spills and are not to place themselves under the edge of the lab bench where chemicals may spill.
9. Leave the lab area clean. Put equipment and chemicals away and wipe off the bench top.
10. Treat chemicals with respect and understand the chemicals you are using. Read the label carefully when removing a chemical from the shelf. Read the Safety Data Sheets (MSDSs) before you begin to work with the chemical. SDS are available in the red binders in each room. Do not remove the SDSs from the binders. Bring the binder to the Department or lab coordinators office to request a copy.

11. Always label a culture or chemical with the proper information. Name of item, date made, concentration, your name/initials, hazard information and class or procedure.
12. Use the chemical fume hood to carry out procedures in which noxious fumes are produced or there is a danger of explosion or when using a concentrated form of a chemical. Do not use a biological safety cabinet/ laminar flow hood for this purpose.
13. When preparing a dilute acid solution, never pour water into concentrated acid; always pour acid into water while stirring constantly. Cool the solution if necessary while mixing.
14. Handle all living organisms used in a laboratory activity in a humane manner. Preserved biological materials are to be treated with respect and disposed of properly
15. Treat all microorganisms as potential pathogens. Always us sterile (aseptic) technique when handling cultures. Use a biological safety cabinet with potential airborne pathogens.
16. Students are never permitted in the storage rooms or preparation areas unless given specific permission.
17. Lab activities require your undivided attention. No loud music or other entertainment allowed in labs. Radios, IPods and other entertainment devices should be played at a low volume so that you can hear what is happening in your surroundings.
18. No cellular phone use is allowed while you are performing any laboratory activity. It is recommended you keep your cell phone on your person to summon help if needed.
19. Notify the lab safety officer or lab coordinator immediately in case of an accident, no matter how small it seems. Contact information is located in every lab room.

Disposal of Wastes:

1. Do not dispose of chemicals in the sink. (Rule of Thumb: If you don't want to drink it, don't dump it in the sink). There is a waste collection area in every room. Be sure to dispose of chemicals in the proper waste collector. Do not mix chemical waste without being instructed to do so**. Any container that is used to collect chemical waste must be properly labeled and closed at all times unless actively pouring into it.**
2. Properly dispose of animal tissue, cultured cells and microbial plate cultures in the red or orange biohazard bags. Never throw biological or biohazardous waste in lab garbage cans. Never place biohazard bags in the trash cans until properly sterilized.
3. Dispose of broken glass in the cardboard "broken glass box" in your lab.
4. Place "Sharps" (scalpels, needles, razorblades, etc) in the sharps boxes.

Do not place general trash in the any of the specialized collection containers.

Who to Contact

If you have any questions, the following are your safety resources:

- Lab Safety Officer/ Lab Manager

  Jason Christian, Rome W-241, O: 706-368-7532, C: 940-273-9710,

  jachrist@highlands.edu

- Physical Plant Director

  Phillip Kimsey, Rome, 706-368-2283 pkimsey@highlands.edu

- Campus safety

Floyd Campus	Campus Safety Cell Campus Safety Office	(706) 252-4813 (706) 295-6347
Heritage Hall Campus	Campus Safety Cell Campus Safety Office	(706) 252-4817 (706) 802-5004
Cartersville Campus	Campus Safety Cell Campus Safety Office	(706) 252-2018 (678) 872-8300
Marietta Site	Campus Safety Office/Dispatch	(678) 915-7348
Paulding Campus	Campus Safety Cell Campus Safety Office	(770) 276-5383 (678) 946-1102
Douglasville Campus	Campus Safety Cell Campus Safety Office	(706) 252-2704 (678) 872-4226

Guidelines for the Use of Chemicals

Safety Data Sheets (SDS, formerly MSDS)
Every laboratory room should have an SDS manual (red binder) in the front of the room, out in the open for instant access. Every chemical in the room should have an SDS in the binder. If you are bringing in a chemical, you must also add the SDS to the binder.
Please keep the SDS binders in plain sight and near the front of the room if possible.

MSDSOnline
MSDSOnline.com is the SDS database used to procure, and maintain all chemicals at GHC. All chemicals need to be recorded in the system. No purchases can be made or no chemicals can be brought on campus without going through MSDSOnline.

Currently, MSDSOnline is being handled centrally by your department Lab Safety Officer.

Note: Chemicals should only be stored or used in rooms that are designed with the proper ventilation and fire protection for such a purpose. Do not store or use chemicals in classrooms or offices. If hazardous chemicals are to be used outside of the laboratory areas, consider safer alternatives and/or develop a SOP for their use.

Storage of Chemicals
It is unsafe to simply store chemicals alphabetically. Our chemicals are stored by classification, identified by color using vinyl tape. Due to the lack of a true universal classification system, we have adopted the ChemAlert Safe Storage Plan with one modification of dividing corrosives into two categories, acids (white) and bases (black).

The color classification is as follows:

Gray No particular storage hazard.
Red Flammables
Yellow Oxidizers
Blue Health hazards
White Acid
Black Bases

In addition, some chemicals are kept in poison cabinets, flammable cabinets and corrosive cabinets.

Flammables and acids also have the caps wrapped with electrical tape to prevent the escape of fumes.

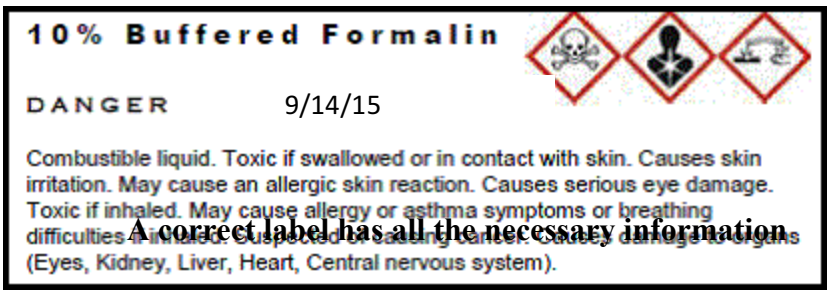
Secondary Container Labeling
Any container that is not empty has to have a label. Even if it is just water, it has to say so.

If the Secondary container is intended for use in less than one day then it must be at least labeled with the identity of the chemical.

Any lab activity that utilizes an "unknown" system for testing or examination, must keep the unknown in a properly labeled container and only the amount need for that lab is distributed immediately before or during the lab.

Labels for secondary containers with the intent on storage longer than one day, have to be in the following form:

1. Chemical name (product identifier)
2. Concentration
3. Date prepared
4. Pictogram
5. Hazard statement (flammable, oxidizer, poison, health hazard, etc). Add the specific hazard if it is known or listed in the SDS (carcinogenic, etc.)
6. Signal word
7. **Never** have a container of any kind unlabeled, for any length of time (even if it is only water).



A correct label has all the necessary information

1,2,3-

trinitroxypropane

WRONG!
This label does not give information if it is spilled, splashed, involved with a fire, etc. Labeling is to protect others who encounter it and might not know the contents and or hazards!

Waste
All chemical waste **MUST** be marked as **"HAZARDOUS**" or "**NON-HAZARDOUS**."
DO NOT set out a container that says "waste" or "acetone waste." That is a violation and **WE WILL BE INSPECTED, WE WILL BE FINED**.

All chemical waste containers must have a tight fitting lid and be closed AT ALL TIMES unless you are actively pouring into it. Otherwise, that is a violation and we will be fined. **Foil, parafilm, plastic, an upside down beaker, or the like are not a tight fitting lid!** This means beakers, flasks, etc… cannot be used as waste containers during a lab and then transferred to a secondary container at end of lab. Students can dispose of their own waste directly in secondary container.

Proper labeling and dating are very specific in regulation and differ for the type of waste. Disposal of waste should be planned in advance to ensure proper handling for safety and compliance.

If a project is completed, disposal of unused chemicals will prevent an unsafe accumulation of unwanted hazardous materials.

Safe Fume Hood Use Guide

Fume hoods are devices designed for work with toxic or hazardous chemicals with the effect of safely capturing the harmful gases, vapors, and fumes generated and exhausting them to the outside air. The fume hood is very effective if installed and used properly and maintained in good working order. Fume hoods are not just fixtures but are installed into the ventilation system of a building and so affect the ventilation of the entire building and the exhaust at the stack. As a result, fume hood function and proper installation not only affects your safety but the safety of others in the building.
The primary parts of the fume hood are:

Face – The face of the hood is the opening where air capture takes place.

Sash – The sash is the glass "window" that travels in the plane of the hood face that opens or closes the hood and protects the user during use.

Baffles – The baffles are located in the back of the hood and direct air in the appropriate direction. The baffles can also be adjusted to account for different vapor densities of chemicals (heavier than air and lighter than air).

Duct – The duct connects the hood to the ventilation system and exhausts to the outside air.

Air foil – The air foil is fixed to the bottom front edge of the hood and is a vent that keeps a minimum gap open at all times but more importantly gives aerodynamic properties that allow better, less turbulent air flow and better capture.

Function:
As the user works at the sash, the air is drawn in at a laminar (even) flow and ideally at about 100 feet per minute. With regard to capture, we are only concerned with velocity (fpm) because this is what actually carries vapors and particles. The air volume is of more concern to the designers of the ventilation system. The air is drawn around the baffles and up to the duct like a chimney. The space around the baffles (slots) can be adjusted so air flow is concentrated at desired areas of the hood. For instance, if a chemical of high vapor density is being used, such as Chloroform, then the baffles may be adjusted to draw more air from the bottom of the hood where the vapors are expected to collect. Standard baffle setup (middle selection) is recommended for most operations with a variety of chemicals and other configurations may be explored if the work is mainly a specific application. It is important for there to be at least an inch or two opening for the rear lower baffle since many vapors handled in hoods are heavier than air.

Safety Guidelines for fume hoods

- Keep the sash as low as possible to minimize the risk of exposure. The sash acts a safety shield and protects your face, so you should be looking through the sash to perform your work. The green arrows are a good guideline for sash position, but sash height should be adjusted depending on the height of the person using the hood.
- Keep lab doors and windows closed. These extra sources of inlet air can: affect the performance of the hood, cause turbulent air currents in the room or cause the room to loose its negative pressure.
- Reduce clutter and do not store large amounts of chemicals in the hood. Excess clutter and chemicals can impede airflow especially to the lower openings. Necessary bottles and equipment should be elevated an inch or two to allow airflow underneath to the rear baffles (a small shelf or blocks of some kind will work for this). Excess chemicals can be a hazard in themselves due to their properties. Store chemicals in cabinets or on shelves, except for the chemicals you need immediately for the work at hand.
- Work at least 6 inches into the hood from the plane of the sash. This will reduce the risk of eddy currents blowing vapors back at you and will maximize capture ability of the hood.

- If hoses or cords must be inserted through the face of the hood, run them underneath the airfoil so the sash can close completely.

Other considerations

- If there is a potential for an explosion hazard due to the chemicals you are using or the experiment you are conducting, special shielding should be used in addition to the sash.
- Protect against blockage of ducts. Lightweight materials such as aluminum foil or tissues can be sucked into the vents and reduce the performance of the hood.
- Run water in hood drains periodically so they do not dry out. Open drains can possibly affect airflow and can cause nuisance odors.
- In a power outage, lower the sash to within an inch or two so the chimney effect will keep some air flowing into the hood and contain any vapors.
- Whenever you are not using the fume hood, always close the sash of the hood as low as possible. Closing the fume hood sash provides added protection of better capture ability of any chemicals being stored in the hood as part of an experiment and also greatly enhances energy conservation measures for the laboratory.
- Some hoods have an emergency exhaust that can be employed in an emergency.

Compressed Gases

Many laboratories require the use of compressed gases for a variety of different operations.

Compressed gases present a unique hazard. Depending on the particular gas, there is a potential for simultaneous exposure to both mechanical and chemical hazards.

Gases may be:

- Flammable or combustible
- Explosive
- Corrosive
- Poisonous
- Inert
- or a combination of hazards

If the gas is flammable, flash points lower than room temperature, compounded by high rates of diffusion, present a danger of fire or explosion. Additional hazards of reactivity and toxicity of the gas, as well as asphyxiation, can be caused by high concentrations of even "harmless" gases such as nitrogen.

Since the gases are contained in heavy, highly pressurized metal containers, the large amount of potential energy resulting from compression of the gas makes the cylinder a potential rocket or fragmentation bomb

Careful procedures are necessary for handling the various compressed gases, the cylinders containing the compressed gases, regulators or valves used to control gas flow, and the piping used to confine gases during flow.

The contents of any compressed gas cylinder must be clearly identified. Such identification should be stenciled or stamped on the cylinder or a label. Commercially available three-part tag systems may also be used for identification and inventory.

No compressed gas cylinder should be accepted for use that does not legibly identify its contents by name. if the labeling on a cylinder becomes unclear or an attached tag is defaced to the point the contents cannot be identified, the cylinder should be marked "contents unknown" and returned directly to the manufacturer.

Never rely on the color of the cylinder for identification. Color coding is not reliable because cylinder colors may vary with the supplier. Additionally, labels on caps have little value because caps are interchangeable.

Handling & Use

Gas cylinders must be secured at all times to prevent tipping.

Cylinders may be attached to a bench top, individually to the wall, placed in a holding cage, or have a non-tip base attached. Chains or sturdy straps may be used to secure them.

If a leaking cylinder is discovered, move it to a safe place--if it is safe to do so--and inform Campus safety and the lab safety officer. You should also call the vendor as soon as possible.

Under no circumstances should any attempt be made to repair a cylinder or valve.

Standard cylinder-valve outlet connections have been devised by the Compressed Gas Association (CGA) to prevent mixing of incompatible gases. The outlet threads used vary in diameter; some are internal, some are external; some are right-handed, some are left-handed. In general, right-handed threads are used for non-fuel and water-pumped gases, while left-handed threads are used for fuel and oil-pump gases. To minimize undesirable connections, only CGA standard combinations of valves and fittings should be used in compressed gas installations; the assembly of miscellaneous parts should be avoided. The threads on cylinder valves, regulators and other fittings should be examined to ensure they correspond and are undamaged.

Cylinders should be placed with the valve accessible at all times. The main cylinder valve should be closed as soon as it is no longer necessary that it be open (i.e., it should never be left open when the equipment is unattended or not operating). This is necessary not only for safety when the cylinder is under pressure, but also to prevent the corrosion and contamination resulting from diffusion of air and moisture into the cylinder after it has been emptied.

Cylinders are equipped with either a hand wheel or stem valve. For cylinders equipped with a stem valve, the valve spindle key should remain on the stem while the cylinder is in service. Only wrenches or tools provided by the cylinder supplier should be used to open or close a valve. At no time should pliers be used to open a cylinder valve. Some valves may require washers; this should be checked before the regulator is fitted.

Opening of Cylinder Valves

Cylinder valves should be opened slowly. Oxygen cylinder valves should be opened all the way. Open up the oxygen cylinder valve stem just a crack. Once the needle on the high pressure gauge has stopped, open up the valve all the way. This back-seats the valve. Oxygen cylinders must have the valve opened up all the way because of the high pressure in the cylinder. There is a back-seating valve on the oxygen cylinder. This prevents the high-pressure gas from leaking out through the threaded stem.

When opening the valve on a cylinder containing an irritating or toxic gas, the user should position the cylinder with the valve pointing away from them and warn those working nearby.

Cylinders containing flammable gases such as hydrogen or acetylene must NOT be stored in close proximity to open flames, areas where electrical sparks are generated, or where other sources of ignition may be present.

Cylinders containing acetylene shall never be stored on their side.

An open flame shall never be used to detect leaks of flammable gases. Hydrogen flame is invisible, so "feel" for heat. One common practice is to use a natural bristle broom to "sweep" the air in front of you. All cylinders containing flammable gases should be stored in a well-ventilated area.

Oxygen cylinders, full or empty, shall not be stored in the same vicinity as flammable gases. The proper storage for oxygen cylinders requires that a minimum of 20 feet be maintained between flammable gas cylinders and oxygen cylinders or the storage areas be separated, at a minimum, by a fire wall five feet high with a fire rating of 0.5 hours. Greasy and oily materials shall never be stored around oxygen; nor should oil or grease be applied to the fittings.

Regulators are gas-specific and not necessarily interchangeable!

Always make sure that the regulator and valve fittings are compatible.

After the regulator is attached, the cylinder valve should be opened just enough to indicate pressure on the regulator gauge (no more than one full turn) and all the connections checked with a soap solution for leaks. ***Never*** use oil or grease on the regulator of a cylinder valve.

If there is any question as to the suitability of a regulator for a particular gas, check with the call the vendor for advice.

The following rules should always be followed in regards to piping:

- Copper piping shall not be used for acetylene.
- Plastic piping shall not be used for any portion of a high pressure system.
- Do not use cast iron pipe for chlorine.
- Do not conceal distribution lines where a high concentration of a leaking hazardous gas can build up and cause an accident.
- Distribution lines and their outlets should be clearly labeled as to the type of gas contained.
- Piping systems should be inspected for leaks on a regular basis.
- Special attention should be given to fittings as well as possible cracks that may have developed.

A cylinder should never be emptied to a pressure lower than 172 kPa (25 psi/in2) (the residual contents may become contaminated if the valve is left open). When work involving a compressed gas is completed, the cylinder must be turned off, and if possible, the lines bled.

When the cylinder needs to be removed or is empty, all valves shall be closed, the system bled, and the regulator removed. The valve cap shall be replaced, the cylinder **clearly marked as "empty,"** and returned to a storage area for pickup by the supplier.

Empty and full cylinders should be stored in separate areas.

Where the possibility of **flow reversal** exists, the cylinder discharge lines should be equipped with approved check valves to prevent inadvertent contamination of cylinders connected to a closed system. "Sucking back" is particularly troublesome where gases are used as reactants in a closed system. A cylinder in such a system should be shut off and removed from the system when the pressure remaining in the cylinder is at least 172 kPa (25 psi/in2). If there is a possibility that the container has been contaminated, it should be so labeled and returned to the supplier.

Liquid bulk cylinders may be used in laboratories where a high volume of gas is needed. These cylinders usually have a number of valves on the top of the cylinder. All valves should be clearly marked as to their function. These cylinders will also vent their contents when a preset internal pressure is reached, therefore, they should be stored or placed in service where there is adequate ventilation.

All compressed gas cylinders, including lecture-size cylinders, must be returned to the supplier when empty or no longer in use.

Always use safety glasses (preferably with a face shield) when handling and using compressed gases, especially when connecting and disconnecting compressed gas regulators and lines.

Transportation of Cylinders

The cylinders that contain compressed gases are primarily shipping containers and should not be subjected to rough handling or abuse. Such misuse can seriously weaken the cylinder and render it unfit for further use or transform it into a rocket having sufficient thrust to drive it through masonry walls.

1. To protect the valve during transportation, the cover cap should be screwed on hand tight and remain on until the cylinder is in place and ready for use.
2. Cylinders should never be rolled or dragged.
3. When moving large cylinders, they should be strapped to a properly designed wheeled cart to ensure stability.
4. Only one cylinder should be handled (moved) at a time.

Safety Training and Laboratory Access

Safety Training

Everyone having access to the laboratories is required to have the appropriate training. All new employees and student assistants will attend a new employee lab safety training session before having access to any of the labs. All personnel will also have to take an annual refresher either online or on campus. Access will be granted by the Lab Safety Officer after the appropriate training. Key access could be withheld if the new employee or annual training is not completed. Training shall cover the appropriate topics and a record of the training will be maintained by Lab Safety Officer.

Lab Visitors

Short-term, casual visitors, such as those touring a laboratory or several labs and outside repair vendors will be accompanied and supervised by qualified GHC personnel. They are also required to follow all safety rules as well. It is the responsibility of the chaperone to enforce the safety rules.

Children are not allowed in the laboratories at any time unless part of an organized GHC sponsored or approved program. The supervising faculty or staff member of the program is wholly responsible for enforcement of the safety rules.

GHC has a policy for volunteers who may want to work in a lab. Volunteers, as well as other visitors such as consulting researchers, service workers and Plant Operations personnel will require proper training before receiving access to the lab areas.

Laboratory Access

Key access will be granted by the Lab Safety Officer or Dean of Natural Science after training following the GHC campus policy for key access.

The following pages contain the outline for on-campus training topics and the sign-in as the record.

Georgia Highlands College
College of Natural Science and Physical Education
Laboratory Safety Training Outline

This training outline provides list of topics to be covered in on-site laboratory safety training.

Occupational Safety and Health Administration (OSHA)

1. Purpose
2. Laboratory Standard
3. Right to know

Chemical Hygiene Plan (CHP)

1. Description

Emergency Action Plan (EAP)

1. Description

Bloodborne Pathogen Exposure Control Plan

1. Description

Laboratory Handbook

1. Description

Personal Protection

1. Proper attire
    a. Clothing
    b. Shoes
    c. Accessories and hair
    d. Electronic devices
2. PPE
    a. Eye protection
        1. Safety glasses
        2. Goggles
        3. Face shields.
        4. Contacts
    b. Gloves
3. Food and Drink
4. Awareness
5. Handwashing

General Lab Rules

1. Conduct
    a. Be responsible
    b. Locks
    c. Computers

2. Cleanliness
3. Equipment
    a. Training
    b. Use
    c. Moving
    d. Repair
4. Glassware
    a. Washing
    b. Breaking
    c. Proper type
    d. heating
5. Compressed Cylinders
    a. Hazards
    b. Storage and Handling
6. Supplies
7. Safety Shower
8. Eye wash
9. Fume hood
10. Waste Disposal
11. Spills

Chemical Handling

1. MSDSOnline.com
2. Storage codes
3. Labeling
4. Waste

Directed study students.

1. Plan ahead
2. Watch materials
3. Make your supervisor supervise!
4. Room Access

Student assistants:

1. Be punctual, both in showing and responding
2. Plan your studying
3. Take charge of your area
4. You are a representative of the department
5. Room Access

Georgia Highlands College
College of Natural Science and Physical Education

Laboratory Safety Training
Participant Record

Trainer_____ Date _____

Duration of Training_____

Name (print)	GHC #	Position and Dept.	Signature	Supervising Faculty

Positions: D = Directed Study/Methods Student, SA = Student Assist., F = Faculty, S = Staff, O = Other

Field Study Guidelines

Field research and study are an integral part of the biological sciences. Frequently, the nature of data collection or study requires the investigator to encounter physical and biological hazards as part of their fieldwork. Recognizing the inherent hazards associated with field work can help prevent injuries and illnesses associated with the tasks and result in a successful collection or field study. This document is intended to prevent illness and injury associated with field work and to serve as a guideline for all labs, field courses, and research conducted through the College of Natural Science and Physical Education.

Before Entering the Field

Safety must be considered as an integral component of any course or research project. The faculty advisor presiding over a course or project is ultimately responsible for safety. Before taking visitors or students into the field, or allowing them into the field without direct supervision, consider hazards that will be encountered including terrain, biological hazards, weather, crime, disease, or trauma and follow the protocols included in this document along with any other specific procedures identified in site-specific or process-specific plans. Consider the students' (and your own) relative fitness level before sending them on arduous tasks. In regions of elevated temperature, consider heat stroke, heat stress, and dehydration. In cooler climates or areas of water saturation, consider hypothermia. Leave an itinerary on file with the department including dates, contact information, and locations for all field excursions. Emergency contact information must be collected from each student beforehand. Students should be queried regarding special conditions (visible or hidden disabilities), special medical conditions (e.g., diabetes, allergies, epilepsy, etc.), or special accommodations. First aid kits should be carried in the field with adequate capacity to treat potential injuries that can be encountered. Instructors should be trained in First Aid. Consult your checklist to ensure all information and equipment are accounted for.

Safety Equipment

A list of safety equipment should be prepared and checked over before leaving. Examples include emergency road repair kit, flashlights, flares, proper clothing, water purification, medications, and specialized equipment (GPS, compass, charts, climbing gear, etc.).
Each supervisor should create an equipment and safety checklist specifically designed and routinely modified for the location of their project (SOP). Use the equipment and safety checklist *before* you leave for the field.

Working in the Field

Use teamwork or at a minimum the buddy system for field classes or special assignments requiring arduous or dangerous fieldwork. Know your own and your field associate's limits and do not exceed them. One injured, ill, or seriously exhausted team member can reduce the functioning of the entire team. You should never be alone in the field. If you get separated, retrace your steps, back to the start point if necessary, until you find your group. Students are to tell their supervisor where they are working and are to stick to their prescribed routes or locations.

Conduct of Students and Workers

Dangerous horseplay, or other risky behaviors not related to research (e.g., firearm use, rock

climbing, placing oneself in other harmful situations unnecessarily), will not be tolerated. The use of alcohol and non-medicinal drugs during University business is prohibited.

Accidents
Most accidents are related to slip, trip or fall. Wear proper footwear and choose paths of travel carefully, paying particular attention to streams, loose rocks, and steep pitches.

Communications
Students entering remote areas should bring a cell phone or use two-way radios. Emergency numbers and contacts should be compiled in advance. In areas of poor communication, or during a field emergency, one person should be appointed as the communications liaison. If necessary, a runner can be used between the central communicator and field unit.

Crime or Violence
Areas with dangerous activities should be approached with prudence. Some areas very close to home can be potentially dangerous when alone or if working at night. If a threatening condition occurs, relocate to a safer location such as locked car, populated area, or well-lighted area if possible. Keep belongings, particularly small and expensive items (cameras, instruments, backpacks, etc.) either locked up or with you at all times. Maintain a group or buddy system when working in areas of crime See resources below.

Vehicle Safety
Students taking their own vehicle or driving others in their personal vehicles are responsible for the welfare of all riders. Vehicle load limits apply and seatbelts must be available for each person. Any driver of a University vehicle, or a vehicle rented by the university, must meet the minimum age specified on the rental agreement, have a valid Georgia driver's license, meet all GHC and DOAS requirements and must follow all vehicle safety laws. Vehicles must be rented through a company that has a GHC rental agreement.
Most fatal field accidents are related to vehicle travel. Drivers will use common sense and operate their vehicles in a conservative manner. Drivers should constantly remember their responsibilities and that their actions could affect the safety and lives of their occupants. Stop if too tired to continue safely. All highway and local by-laws, rules, and regulations must be strictly adhered to. Private and university vehicles are not to be used for recreational or unsafe purposes while conducting university business.

Boats and Watercraft
Operation of boats or watercraft must comply with all pertinent regulations dictated by the United States Coast Guard, local authorities, or meet the requirements of the jurisdictional waters they apply. Any student operator must be checked out by an experienced faculty or field advisor. This includes the operation of human or sail-powered watercraft such as sailing dinghies, kayaks, canoes, etc. Safety equipment shall include PFDs, flares, handheld radio, and emergency supplies as deemed appropriate for the situation. All equipment and supplies should be checked before each excursion.

Medical and First Aid
Health risks are specific to area of travel. Consult health advisories for necessary immunizations

or other precautions. Sites such as consulates, the CDC (see resources) are good sources for information. Carry a copy of your medical insurance agreement for emergency treatment.
First aid training is recommended for all participants. Environmental conditions such as exposure, dehydration, heat stroke and heat exhaustion must be considered in advance.
Make a first aid kit checklist (cold compresses, burn kit, dressings, etc.).
Standard first aid kits usually need augmentation tailored to specific field conditions.
Antihistamines, analgesics, disinfectants, and in some cases sutures and anti-venom may be necessary. Preexisting conditions placing field workers at risk, or those under medication that may affect their ability in the field, must be identified to the field supervisor in advance.

Special Field Considerations
Recognize the potential for wildlife encounters with venomous insects and dangerous plants (poison oak, briar, etc.) and animals (snakes, mountain lions, jellies, etc.).
Animal sampling, trapping and handling techniques must be written into a protocol that includes the safety risks.
Consider communicable diseases (hemorrhagic fever, hanta virus, rabies, Lyme disease, etc.).
Consider training options. Discuss risks and hazards and incorporate preventative measures.

Each Field Station or site should have specific safety protocols outlined that also must be observed. These will detail specific hazards associated with that location.
Most field sampling activities should have an SOP. Be sure to follow the proper procedure.

Chemical Safety
Prudent practices used in the laboratory extend to the field. Proper personal protection (gloves, dust masks, respirators if necessary) should be worn. All chemicals transported (fixatives, solvents, etc.) must be transported in a labeled and durable secondary container. Any hazardous wastes must be disposed of properly and legally. SDS sheets should be available in the field handbook and the hazards and safe handling reviewed by anyone who may come into contact with the chemicals.

Emergency Notifications
Lab Safety Officer and/or Department Dean must be notified of any serious injury, fatality, or other tragedy associated with the Department as soon as possible, but absolutely within 24 hours.

Acquiring Materials and Supplies

Laboratory materials can be provided from many funding sources. There are many sources for funding and can be specific as to what can be purchased. These budgets require approval from the department Dean for any purchases. In addition, any purchases made with the student lab fee fund must be used for items that students will be directly involved in.

Equipment and supplies purchased for instructional laboratory activities are for those uses only. Do not take items from the instructional laboratory rooms and the prep rooms. Neither of these areas maintain general supplies for all to take. A rule of thumb, unless you are prepping an instructional lab, you do not belong in the prep room nor can you take anything from there.

Purchase Requests

Always consult with the Lab Safety Officer/ Lab Coordinator or others who are making purchases for you before you begin to search for products to purchase. There are specific rules for several different commodity categories involving vendors and preapprovals.

When requesting a purchase, provide the list with description of the items, catalog number, vendor and quantity. Please do this by email (preferred) or some other written form. DO NOT send large spreadsheets or complicated Word documents. A simple list is all that is needed.

Quotes

Prior to requesting a quote from a vendor, consult the Lab Safety Officer/ Lab Coordinator or other purchaser to ensure compliance with all appropriate policies.

Inventory

Most equipment items are inventoried. Approval is required before taking anything off of campus. Loaning equipment is not allowed without special approval.

Repairs

Contact the Lab Safety Officer/ Lab Coordinator or other purchasers if equipment purchases are needed. Special procedures and approvals may be needed before a service technician can begin service.

Guidelines for Student Laboratory Assistants

Student Laboratory Assistants for the College of Natural Science and Physical Education are part-time employees of Georgia Highlands College. The assistants are a vital part of a team effort directed toward the education of students in the sciences. As such, they are depended upon to be responsible and reliable support personnel in a variety of laboratory settings.

Responsibilities of Student Laboratory Assistants include any or all of the following: Preparation of media and solutions, care of laboratory animals and plants, setting up of experiments, care of laboratory instruments, equipment, glassware and facilities. Duties and assignments range from semi-skilled routine tasks to highly specialized technical procedures.

General Personnel Information

Student Laboratory Assistants are employed on a semester-to-semester basis as the need for assistants arises. Student laboratory assistants are assigned to courses or "at large' at the beginning of the term. Student Laboratory Assistants are employees of GHC and are expected to act in a professional manner, follow and encourage others to follow safety rules, practice good personal habits and be able to work productively with others. Failure to do so could result in re-assignment or termination.

Supervision

Student Laboratory Assistants are hired by the Laboratory Manager of the department and supervised by the same, with cooperation of the faculty and staff of the department.

Pay Period

- The work week for Student Laboratory Assistants starts on Saturday at 12:01 am and ends the following Friday at midnight. **Student laboratory assistants are permitted to work a maximum of 19 hours per week.** The maximum applies even if a student works in more than one department. The combined total should not exceed 19 hours. No promises are ever made to provide a student a consistent number of hours each week.
- For purposes of payroll, the two-week period is the official pay period. Each individual week is considered separately regarding compensation time calculations.
- Students are paid on Friday of the week following the due date for electronic timecard system, ADP.

Attendance, Tardiness and Absenteeism

- All Student Laboratory Assistants are advised of their work hours when they are hired. For the University and the Department to maintain a smooth and consistent operation, its employees must report to work at the designated time and remain on duty in accordance with his/her schedule.
- All Student Laboratory Assistants are expected to report to work promptly at the beginning of their workday and after meal breaks. There are seldom replacements for someone tardy or absent so make arrangements to cover your labs. If any employee finds it necessary to be absent or late for work, such absences or tardiness must be immediately reported to the Lab Coordinator. **It is important that you speak to a live person rather than leave a message or send an email** so your duties can be covered by someone else.

  It is important that you plan your studies and your work schedule carefully. It is better for the department to plan on having someone else do the job from the beginning than to replace you at the last minute. You have two important responsibilities; you are a student and a student assistant.

A record of tardiness or absenteeism may result in disciplinary action, and can eventually result in termination of employment. In addition, disruptive or uncooperative behavior will not be tolerated among the student assistant workforce. Those doing so will be terminated.

Reporting Hours

In all cases, student laboratory assistants are expected to maintain and report the appropriate information on their ADP time cards. Send an email to your supervisor for any clocking errors or discrepancies.

The ADP time records must be a true reflection of the time worked each day. Any attempt to defraud GHC by supplying false information will result in termination.

Duties of the Student Laboratory Assistants

Student assistants may be responsible for setting up labs, making solutions, supplying all glassware, instruments, and equipment, and monitoring the successful completion of experiments, keeping the lab clean and in order at all times, as well as other duties not listed here. All student laboratory assistants will receive job-specific safety and operational training

Special attention should be given to the chemicals and supplies. You should check two weeks in advance of what will be needed to allow for supplies to be ordered. If supplies are needed it should be brought to the attention of the lab coordinator as soon as possible It is best to do so in writing so it is not forgotten (note, email, etc.). The same attention should be given to the equipment. If something is not functioning properly, it should be brought to the attention of your

supervisor. When setting something aside for repairs, label it with the condition, your name and the date. Inform the lab coordinator as soon as possible.

Some guidelines to follow for all student laboratory assistants

- Wear eye protection whenever you are in the lab.
- Make sure all materials and supplies are returned to their proper location.
- Report any accidents to the instructor or lab coordinator no matter how small they may seem.
- Always wear the proper attire. A lab coat is recommended.
- Do not force glass tubing or thermometers through rubber stoppers. Lubricate the tubing and introduce it gradually and gently. Grip the glass near the insertion point to prevent excess torque. Protect your hands with a towel when you are inserting lubricated tubing into stoppers or when you are cutting glass.
- Check glassware for chips or cracks before washing. Place glassware for repair in a designated area.
- Always rinse glassware immediately after use. This rinse minimizes the amount of cleaning later on. Once a chemical has dried on glassware, it is difficult to remove. Some special situations may require rinsing with deionized water.
- Scrub **all** surfaces of the glassware with a brush. Remove **all labels** and any dried on dirt. Sometimes a razor blade and/or solvent can be used to scrape off labels.
- Rinse each piece of glassware 3 times with water to remove soap film. Check it and rinse again if needed. Most soap leaves a film that must be removed. Also, soaps react with some chemicals and will denature enzymes and proteins.
- Do not put your fingers into glassware; especially clean glassware you are putting away.
- If glassware has soap spots or needs additional cleaning, wash again or place in a soaking solution. Do not put dirty glassware away. Hang all brushes to dry to prevent rusting.

Replacing Glassware

- All glassware should be put away in a manner to avoid collecting dust, such as beakers upside down.
- Do not stack glassware in such a way to create a hazard.
- Do not put dirty glassware away.
- Glassware with cracks or chips should be marked and set aside for repair or discarding.

Failure to Comply

All students, faculty, staff and visitors who work in the laboratories at Georgia Highlands College are expected to comply with the procedures published in this Laboratory Handbook.

In instructional laboratories, the instructor assigned to teach the course is responsible for enforcing that students enrolled in the course are in compliance with safety procedures. Students who do not comply may be subject to a reduction in their grade and/or dismissal from the laboratory, according to the policies established in the course syllabus.

Failure of faculty and staff to comply with safety procedures may result in negative performance reviews, loss of laboratory privileges, and possibly termination of employment

Laboratory Safety Violation Report Form

The Laboratory Safety Violation Report Form is the method used to inform a faculty or staff of a safety violation. It is created and given to the non-compliant party by the Laboratory Safety Officer, the College Dean. This form is not meant to be a punishment. It is a method of informing the need for changes to be in compliance. Other action may come as the result of a collection of violations or violations of considerable danger (see Laboratory Safety Standards). That action is done by the College Dean. However, this form is not that process, only a way to inform of a violation and the way to resolve it. This process focuses on safety and compliance only. Corrections of safety violations could be viewed as a positive action and favorable for a faculty or staff member.

Maintaining records of such actions demonstrates GHC's proactive response and commitment to safety. It also provides a record of cooperation with compliance corrections or demonstrates a pattern of non-compliance.

Safety violations can be for any regulation we are subject to (see BOR Statement, pg 2)

Georgia Highlands College

LABORATORY SAFETY VIOLATION REPORT

This form is given to the Georgia Highlands College employee by the Department Chair along with the Laboratory Safety Officer and the Department of Environmental, Health and Safety. The purpose is to inform the employee of the need for changes to be in compliance with any regulations we are subject to or to eliminate a hazardous situation. Other action may come as the result of this violation, a collection of violations, or violations of considerable danger. However, the first and foremost purpose of this form and proposed action described is to eliminate hazards and be in compliance.

Date: _____

Employee(s):

_____

_____

_____

Department:

_____

Violation Classification:

☐	☐	☐	☐
Imminent Danger	Serious Violation	Non-Serious Violation	Documentation Violation

Summary of Violation (attach additional information):

_____

_____

_____

_____

_____

_____

Response Meeting

In Attendance:

_____

_____

_____

Date: _____ Time: _____

Comments:

_____

_____

Corrective Action:

_____

_____

_____

_____

Additional Training Required:

_____

_____

_____

_____

I have read and understood the above safety violation report. I further understand that I have received a written warning and that failure to correct the violation may result in further disciplinary action.

Employee Signature: _____ Date: _____

Supervisor Signature: _____ Date: _____

Laboratory Safety Standards

The health and safety of workers and building occupants is the most important factor to consider in laboratory work. In addition to these health and safety concerns, compliance with OSHA, State of GA and EPA regulations is also important because of the severe financial consequences, especially related to EPA hazardous waste regulations. Fines for seemingly minor violations, e.g., improper labeling, lids not screwed-on tight, etc., may run into the tens of thousands of dollars, therefore compliance with these regulations must receive special attention.
Sources of environment, health and safety standards and key compliance issues include:

Standard	Key Compliance Issues
OSHA Laboratory Standard	Laboratory Safety Plan, training of staff, MSDSs, emergency plan, secure compressed gas cylinders, outdated peroxide-formers
EPA/State Hazardous Waste regulations	Lids, labels, mixing incompatibles, secondary containment, location
Fire/Life Safety Codes	5-gallon open storage flammables limit, clear laboratory egress, hallway storage
Biological Safety, Security	Biological agents and toxins use practices, containment, facilities, management and security
University and BOR policies	Training, prevention of injuries, personnel policies
Consensus standards of good laboratory practice	Hazardous material inventory minimization and storage compatibility, housekeeping, appropriate attire, food & drink within designated area

VIOLATION SEVERITY CLASSIFICATIONS

The University uses the following categories of violations:

Imminent danger

a process, action, or condition where there is reasonable certainty a hazard exists in a GHC laboratory that can be expected to cause serious physical harm.

Serious violation

a process, action, or condition in a GHC laboratory that will probably lead to physical harm or significant exposure to biological or physical agents or violates regulatory standards (e.g. hazardous waste container management).

Non-serious violation

a process, action or condition that has a direct relationship to health and safety in a GHC laboratory but probably would not cause serious physical harm or significant exposure to biological or physical agents. Related non-serious violations may result in a serious violation where in combination they present a substantial probability of exposure, injury or physical harm.

Documentation

Required GHC laboratory documentation has not been completed, updated, submitted, and/or retained.

ENFORCEMENT POLICIES

Imminent danger

Environmental, Health & Safety, along with the Department Dean and Lab Safety Officer, notifies lab personnel to immediately cease operations and close the laboratory. The Lab Safety Officer also notifies the Facilities to secure the area if necessary. The Lab Safety Officer or Lab Coordinator will perform follow-up inspections to ensure compliance.

Serious violation

Environmental, Health & Safety, along with the Department Dean and Lab Safety Officer, notifies lab personnel and instructor, if available, of the violation and sets a deadline for abatement, and may recommend that the Instructor shut down the operation until abated. Follow-up notification, in writing, goes to the instructor and safety supervisor. Lab Safety Officer/ Lab coordinator will perform follow-up inspections to ensure compliance if appropriate. ALL laboratory personnel may be required to complete additional training. All lab members must complete the training course within two weeks of the laboratory safety inspection report date.

Non-serious violation

Environmental, Health & Safety, along with the Department Dean and Lab Safety Officer, notifies laboratory personnel of the violation and requests abatement as soon as practicable. Follow-up notification will be sent in writing to the faculty or staff involved. The Lab Safety Officer will send an annual report with summary of violations to the college dean.

Documentation violations

Environmental, Health & Safety, along with the Department Dean and Lab Safety Officer, notifies laboratory personnel of the violation and requests abatement as soon as practicable. Follow-up notification will be sent in writing to the faculty or staff involved. The Lab Safety Officer will send an annual report with summary of violations to the college dean.

Appendix A
Autoclave Testing and Operations Protocol

The following protocol includes procedures that comply with the Georgia Department of Natural Resources, Environmental Protection Division Rules for Solid Waste Management (Chapter 391-3-4). Specific requirements as they apply to Biomedical Waste (Rule 391-3-4-.15) are also included.

I. Introduction

Moist heat, in the form of pressurized steam under pressure, is the most dependable medium for the destruction of all forms of microbial life. Steam sterilizers (autoclaves) are instruments that produce superheated steam under high pressure, and are used for two processes: decontamination and sterilization. They must be properly used to be effective. The effectiveness of decontamination by steam autoclaving depends upon various loading factors that influence the temperature to which the material is subjected and the contact time. Particular attention must be given to packaging, including the size of containers and their distribution in the autoclave. Containers must have good steam permeability and must be arranged in the autoclave in a manner that promotes free steam circulation. For example, tight-fitting containers do not permit steam penetration, and thus are not acceptable for use in autoclaves. Stacking containers above one another and overloading an autoclave can also result in poor performance. This guidance document establishes the desired protocol for the effective operation of autoclaves for the decontamination of cultures and other potentially biohazardous materials.

Autoclaves should receive routine inspection and testing to determine the need for maintenance and repair. Autoclave door gaskets may become distorted if the door is tightly shut for prolonged periods resulting in leaks. Doors should be kept open or loosely closed except when the autoclave serves as a barrier between clean and dirty areas.

II. Autoclave Testing

Autoclaves shall be tested periodically to ensure effectiveness. Testing parameters include biological indicators (described below), which are used to monitor the sterilization process. Chemical indicators (autoclave tape) are used in conjunction with biological indicators and physical parameters (i.e., pressure and temperature readings). They provide instantaneous feedback to confirm that the load has been sterilized; however, they must not be used as the sole indicator of sterility. The results of biological indicator testing must be kept on file.

Chemical Indicators

Periodicity:

One strip is dated and included in each load of the autoclave.

Method:

Tape indicates that time, temperature, and the presence of steam have been adequate to ensure sterilization. The strip must completely change color (colors

vary by manufacturer) or reveal the word "autoclaved" to ensure effective operation.

Biological Indicators

Periodicity:

Every 40 hours of use (required for autoclaves that are used to deactivate human or non-human primate blood, tissues, clinical samples, or human pathogens), or

Method

A commercially available test indicator kit that uses bacterial spores *Geobacillus stearothermophilus* that are rendered unviable at 250 degrees F or 121 degrees C. For the test, ampoules of *G. stearothermophilus* are autoclaved along with a load of waste. Upon completion of the cycle, the ampoules are incubated for 48 hours at 60 º C and then observed for any sign of growth, which would indicate that the autoclave is not sterilizing properly. If for any reason the integrity of the sterilization process is in question, the load should be considered contaminated and should be reprocessed.

III. Autoclave Record Keeping

The following records regarding autoclave operations must be maintained on site:

1. Maintenance records
2. Operations log (each load of deactivated material shall be logged as follows):

Date, time, and operator's name
Type and approximate amount of waste (lbs)
Confirmation of sterilization

- Record the temperature, pressure, and length of time the load is sterilized. Note that temperature sensitive autoclave tape is not sufficient to indicate that the load reached sterilization conditions because the tape will change color at lower temperatures, OR
- Save the autoclave printout, if the autoclave has a working printer.

IV. Autoclave Operating Procedures

A. What Materials Should Be Autoclaved

The following materials need to be autoclaved prior to disposal:

- Culture and stocks of infectious agents (bacteria, molds, viruses)
- Culture dishes and related devices
- Contaminated solids such as paper towels, cloth and plastic pipette tips, pipettes and vials, petri dishes and gloves
- Discarded live and attenuated vaccines

- Recombinant DNA, plant & animal specimens with recombinant DNA
- Animal tissue specimens
- Pathological animal wastes
- Cages of potentially pathogenic animals
- Pathogenic plant matter.

B. Autoclave Cycles

There are three basic autoclave cycles:

1. Gravity or "Fast Exhaust" Cycle—Used to sterilize dry goods, glassware, etc. This cycle charges the chamber with steam and holds it at a set temperature for a set period of time. At the end of the cycle a valve opens and the chamber rapidly returns to atmospheric pressure. Drying time may also be added to the end of the cycle.
2. Liquid or "Slow Exhaust" Cycle—Used to prevent sterilized liquids from boiling, steam is exhausted slowly at the end of the cycle, allowing the liquids (which will be super-heated) to cool.
3. Pre-Vacuum Cycle—For porous materials, animal bedding, etc. This cycle partially evacuates the chamber prior to introducing steam for greater steam penetration. Pre-vacuum cycles are not available on all machines.

V. Autoclave Training and Operation

Principal investigators and/or supervisors must train and qualify their staff for operation of autoclaves. Qualified autoclave users should understand the time, temperature, pressure relationships required for proper materials decontamination. Additional training on handling materials to be decontaminated should also be provided. Supervisors should maintain a permanent record of training provided to their staff. *Lab safety officer is available for autoclave training.*

VI. Autoclave Maintenance

Follow manufacturer recommended routine maintenance procedures. For repair, use manufacturer warranty if possible. For autoclaves out of warranty, contact the Biology Lab Safety Officer.

VII. Autoclave Usage Tips

- Regularly inspect your autoclave components for proper operation. If a problem is found, promptly notify your area supervisor who will call facilities or maintenance. **DO NOT OPERATE AN AUTOCLAVE UNTIL IT HAS BEEN PROPERLY REPAIRED**.

- Never place sealed containers in an autoclave. Large bottles with narrow necks can simulate sealed containers if filled with too much liquid.

- Don't autoclave items containing solvents, volatile or corrosive chemicals (phenol, trichloroacetic acid, ether, chloroform, etc.).

- After loading and starting the autoclave, processing time starts ***AFTER*** the autoclave reaches normal operating conditions of 121 degrees C (250 degrees F) and 15 psi pressure.

- Decontamination conditions vary with type of load therefore processing times will vary according to the conditions. A minimum of 30 minutes is needed to decontaminate biological waste.

- At the end of a decontamination cycle make sure that the pressure in the autoclave chamber is near zero before opening the door. Slowly crack open the autoclave door and allow the steam to gradually escape from within the autoclave.
  CAUTION: Opening the autoclave door too quickly may result in glassware breakage and/or steam burns on your skin.

- Allow materials inside the autoclave to cool for 10 minutes before removing them from the autoclave.

- After autoclaving, waste can be disposed of as solid waste.

- Always follow written lab procedures; however, dry goods typically require about 30 minutes sterilization, plus about 20 minutes drying time (dry time may need to be increased for enclosed items such as pipette tips or bottles with lids).

- Average liquid sterilization times (add an additional 10 to 20 minutes for crowded items):

<500 ml, 30 minutes	500 ml - 1 L, 40 minutes	2 L - 4 L, 55 minutes	4 L, 1 hour

- Not all plastics can be autoclaved. Polypropylene and polycarbonate will survive, but polyethylene and high density polyethylene will not. The different types of plastic can be identified by looking for initials imprinted on the bottom of containers (PP=polypropylene, PC=polycarbonate, PE=polyethylene, HDPE=high density polyethylene). If you are unsure about a new container, place it in an autoclave safe container the first time.

- To prevent the bottoms of bottles from breaking, place them in a tub with 1 to 2 inches of water.

Autoclaving new glassware for 90 minutes will partially temper it, increasing its strength.

Appendix B

Supervisor's Accident / Injury Report Form

Name of Supervisor: _____

Email address:

Personal Information				
☐	*Student*	☐	*Employee*	
Full Name:				
Department:				
Phone Number/Ext.:				
Email Address:				
Building Information				
Building Name:				
Room Number:				
Incident Information				
Date of accident/injury:		*Time of accident/injury:*		
Type of accident/injury (please choose all that apply)				
☐	*Strain or sprain*	☐	*Fracture*	☐ *Wound*
☐	*Skin*	☐	*Foreign body*	☐ *Amputation*
☐	*Chemical Exposure*	☐	*Slip/trip/fall*	☐ *Puncture*
☐	*Cut/Laceration*	☐	*Assault*	☐ *Contusion*
Other (please list):				
Body part affected (please choose all that apply)				
☐	*Eyes*	☐	*Head*	☐ *Face and Neck*
☐	*Feet*	☐	*Legs*	☐ *Finger*
☐	*Arms*	☐	*Hands*	☐ *Upper Back*
☐	*Lower Back*	☐	*Chest (Respiration)*	☐ *Trunk/internal organs*
Other (please list):				
Name(s) of witness(es):				
How did the accident/injury occur?				
Please state how the injury/illness occurred. Include equipment, materials or chemicals in use when the accident/injury occurred.				
What caused the accident/injury?				
Please state why the event occurred including conditions that contributed to the accident/injury, such as: slippery surface, chemical reaction, failure to use safety equipment, etc.				
Supervisor's signature		*Date*		*Phone number*

Appendix C
Spill Cleanup in Laboratories

Chemical spills and accidents need to be minimized as much as possible. If a chemical spill should occur, a quick response with a stocked chemical spill kit will help minimize potential harm to personnel, equipment and laboratory space. This guidance document provides a list of the minimal equipment required for a spill kit. You may add equipment to the kit, provided all personnel are proficient in its use. An example would be adding a metallic mercury spill kit. Contact the Lab Safety Officer/ Lab Coordinator for information and guidance in construction of a more specialized spill kit (for use with mercury, hydrofluoric acid, etc.). The Principle Investigator or Supervisor should be responsible for reviewing their spill cleanup procedures with you.

These procedures are provided to give guidance to knowledgeable laboratory personnel on the safe and effective way to clean up small laboratory spills. These procedures do not take the place of the Department of Environmental Health & Safety or specially trained responders. If you have ANY questions or concerns about the spill cleanup process, the contacts listed below will be able to help.

Jason Christian	706-368-7532
Phillip Kimsey	706-252-1703
Campus Safety	706-252-4813

The majority of chemical spills can be prevented or minimized by:

- Maintaining a neat and organized work area
- Performing a laboratory procedure review prior to conducting new experimental procedures;
- Storing liquid chemicals in secondary containment bins;
- Keeping reagent chemical containers sealed or closed at all times, except when removing contents;
- Ordering reagent chemicals in plastic or plastic coated glass containers whenever possible;
- Using secondary containment to store and move chemicals.
- Place chemical containers being used in a hood or lab bench area that reduces the possibility of accidentally knocking over a container.
- Keep all unused reagents in their appropriate storage area and keep your work area clean of needless equipment and clutter.
- Plan your movements. Look where you are reaching to ensure you will not cause a spill. Avoid transporting chemicals from the stockroom during periods of high traffic in the hallways such as between classes.
- Transport chemical containers in a chemical carrier or cart.
- Place absorbent plastic backed liners on benchtops or in fume hoods where spills can be anticipated. For volumes of liquid larger than what can be absorbed by liners, use trays.

Avoid working alone when hazardous chemicals are involved

Minor or Small, incidental spills

Spills that can be cleaned up by lab personnel without putting themselves or others in danger.

Minor spills do not necessarily need additional assistance. Laboratory workers who have had the proper training and possess the appropriate equipment can safely and effectively handle the majority of chemical spills that occur in the laboratory.

Labs can handle spills involving one liter or less of liquid and one pound or less of a solid. If the spill is large, contact the Lab Safety Officer to assist with the cleanup.

Contact The Lab Safety officer with any questions or concerns about proper spill clean-up practices.

Complete an incident report form. It is important that we track even the smallest incident.

Major or Large or extremely dangerous spills

- *Spills that present an immediate hazard (fire, explosion, chemical exposure, etc.)*
- *Any spill of highly dangerous chemicals*
- *Moderate or large-scale chemical spills*
- *Or if the spill is large or if you're unsure how to classify it*

In addition, spills involving multiple chemicals may pose various hazards. Always contact the Lab Safety Officer if multiple chemicals are involved in a spill.

If the spill is too large for you to handle, involves materials listed in the table below; is a threat to personnel, students or the public, Evacuate personnel from the spill area and notify adjoining labs.

- Isolate the spill area.
- Remove ignition sources and shut down equipment.
- Call Campus Safety
- Notify the Lab Supervisor, Lab Safety Officer or Lab Coordinator from a safe location

NOTE: Large or extremely dangerous spills (major spills) are not to be cleaned up by lab personnel! Call GHC Campus Safety at 706-252-4813

General Spill Cleanup Procedures

In the event of a chemical spill, first decide if you are trained, knowledgeable and equipped to handle the incident. **Immediately evacuate the lab and notify the Lab Safety Officer or 911 if there is a possibility of an acute respiratory hazard present or if you need assistance to clean up the spill. Never proceed to clean up a spill if you do not know the hazards associated with the chemical or if you are unsure of how to clean up the spill. If anyone is injured or contaminated, immediately notify GHC Campus Safety and begin decontamination measures or first aid, if trained.**

Don the personal protective equipment from the spill kit; splash goggles and nitrile/Silver Shield combination gloves. Always find another for assistance. They should also don splash goggles and nitrile/Silver Shield combination gloves. Make sure that all forms of local exhaust i.e. fume hoods, are operating. If broken glass is involved, do not pick it up with your gloved hands. Use the scoop or tongs to place it in the bag, then place the bag in a strong cardboard box or plastic container. Follow the procedures provided below based on the class and type of chemical.

All tools used in the cleanup need to be decontaminated (plastic scoop, tongs, etc.). Remove all gross contamination with a wet paper towel. Dispose of the contaminated paper towels as waste. Rinse the tools off with copious amounts of water. Dispose of the gloves as waste. Dry the tools off and place back into the spill kit along with the splash goggles.

Liquid Spills other than flammable liquids

Spread the chemical spill powder over the spill starting with the edges first. This will help to confine the spill to a smaller area. Spread enough powder over the spill to completely cover the liquid. There should be no free liquid. Use the plastic scoop to ensure that the liquid was completely absorbed by the powder. Pick up the powder with the scoop and place in the polyethylene bag. Wipe the area down with a wet paper towel. Dispose of the paper towel with the waste generated from the spill cleanup. Seal bag with tape and contact the Lab Safety Officer for disposal.

Flammable Liquid Spills

Control all sources of ignition. Lay the chemical spill pads over the spill. These pads are designed to suppress the vapors emitted by a volatile liquid. Allow pads to completely soak up the liquid. Pick up pads with tongs or other device that minimizes direct contact with a gloved hand. Place in the polyethylene bag. Wipe the area down with a wet paper towel. Dispose of the paper towel with the waste generated from the spill cleanup. Seal bag with tape and contact the Lab Safety Officer for disposal.

Solid Spills

Use the plastic scoop to place the spilled material into the polyethylene bag. Care should be taken so as not to create dust or cause the contaminated powder to become airborne. After the bulk of the material is cleaned up, wet a spill pad and wipe the area down. Place the pads into the polyethylene bag. Wipe the area down with a wet paper towel. Dispose of the paper towel with the waste generated from the spill clean up. Seal bag with tape and contact the Lab Safety Officer for disposal.

Note: Precautions must be taken to minimize exposure to the spilled chemical. Be careful not to step in the spilled material and track it around.

First Aid Guide

In case of injury or potential exposure, attend to victim(s) immediately as outlined below:

- For spills affecting small portions of skin, immediately flush with flowing water for at least 15 minutes. If no visible burn exists, wash with warm water and soap, removing any jewelry
- For spills on clothes, don't attempt to wipe the clothes. Quickly begin showering while removing all contaminated clothing, shoes and jewelry. It may be necessary to cut the clothes off in some instances to prevent contamination of the eyes.
- Do not use creams, lotions or salves.
- Avoid breathing the vapors of spilled substances.
- Contaminated clothes should be discarded or laundered separately from other clothing.
- For splashes into the eye, immediately flush with tepid potable water for at least 15 minutes. Hold the eyelids away from the eyeball, moving eye in all directions to wash thoroughly behind the eyelids. Use eyewash for this purpose.
- In all cases, seek medical attention: 911 for emergency response.

Guide for Chemical Releases to the Environment

If hazardous or regulated materials are spilled outside of buildings or unintentionally released to the environment via a sewer or fume hood:

- Contact the Lab Safety Officer at 706-368-7532 (Office) or 940-273-9710 (Cell) immediately
- Be prepared to provide the name of the chemical(s) involved, quantities released and approximate time of the incident.
- The Lab Safety Officer will contact the appropriate regulatory agencies and initiate reporting if necessary

Mercury Use and Spill Procedures

Mercury must be used and handled with care since it is a subtle poison with cumulative effects not easily reversed. Metallic mercury and its compounds can be absorbed into the body by inhalation, ingestion or contact with the skin. If spills are frequent and mercury is added to the ambient air level, the combined concentration may reach or exceed toxic limits.
The Lab Safety Officer should be notified in all spills involving Mercury or other highly toxic materials.

Mercury Handling Procedures

Mercury spills can be avoided by using supplies and equipment which do not contain mercury. It is recommended that all researchers seek alternatives to mercury use.
However, if mercury or mercury -containing equipment must be used, proper handling is essential to preventing spills and maintaining a healthful working environment. Use the following guidelines when handling mercury:

- Keep mercury containers closed and stored in secondary containers in a well-ventilated area.
- Transfer mercury from one container to another in a hood over a tray or pan to confine any spills.
- Provide mercury manometers and other mercury containing equipment with spill control and containment devices such as trays or pans.
- Move instruments or apparatus containing mercury in an enameled or plastic tray or pan that can be cleaned easily and is large enough to contain the mercury.

Mercury Spill Guide

Every effort should be made to prevent spills of metallic mercury since the substance is extremely difficult and time consuming to clean up. Globules can get into cracks and crevices, under table legs, under and into equipment. When a spill does occur, the following procedures are to be used.

- Notify people in the immediate area that a mercury spill has occurred and isolate the area to avoid more extensive contamination by tracking.
- If the spill occurred on the floor, determine the extent of the area and mark the boundary of the spill.
- Call the Lab Safety Officer for cleanup and removal instructions. It is preferred that the lab or spill area be evacuated until the spill is removed.
- Always thoroughly wash hands, arms and face several times after working around mercury areas.

Cleanup Procedure

- Special mercury vacuum cleaners are for larger spills such as those involving a manometer or larger instrument. Do not use a standard vacuum cleaner to pick up mercury.
- The preferred method of spill cleanup is to collect the mercury because elemental mercury can be recycled. Push pools and globules of mercury together and collect by suction using an aspirator bulb or a vacuum device made from a filtering flask, a rubber stopper and several pieces of flexible glass tubing.
- Metallic mercury from spills, broken thermometers or other equipment, and contaminated mercury from laboratory activities should be contained in thick-walled, high-density polyethylene bottles. Place any discarded rags, sponges, shoe covers and other debris from cleanup activities in a sealed plastic bag for pick up by Environmental waste companies.

Biohazard Spills

Biohazard Spill Cleanup Procedures

The following procedures are provided as a guideline to biohazardous spill cleanup. In each of the following cases, depending on the size of the spill, notify everyone in the laboratory and contact the Laboratory Safety Officer. If a spill contains BSL 2 or higher containment material, or if the spill is considered too large or too dangerous for laboratory personnel to safely clean up, secure the entire laboratory and call Campus Safety/ Lab Safety Officer immediately for assistance.

Inside the Biosafety Cabinet

- Wait at least five minutes to allow the BSC to contain aerosols.
- Wear laboratory coat, safety glasses and gloves during cleanup.
- Allow BSC to run during cleanup.
- Apply disinfectant and allow a minimum of 20 minutes contact time.
- Wipe up spillage with disposable disinfectant-soaked paper towels.
- Wipe the walls, work surfaces and any equipment in the cabinet with disinfectant-soaked paper towels.
- Discard contaminated disposable materials using appropriate biohazardous waste disposal procedures.
- Place contaminated reusable items in biohazard bags or autoclavable pans with lids or wrap in newspaper before autoclaving.

- Expose non-autoclavable materials to disinfectant (20 minutes contact time) before removal from the BSC.
- Remove protective clothing used during cleanup and place in a biohazard bag for autoclaving.
- Run BSC 10 minutes after cleanup before resuming work or turning BSC off.

In the laboratory, outside the Biosafety Cabinet

- Call the Lab Safety officer if the material is BSL 2 or greater.
- Clear area of all personnel. Wait at least 30 minutes for aerosol to settle before entering spill area.
- Remove any contaminated clothing and place in biohazard bag to be autoclaved.
- Put on a disposable gown, safety glasses and gloves.
- Initiate cleanup with disinfectant as follows:
    - Place dry paper towels on spill then layer a second set of disinfectant soaked paper towels over the spill.
    - Encircle the spill with additional disinfectant being careful to minimize aerosolization while assuring adequate contact.
    - Decontaminate all items within the spill area.
    - Allow at least a minimum of 20 minutes contact time to ensure germicidal action of disinfectant.
    - Wipe equipment and reusable items with appropriate disinfectant.
    - Discard contaminated disposable materials using appropriate biohazardous waste disposal procedures.

Inside a centrifuge

- Clear area of all personnel.
- Wait 30 minutes for aerosol to settle before attempting to cleanup spill.
- Wear a laboratory coat, safety glasses and gloves during cleanup.
- Remove rotors and buckets to nearest BSC for cleanup.
- Thoroughly disinfect inside of centrifuge.

- Discard contaminated disposable materials using appropriate biohazardous waste disposal procedures.

Outside the laboratory, in transit

- To prevent a spill, transport labeled biohazardous material in an unbreakable, well-sealed primary container placed inside of a second unbreakable, lidded container (cooler, plastic pan or pail) labeled with the biohazard symbol.

- Should a spill occur in a public area, do not attempt to clean it up without appropriate PPE.

- Secure the area, keeping all people well clear of the spill.

- Call the Lab Safety Officer to assist in cleanup.

- Stand by during spill response and cleanup activity and provide assistance only as requested or as necessary

Appendix D
Spill Plan Guidelines

Each work area where hazardous substances are used should have a spill plan. Experiments and research projects should always be designed to minimize the possibility of an accidental release of hazardous substances.

An effective spill response procedure should consider all of the items listed below. The complexity and detail of the plan will, of course depend upon the physical characteristics and volume of materials being handled, their potential toxicity, and the potential for releases to the environment.

1. Review Safety Data Sheets (SDSs) or other references for recommended spill cleanup methods and materials, and the need for personal protective equipment (e.g., respirator, gloves, protective clothing, etc.)
2. Acquire sufficient quantities and types of appropriate spill control materials to contain any spills that can be reasonably anticipated. The need for equipment to disperse, collect and contain spill control materials (e.g., brushes, scoops, sealable containers, etc.) should also be reviewed..
3. Acquire recommended personal protective equipment and training in its proper use. For example, if an air purifying respirator or self-contained breathing apparatus are needed, personnel must be enrolled in the Respiratory Protection Program and attend annual training and fit-testing.
4. Place spill control materials and protective equipment in a readily accessible location within or immediately adjacent to the laboratory.
5. Develop a spill response plan that includes:
    - Names and telephone numbers of individuals to be contacted in the event of a spill.
    - Evacuation plans for the room or building, as appropriate.
    - Instructions for containing the spilled material, including potential releases to the environment (e.g., protect floor drains).
    - Inventory of spill control materials and personal protective equipment.
    - Means for proper disposal of cleanup materials (in most cases, as hazardous waste) including contaminated tools and clothing.
    - Decontamination of the area following the cleanup.
6. Discuss the spill response plans with all personnel in the area. Share your spill plan with the Lab Safety Officer

Recommended Spill Control Material Inventory

Personal Protective Equipment

2 pairs chemical splash goggles
2 pairs of gloves (recommend Silver Shield or 4H)
2 pairs of shoe covers
2 plastic or Tyvek aprons and/or Tyvek suits

Absorption Materials

4 3M POWERSORB spill pillows (or equivalent)
1 3M POWERSORB spill sock
2 DOT pails (5 gallon) with polyethylene liners
- 1 filled with loose absorbent, such as vermiculite or clay
- 1 with minimum amount of loose absorbent in the bottom

Neutralizing Materials

Acid Neutralizer
Caustic Neutralizer
- commercial neutralizers, such as Neutrasorb (for acids) and Neutracit-2 (for bases) have built in color change to indicate complete neutralization

Solvent Neutralizer
- commercial solvent neutralizers, such as Solusorb, act to reduce vapors and raise the flashpoint of the mixture

Mercury Spills

Small mercury vacuum to pick up large drops (optional)
Hg Absorb Sponges - amalgamate mercury residue
Hg Absorb Powder - amalgamates mercury
Hg Vapor Absorbent - reduces concentration of vapor in hard to reach areas
Mercury Indicator - powder identifies presence of mercury

Clean-up Tools

Polypropylene scoop or dust pan
Broom or brush with polypropylene bristles
2 polypropylene bags
sealing tape
pH test papers
waste stickers

Appendix E:
Additional Information

Chemical Hygiene Plan

The development and implementation of a written Chemical Hygiene Plan (CHP) is the foundation of compliance required by the Occupational Safety and Health Administration (OSHA) as stated in the publication Occupational Exposure to Hazardous Chemicals in Laboratories (Federal Register, January 31, 1990, pages 3327-3335, part of CFR 1910).

The Chemical Hygiene Plan for Georgia Highlands College can be found at:

http://www.highlands.edu/site/faculty-jachrist-lab-safety