TABLE OF CONTENTS

Berea College Model Hygiene Plan

Chapter 1 Page
Introduction
Work Practices and Administrative
Controls_____ 1

Chapter 2
Responsibilities_____ 6

Chapter 3
Standard Operating Procedures_____ 9

Chapter 4
Spill Response Procedures_____ 21

Chapter 5
Controlling Chemical Exposures_____ 24

Chapter 6
Lab Chemical Hoods and Other Engineering Controls_ 26

Chapter 7
Accident and Incident Reporting_____ 28

Chapter 8
Prior Approval_____ 29

Chapter 9
Employee information and Training_____ 30

Chapter 10
Chemical Hygiene Officer_____ 32

Chapter 11
Special provisions For Select Carcinogens_____ 33

Chapter 12
Planning For Emergencies_____ 35

Chapter 13
Chemical Purchase, Inventory, Storage, and Disposal_____ 37

Chapter 14
Equipment Used in Physics and Geology Shop_____ 41

APPENDIX LIST

Appendix I
Laboratory Standard

Appendix II
Chemical Compatibility Chart

Appendix III
Miscellaneous Forms

Appendix IV
Peroxidizable Compounds
a. Procedure for Use and Storage
b. List of Peroxidizable Compounds

Appendix V
Hazard Assessment and Personal Protective Equipment Requirement

Appendix VI
Chemical Resistance of Common Glove Materials

Appendix VII
List of References and MSDS Internet Sites

Appendix VIII
Substances Considered Carcinogenic By OSHA

Appendix IX Laboratory Specific Standard Operating Procedures

CHAPTER 1

INTRODUCTION

Purpose

The Purpose of the Chemical Hygiene Plan is to define practices and procedures to help ensure that Laboratory Workers at Berea College are protected from the health and safety hazards associated with the hazardous chemicals with which they work.

Background

The Chemical Hygiene Plan is part of the College's compliance with the regulations promulgated on January 31, 1990 by the U.S. Department of Labor Occupational Safety and Health Administration (OSHA) and adopted by Kentucky OSH. This Standard entitled "Occupational Exposure to Hazardous Chemicals in Laboratories" is hereafter referred to as the Lab Standard. See Appendix I to review a copy of the Lab Standard.

Overview

The Chemical Hygiene Plan must include:

- Standard Operating Procedures
- Criteria to determine and implement specific control measures, such as engineering controls and personal protective equipment
- An ongoing program be developed to ensure that Laboratory chemical hoods and other engineering controls are functioning properly
- Information and training requirements
- Circumstances under which a particular laboratory function will require "prior Approval"
- Provisions for medical consultation and medical exams
- Designation of a Chemical Hygiene Officer and if appropriate, establishment of a Chemical Hygiene Committee
- Additional precautions for work with select carcinogens, reproductive toxins, and extremely toxic substances
- The Chemical Hygiene Plan will be reviewed annually by the Institutional Chemical Hygiene Officer and the Chemical Hygiene Committee. The annual review will include the specific Standard Operating Procedures (SOPs) for the different laboratories. Review and revision dates must be identified in the plan.
- All laboratory workers prior to the commencement of lab duties must read this Chemical Hygiene Plan. In addition to the plan, the laboratory workers must be familiar with and adhere to the standard operating procedures developed by the Laboratory Manager. (See Chapter 10

for discussion of the role of the Institutional Chemical Hygiene Officer and the Laboratory manager/Chemical Hygiene Officer)

- A written record stating that each Laboratory Worker has reviewed the Chemical Hygiene Plan and related health and safety policies and guidelines will be maintained by the Department chairman and a copy filed with the Environmental Health and Safety Department. (See Appendix III for an example of a training record form)

Definitions

Hazardous Chemical- OSHA has defined a hazardous chemical as "a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principals that acute or chronic health effects may occur in exposed employees"

Laboratory-OSHA defines a laboratory as a "workplace where relatively small quantities of hazardous chemicals are used on a non-production basis".

Lab workers- The Laboratory Workers referred to in the Lab Standard are employees. OSHA defines an employee as "an individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments." An example of a laboratory Worker would be a College Teaching assistant, Research assistant or Faculty member instructing an academic lab. OSHA would not consider students in academic laboratory employees. However, as a matter of good safety practice, the principles outlined in this Chemical Hygiene Plan should apply to students in our laboratories. All Students involved in laboratory activities must sign a Student contract Form. (See Appendix III for a copy of the form). Also included in this plan will be visiting professors and volunteers that might be working in the lab. The Laboratory manager must ensure that these groups working in their Laboratories are adequately instructed in the applicable safety procedures.

Assistance

If there is any questions about where the Lab Standard applies and whom it covers, please contact the Department of Environmental Health and Safety at 3350.

Work Practice and Administrative controls

Authorized Access- The Laboratory Manager must restrict access to laboratories. Children under the age of 17 are not allowed in laboratories except as authorized by the Laboratory Manager for an officially sanctioned activity, (for example, a class or open house). Pets are prohibited from laboratories.

Containers- Check the integrity of the containers and if damaged or leaking, transfer to an acceptable container or call Environmental Health and Safety at 3350 for assistance. For disposal, fill out a "Hazardous Waste ticket" (See waste Management Procedures Chapter 12) A sample ticket is located in Appendix III

Cylinder Handling- Use appropriate hand carts to move cylinders. **Cylinders must be secured at all times**. Always make sure valve is closed and the valve cap is in place when the cylinder is not hooked to a regulator Do not move extremely toxic gases (e.g. hydrogen

sulfide, chlorine and arsine) through normal travel corridors during business hours. The use of these types of gases would require a specific safety plan or SOP be developed that would address safe work procedures and emergency response. Do not allow anyone to ride in an elevator with a gas cylinder(s) or cryogenic liquids. See additional safety rules for compressed gas cylinders on pages 18, 19&20.

Broken Glassware- Broken glassware cannot be disposed of in the regular garbage. It should be placed in a box with a plastic liner so that no shards can present a hazard when disposing of the entire container. Do not overfill the container and try to keep it under 30 pounds.

Glass Tubing- When inserting tubing into stoppers, lubricating tubing as well as wearing gloves or wrapping in a thick cloth will help to protect hands from being cut in the event of the tubing slipping and breaking.

No Smoking This policy exists throughout the campus and applies in all laboratories.

Working Alone –No individual **(regardless of experience)** shall work alone in a laboratory or perform a laboratory procedure at Berea College without consent of the Faculty instructor and/or Laboratory manager. **No person will be permitted to work alone when handling hazardous materials or working with potentially hazardous equipment and instrumentation**. Any individual enrolled in a research project or an independent study in which no other individuals are enrolled and laboratory procedures are part of the study shall schedule this work through their instructor.

There must be at least one other person within earshot who knows you are working in the laboratory area and can provide assistance in an emergency, or call for help. The individual must check in with the instructor at the beginning of the procedure and every 30 minutes there after. Failure to comply with the required communication and safety checks may directly influence the individual's grade and enrollment in the course as well as the institution.

Housekeeping- Exits, aisles and safety equipment must not be obstructed in any way with equipment, furniture, etc. No items must be stored in the corridors.

Food, Drink, Cosmetics- Eating, drinking and the application of cosmetics is forbidden in areas where hazardous chemicals are used and must be done only in well-defined designated non-chemical areas. Do not store food in the same refrigerator with chemicals, biohazards or radioactive materials. Refrigerator, microwaves and ice machines must have labels that denote their use, "Not for Food or Drink.

Horseplay-Practical jokes or other inappropriate and unprofessional behavior in the laboratory setting is forbidden. Avoid distracting or startling any other workers.

Equipment-Use proper equipment that is in good condition. For example, never use chipped or cracked glassware. Shield pressurized or vacuum apparatus and safeguard against bumping or overheating.

Disposal of Waste- Always segregate incompatible waste. When in doubt use separates containers for different chemical materials? See Appendix II for chemical compatibility chart.

List all chemical waste on the waste ticket and include the amount of the waste placed in the container. **Do not use chemical formulas to identify waste materials.** Also, include the class name and the instructor's on the label. When the waste container is full, place the container in the return to bunker cabinet. The waste will be collected by the EHS Department and prepared and stored for final disposal.

Hazardous Materials- Hazardous materials should not be used on open laboratory benches.

Mouth Pipetting- Mouth pipetting is forbidden.

Perchloric Acid- If Perchloric acid is heated above ambient temperature it will give off vapors that can condense and form explosive perchlorates. When heating perchloric acid above ambient temperatures, a specifically designed and dedicated chemical hood with a wash down system or a local scrubbing or trapping system must be used. Contact the Department of Environmental Health and Safety before initiating any work with perchloric acid.

Personal Hygiene- Hands should be washed frequently throughout the day, before leaving the lab, after contact with any hazardous material and before eating.

Personal use of Chemicals- Lab workers are not allowed to remove chemicals from the lab or chemical inventory for personal use.

Checking out Chemicals- Only Instructors, Teaching Assistants, and Research Assistants are allowed to check out chemicals from the chemical storage bunker.
Transporting hazardous chemicals from the chemical storage area to a laboratory requires two individuals. These individuals must have the following personal protective equipment on when transporting hazardous chemicals:

1. Safety goggles
2. Splash Apron
3. Gloves

Chemical Transporting and Handling-Use bottle carriers for transporting chemicals that are in glass containers. Make sure the caps are secured. If you use the elevator to transport chemicals do not let unprotected individuals get on the elevator.
After using chemicals, close the caps securely and avoid storing chemical containers in hard to reach areas. Pour chemicals carefully, and never add water to acid. Metal containers and non-conductive containers (e.g., glass or plastic) holding more that five gallons of flammable liquids must be grounded when transferring from one container to another.

Chemical Storage- Chemical should be stored by compatibility. Oxidizers should be separated from organics and flammables. Strong Acids and Bases should be separated. Air/Water reactivities must be kept dry and cyanides should be stored away from acids. See Appendix II for examples of incompatible chemicals.
Volatile toxic substances must be stored in volatile storage cabinets adequate to the purpose. When volatiles must be stored in a cooled atmosphere, explosion proof refrigerators must be used.

Cylinder Storage- Cylinders must be stored in well-ventilated areas with their protective caps screwed on and the cylinder secured (e.g., Strapped or chained in an upright position) to reduce

the chance of the cylinder being knocked over. **Do not store cylinders near heat of high traffic areas.** Whenever possible do not store empty and full cylinders together. Clearly mark empty cylinders. Storage of large quantities of cylinders must be done in the approved gas cylinder storage area located in the chemical storage bunker.

Chemical Spills and Accident Response As a general rule small spills and releases (e.g., less than one liter) can be handled by laboratory personnel under the supervision of the Laboratory Manager. For emergency situations i.e., large spills and leaks, or fires, evacuate and call 3333 (Public Safety) from a safe location. See Chapter 12, planning for Emergencies for more information. Also, contact the Department of Environmental Health and Safety for waste disposal information and spill cleanup supplies.

Chemical labels- All chemical containers must be labeled. All labels must be legible, in English and include chemical product name. **Do not use chemical formulas. If the chemical is made in the laboratory, please include information relative to the hazard, the class number, the name of the instructor and date.** Labels on incoming containers must not be removed or defaced. All peroxidizable compounds and other chemicals that may become unstable over time (e.g., picric acid, ethers) must be dated. See Appendix IV for storage and use of peroxidizable compounds. Waste chemical containers must be clearly marked "HAZARDOUS WASTE" indicating specific name of waste chemical and must be dated when full.

Attire- At a minimum all lab personnel should be wearing a lab coat or lab apron and impact and splash-proof safety goggles when there is active work being done with chemicals in the lab. Also, legs, feet, and chest area should be covered. Open toed shoes, shorts, halter or tube tops are not permitted in the labs. Loose clothing and long hair should be confined.

Engineering Controls

Laboratory Chemical Hood and Other Engineering Controls See Chapter 6, "Laboratory Chemical Hoods"
Safety Shower/Eyewashes-Safety showers and/or eyewashes are required in labs where corrosive chemicals are used. The Environmental Health and Safety
Department is charged with testing the eyewashes and shower units. An inspection log detailing the inspection findings can be obtained by contacting the EHS Department.

CHAPTER 2

RESPONSIBILITIES

Background

Berea College is committed to providing a safe and healthful environment for all persons associated with the College. Berea College intends to be a role model in its environmental stewardship, health protection, and safety standards, and its compliance with all laws and regulations relating to the environment, health and safety. Management, faculty, staff, and students are asked to support these goals in all college activities. The following information outlines the specific responsibilities associated with laboratory safety and the Chemical Hygiene Plan.

Faculty in charge of supervising laboratories (referred to as Laboratory Managers throughout the document) has the following responsibilities for implementing the Chemical Hygiene Plan:

- Inform and train students/employees concerning chemical safety as required by this plan. Document all training. Recommend maintaining signed student safety contracts at least one year.

- Develop Specific Standard Operating Procedures (SOP) for Laboratory Procedures using Hazardous Chemicals. (The safety SOPs can be incorporated into the specific lab procedure)

- Implement and enforce rules and standards of this plan concerning health and safety for laboratories under the Laboratory Manager's jurisdiction and restrict access to the laboratory.

- Serve as the Chemical Hygiene Officer for his or her laboratory(s)

- Ensure compliance of Laboratory Workers with this Plan

- Ensure the availability and enforce the proper use of appropriate personal protective equipment and relevant heath and safety reference materials.

- Remain cognizant of chemicals stored and used in labs and their associated hazards

- Advise the Environmental Health and Safety Department of what chemicals need to be stored in the laboratory on a full time basis. All other chemicals should be checked out of the central chemical store- room and either returned to the "return to bunker storage cabinet" located in Science Building Room 306 or contact the EHS department at 3350 for pickup.

- Conduct internal inspections of labs for health and safety concerns. See Appendix III for a sample of a self- inspection form.

- Request allocation of funds for health and safety improvements and special protective equipment needed for the lab.

Environmental Health and Safety Department (EHS) responsibilities regarding the implementation of the Chemical Hygiene Plan:

- The Director of the Environmental Health and Safety department is designated as the "Institutional Chemical Hygiene Officer for Berea College".

- The EHS Department will conduct an annual review and update of the Chemical Hygiene Plan that will include recommendations from the Laboratory Managers.

- The EHS Department will serve as resource for information for the Laboratory Managers

- The EHS Department will be responsible for maintaining the chemical inventory system and the central MSDS Library.

- The EHS Department will conduct regular safety inspections of all laboratories including ventilation systems, and operational checks on the safety eyewash and showers.

- The EHS Department is responsible to ensure that adequate training is provided to faculty, staff, student employees, and technicians who work with hazardous chemicals or work in areas where hazardous chemicals are stored or used.

- The EHS Department will monitor procurement, use and disposal of chemicals used in the labs.

- The EHS Department will keep up to date on the current legal requirements concerning regulated substances and communicate this information to Laboratory Managers.

Laboratory Worker/Student responsibilities regarding implementation of the Chemical Hygiene plan:

- Follow health and safety standards and rules

- Report all hazardous conditions to the Laboratory Supervisor

- Wear and use prescribed protective equipment

- Report any suspected job-related injuries or illnesses to the laboratory manager and seek treatment immediately

- Do not operate any equipment or instrumentation without proper instruction and authorization.

- Remain aware of the hazards of the chemicals in the lab and how to handle hazardous chemicals safety. Communicate this information to students using the laboratory.

- Request information and training when unsure how to handle a hazardous chemical or procedure.

- Review and follow all requirements outlined in the Berea College Student Contract for college laboratories. Each student/worker is required to sign this contract. (See Appendix III for copy of the Student Contract Form).

College Administration including the President, Vice President of Business, the Dean of Academic Affairs, and Department Chairs have the primary responsibility for the health and safety of their staff and students. Specific responsibilities regarding the implementation of the chemical Hygiene Plan include:

- Establish and support the organizational structure necessary to develop and implement the required policies and procedures covered by the Chemical Hygiene Plan.

- Develop and support budgets for health and safety improvements and general operating expense.

- Maintain involvement in the policy development process to help identify safety issues and implement action plans and programs.

CHAPTER 3

STANDARD OPERATING PROCEDURES

Purpose

The Lab Standard requires operating procedures relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals. These procedures represent the general guidelines that will apply to all laboratory work involving hazardous chemicals. Individual laboratories or research groups are required to develop more detailed procedures as their situations warrant. These procedures must be written, and added to the existing laboratory's Chemical Hygiene Plan and made available to Laboratory workers.
Please include your Laboratory Specific Information in Appendix IX.
(See Appendix III for a copy of the Lab Specific SOP Form)

Hierarchy of Defense

To protect workers from exposure to hazardous chemicals there is a hierarchy of defense. Personal Protective Equipment (PPE) is the last line of defense. It is imperative that all lab personnel know what PPE is appropriate for all operations in the lab, what work practices are to be followed and then understand how the engineering controls work.
The following Standard Operating Procedures apply to all labs at Berea College.

Procedure Review

1. **Never work alone in a laboratory when handling hazardous materials or working with potentially hazardous equipment/instrumentation**. (See Work practice and Administrative Controls Page 3 for specific requirements for independent study and research)

2. **Appropriate personal hygiene practices shall be followed at all times**.
   a. Wash promptly whenever a chemical has contacted the skin and wash thoroughly with soap and water before leaving the laboratory area.
   b. Avoid inhalation of chemicals: do not sniff to test chemicals.
   c. Do not use mouth suction to pipette anything; use suction bulbs.
   d. Smoking is prohibited.
   e. Do not bring food, beverage, tobacco or cosmetic products into a laboratory or chemical storage area.

3. **Professional Standards of conduct**
   a. Do not engage in practical jokes or horseplay
   b. Report all accidents/incidents immediately to your supervisor or teacher.
   c. Inform others when they are performing tasks in a manner that is potentially dangerous/harmful to themselves and in violation of the Chemical Hygiene Plan.

4. **Appropriate Personal Protective Equipment shall be worn at all times**;

Attire- At a minimum all lab personnel should be wearing a lab coat or lab apron and impact and splash-proof safety goggles when there is active work being done with chemicals in the lab. Also, legs, feet, and chest area should be covered. Open toed shoes, shorts, halter or tube tops are not permitted in the labs. Loose clothing and long hair should be confined.

Eye Protection *The eye is the most vulnerable part of the body from an injury standpoint and must be protected*

a. **Safety Glasses**- Safety glasses can be an option to goggles when no splash hazards exist. Safety glasses offer no protection against splashes. The safety rating is based on impact protection only. All safety glasses and goggles must comply with the Z87.1 ANSI Standard for impact protection. When working with UV, IR Lasers, and Ionizing light sources, which can damage the eye, it may be necessary to wear safety glasses, which filter specific wavelengths of light.

b. **Goggle requirement**- Impact and splash-proof goggles must be worn when working with chemicals. Goggles meeting the above listed requirement can be worn over glasses and contact lens. (In 1995 the Committee on Chemical Safety of the American Chemical Society revised its position on the wearing of contact lenses in the Chemical laboratory)

c. **Face Shield**- Face shields must always be used with goggles or safety glasses. They are not approved to wear alone when working with chemicals and they are not designed to withstand an impact. Face shields should be worn with goggles if the procedure has the potential for a mild explosion, the procedure requires use of concentrated corrosive chemicals, (i.e. acids, alkali's, strong oxidizers), highly skin absorbable chemicals, or is an unknown reaction.

d. **Gloves -** Glove assessments should be done for all chemicals in the lab and if one glove will not work for all chemicals, written information needs to be provided to all lab workers. **All glove materials are not equally effective in protection from chemical hazards.** Consult a chemical resistance chart such as the one found in Appendix VI. You can also consult a glove manufacturer or the EHS Department for assistance in appropriate selection.

e. **Aprons, lab coats, and clothing- Always** wear either a high-necked laboratory apron or lab coat that is calf or ankle length. Fire resistant materials are recommended. When working with hazardous chemicals, legs and feet should be covered i.e. no open toed shoes and shorts are allowed in the labs.

f. **Shoes -** Always wear low-healed shoes with fully covering "uppers". Do not wear shoes with open toes or uppers constructed of woven material. Leather shoes are highly recommended for all chemical procedures.

g. **Respiratory Protection- The** use of some substances may require respirators. Any procedure that may require a respirator must be reviewed by the Department of Environmental Health and Safety to determine if the Respiratory Program should be implemented. See chapter 4 for a discussion of "Controlling Chemical Exposures".

Note: Please see the Hazardous Assessment and Personal Protective Equipment Requirements for General Laboratory Operations Appendix V.

f. Housekeeping Practices

* Access to emergency equipment, showers, eyewashes, and exits should always be kept clear.
* Keep all work areas clear of clutter. Clean all work areas immediately following use.
* Do not store chemicals in aisles, hallways, and stairways or fume hoods.
* Return all chemicals to designated storage areas at the end of each day.

* Promptly clean up all spills or notify EHS that you need assistance with spill clean- up.
* Do not leave chemicals on shelves over the workbenches
* Glassware should be rinsed and dried immediately following use to prevent others from coming in contact with any residues on or in the glassware.

The following Standard Operating Procedures are covered in Separate chapters.

Hazardous Spill Response Procedure
Medical Monitoring and Accident Reporting
Prior Approval
Controlling Chemical Exposures
Laboratory Chemical Hoods

PROCEDURES FOR SPECIFIC CLASSES OF HAZARDOUS MATERIALS

The specific rules and procedures for working with hazardous chemicals give insight into the proper methods for handling hazardous materials. The following information will address some of the basic physical hazards which may result for acute exposure to different types of laboratory chemicals. This section offers some specific guidelines for working with five fundamental classes of laboratory chemicals: flammables, corrosives, oxidizers, reactive, and compressed gases.

1. Flammable Solvents

Flammables are the most common chemicals found in a laboratory. Their primary hazard is their ability to readily ignite and burn. Please note that it is the vapor of a flammable liquid, no the liquid itself, that ignites and causes fire.

The rate at which a liquid vaporizes is a function of its vapor pressure. In general, liquids with high vapor pressures evaporate at a higher rate compared to liquids of lower vapor pressure. Vapor pressure will increase rapidly as the temperature is raised as does the evaporation rate. A reduced pressure environment will also increase the rate of evaporation.

The flash point of a liquid is the lowest temperature at which a liquid gives off vapor at such a rate to form an air vapor mixture that will ignite, but will not sustain ignition. Many commonly used flammable solvents have flashpoints significantly lower than room temperature. For example:
Diethyl ether has a flash point of -45.0 degree C
Acetone has a flash point of -17.8 degree C
Isopropyl Alcohol has a flash point of 11.7 degree C

The limits of flammability define the range of fuel/air mixtures that will sustain combustion. The lower limit of the range called the Lower Explosive Limit or LEL, and the higher limit of the range is called the Upper Explosive Limit or UEL. Material with very broad flammability ranges (i.e. acetylene, LEL 3% and UEL 65%) are particularly treacherous due to the fact that virtually any fuel and air mixture combination may form an explosive atmosphere.

The vapor density of a flammable material is the density (mass to volume ratio) of the corresponding vapor relative to air under specific temperature and pressure conditions. Flammable vapors with densities heavier than air are potentially lethal because they will accumulate at floor level with remarkable ease very much like a liquid would. The obvious threat is that these mobile vapors may eventually reach an ignition source such as an electrical outlet or a Bunsen burner at another student's bench.

Uses and Storage of Flammable Liquids

1. Flammable liquids not in use must be stored in safe containers inside a fire resistant storage cabinet or inside storage rooms.
2. Minimize the amount of flammable liquids stored in a Laboratory
3. Use flammables only in areas free of ignition sources
4. Transferring flammable liquids from one metal container to another can generate static charge on the container. This fact must be kept in mind when transferring flammable liquids because the discharge of static can generate a spark and ignite the liquid. To prevent this from occurring, use a bond and ground procedure on the containers. Bond the two containers together with a bond strap/wire and ground the transferring container with a ground strap. All bonding and grounding connections must be metal to metal. Bond and ground straps can be found in the Prep Lab in the Science Building.
5. Never heat flammables with an open flame. Instead use steam baths, water baths, oil baths, hot air baths, sand baths or heating mantles. Always follow the instructions of the Laboratory Manager/Instructor.
6. Never store Flammable chemicals in a standard household refrigerator. There are several ignition sources located inside a standard refrigerator that can set off a fire or explosion. Flammables can only be stored in a refrigerator rated for flammable chemicals (i.e. explosive proof rating). Note: there is no safety benefit from storing a flammable chemical in a refrigerator if the flashpoint of the chemical is below the temperature of the refrigerator.

Health Hazards Associated with Flammables

In general flammable vapors are irritation to mucous membranes of the respiratory system and eyes, and in high concentrations are narcotic. An acute response may have the following symptoms:

1. Inhalation-headache, fatigue, dizziness, drowsiness, narcosis (stupor/unresponsiveness)
2. Ingestion-Slight gastro-intestinal irritation, dizziness, fatigue
3. Skin Contact-dry, cracked, and chapped skin

Chronic or long term health effects will vary depending on the specific chemical, the duration and concentration of the exposure. Chronic effects can range from mild irritation to damage to organ systems, reproductive system and cancer. Always review the MSDS for the chemical you are working with to determine both acute and chronic hazards.

Flammable Groups Exhibiting Similar Heath Effects

Hydrocarbons-aliphatic hydrocarbons are narcotic but their systemic toxicity is relatively low. Aromatic hydrocarbons are all potent narcotic agents and overexposure to the vapors can lead to loss of muscular coordination, collapse, and unconsciousness. Benzene is toxic to the bone marrow and can cause leukemia.

Alcohols-vapors only moderately narcotic

Esters-vapors may result in irritation to the nose, throat, and upper respiratory tract.

Ketones-systemic toxicity is generally not high.

First Aid Procedures for Exposures to Flammable Materials

Inhalation-remove person to safe area if it is safe to do so. Get medical attention and do not leave the person alone.

Ingestion-remove person from source of contamination and get medical attention

Dermal exposure- remove person from source of contamination. Remove contaminated clothing, jewelry, and shoes from affected area and flush with water for at least 15 minutes and obtain medical attention.

Eye contact- remove person from the source of contamination. Flush eyes with water for at least 15 minutes and obtain medical attention.

Personal Protective Equipment (PPE)/Engineering controls

Always use a fume hood when working with flammable liquids. Nitrile and neoprene gloves are effective against most flammables. Wear a nonflammable lab coat/apron to provide a barrier to you skin and splash proof goggles. Follow the recommendations for PPE in the Material Safety Data Sheet for a specific chemical (Also see appendix VI for more information on gloves).

2. Oxidizers

Oxidizers or oxidizing agents present fire and explosion hazards on contact with combustible materials. Depending on the class, an oxidizing material may increase the burning rate of combustibles with which it comes in contact with; cause spontaneous ignition of combustibles with which it comes in contact; or undergo and explosive reaction when exposed to heat, shock, or friction. Oxidizers are generally corrosive.

Example of common oxidizers

Peroxides	Nitrates
Nitrates	Perchlorates
Chlorates	Chlorites

Hypochlorites Dichromates

Use and Storage of Oxidizers

1. Store oxidizers away from flammables, organic compounds, and combustible materials.
2. Strong oxidizers like chromic acid should be stored in glass or other inert container, unbreakable if possible.
3. Reaction vessels containing oxidizers should never be heated in oil baths, but rather on a heating mantle or sand bath.

Use and storage of Perchloric Acid

Perchloric acid is an oxidizing agent of particular concern. The Oxidizing power of perchloric acid increases with an increase in concentration and with an increase in temperature. Cold, 70% perchloric acid is a strong, non-oxidizing corrosive. A 72% perchloric acid solution at elevated temperatures is a strong oxidizing agent. An 85% perchloric solution is a strong oxidizer at room temperature.

1. Do not attempt to heat perchloric acid if you do not have access to a perchloric fume hood equipped with a wash down system to remove residue. The hood should be washed down after each use.
2. When possible substitute a less hazardous chemical for perchloric acid
3. Store on a metal shelf or in a metal cabinet away from organic or flammable materials. Also store in a glass secondary container to contain spills. Please note-We will not stock anhydrous perchloric acid. It is unstable at room temperature and can decompose spontaneously with a severe explosion and will explode upon contact with wood.

Health Hazards associated with Oxidizers

Oxidizers are covered here due to the potential to add to the severity of fire or to start a fire. In general Oxidizers are corrosive and many are highly toxic.

Acute health Effects

Some oxidizers such as nitric and sulfuric acid vapors, chlorine, and hydrogen peroxide act as irritant gases that can cause inflammation in the surface layer of tissues when in direct contact. They can also cause irritation of the upper airways, conjunctive, and throat. Some oxidizers such as fluorine can cause severe burns to tissue. Nitrogen trioxide is very damaging to tissue, especially the respiratory tract. The symptoms from an exposure to nitrogen trioxide may be delayed for hours, but fatal pulmonary edema may result.

Osmium tetroxide is also dangerous due to its high degree of acute toxicity. It is a severe irritant of both the eyes and respiratory tract. Inhalation can cause headache, coughing, dizziness, lung damage, difficulty breathing and may be fatal. This chemical has poor warning properties. It is difficult to detect in the atmosphere at levels 10,000 greater than the Permissible Exposure Limit (PEL). For this reason, it is recommended that laboratories using this chemical have necessary safe guards in place before the container is even opened.

Chronic Health Effects

Nitrobenzene and Chromium compounds can cause hematological and neurological changes. Compounds of chromium and manganese can cause liver and kidney disease. Chromium (VI) Compounds have been associated with lung cancer.

First Aid

In general, if a person has inhaled, ingested, or come into direct contact with any oxidizer, the person must be removed from the source of contamination as quickly as possible when it is safe to do so. Seek medical help immediately. Exposure to skin and eyes should be flushed with water for a minimum of 15 minutes.

Personal Protective Equipment (PPE)

In many cases the glove of choice will be neoprene, polyvinyl chloride (PVC), or nitrile. Be sure to consult a glove compatibility chart to ensure the glove material is appropriate for the chemical you are working with (see appendix VI)

Always use goggles when working with oxidizers. Use a face shield over goggles if there is potential for splashing. Follow recommendations for PPE on the Material Safety Data Sheet for the specific chemical.

Always use materials in a chemical fume hood as most present inhalation hazards. Compressed gas cylinders should be kept in ventilated cabinets.

3. Corrosives

Corrosives are most commonly acids and alkalis, but many other materials can be severely damaging to living tissue.
Corrosives can cause visible destruction or irreversible alterations at the site of contact. Inhalation of the vapor or mist can cause severe bronchial irritation. Corrosives are particularly damaging to the skin and eyes.
Certain substances considered non-corrosive in their natural dry state are corrosive when wet such as when it touches moist skin or mucus membranes. Examples of such materials are lithium chloride, halogen fluorides, and alkyl iodide.
Sulfuric acid is a very strong dehydrating agent and nitric acid is a strong oxidizing agent. Dehydrating agents can cause severe burns to the eyes due to their affinity for water.

Use and Storage of Corrosives

1. Always store acids separately from bases. Also, it is recommended that acids be stored separately from flammables, primarily because some acids are strong oxidizers (i.e.- nitric acid)
2. Do not work with corrosives unless an emergency shower and a continuous flow eyewash station are available.
3. Add acid to water, but never add water to acid. This is to prevent splashing from the acid due to excessive heat generated as the two substances mix.
4. Never store corrosives above eye level. Store on a low shelf or cabinet

5. When possible purchase corrosives in containers that are coated with a protective plastic film that will minimize the danger to personnel if the container is dropped.
6. It is good practice to store corrosives in a tray or bucket to contain any leakage.
7. Store corrosives in a wooden cabinet or one that has a corrosion- resistant lining. Corrosives can damage the cabinet causing the supports to weaken. This can result in a potentially serious accident.

Special Handling Procedures for Hydrofluoric acid

Hydrofluoric acid is extremely hazardous and requires special handling procedures. This acid can cause severe burns and inhalation of anhydrous hydrogen fluoride can be fatal. Initial skin contact with hydrofluoric acid may not produce any symptoms until permanent damage has been done.
*Use of this acid requires special training concerning its hazards.
* Always use this acid in a properly functioning hood and wear personal protective clothing!
* Never store hydrofluoric acid in glass because it is incompatible with glass
* Exposure to hydrofluoric acid requires immediate attention. Wash area for at least 15 minutes and seek medical attention. If vapors are inhaled move person immediately to an uncontaminated area and seek medical attention immediately.
* Creams for treatment of hydrofluoric acid exposure are commercially available.

Health Hazards Associated With Corrosives

All corrosives possess the property of being severely damaging to living tissues and will attack other material such as metal.
Skin contact with alkali metal hydroxides (i.e.-sodium hydroxide and potassium hydroxide) is more dangerous than with strong acids. It can cause deeper tissue damage because there is less pain than with an acid exposure. The exposed person may not wash it off before damage occurs or seek medical help immediately.
All hydrogen halides (Hydrofluoric acid) are acids that are serious respiratory irritants and can cause severe burns.

Acute Health Effects

Inhalation- Irritation of mucus membranes, difficulty in breathing, fits of coughing, pulmonary edema.

Ingestion-Irritation and burning of mouth, lips throat, pain in swallowing and swelling in the throat, painful cramps, vomiting, shock and perforation of the stomach.

Skin Contact- burning, redness and swelling, painful blisters and damage to tissues. Alkalis have a slippery, soapy feeling.

Eye contact-stinging, watering of eyes, swelling and painful blisters, damage to tissues and loss of eyes or eyesight.

Chronic Health Effects

Symptoms associated with a chronic exposure vary depending on the chemical

First aid

Inhalation- remove person from source of contamination if safe to do so and seek medical attention immediately.
Ingestion- remove person from source of contamination and seek medical attention immediately. Be able to tell first responders the name of the chemical.
Skin contact- remove person from source of contamination if safe to do so and take to an emergency shower or source of water and flush for at lest 15 minutes. Remove all contaminated clothing. Seek medical attention immediately.
Eye contact- remove person from contamination and flush eyes with water for at least 15 minutes keeping eyes open and moving eyes around to flush the entire area of the eye. Do not let person rub their eyes and seek medical attention immediately.

Personal Protective Equipment

Always wear proper gloves when working with acids. Neoprene and nitrile gloves are effective against most aids and bases. PVC is also effect on many acids. See appendix VI for more specific information. A rubber coated apron and goggles should also be worn. If splashing is likely to occur, wear a face shield over the goggles. Follow the recommendations on the Material Safety Data Sheet for the specific chemical

4. Reactive

General Characteristics of Reactive Chemicals

Polymerization Reactions- Polymerization is a chemicals reaction in which two or more molecules of a substance combine to form repeating structural units of the original molecule. This can result in an extremely high or uncontrolled release of heat. Styrene is an example of a chemical that has this characteristic.

Water Reactive- when a water reactive chemical comes in contact with water it will either liberate heat which can cause ignition of the chemicals itself if it is flammable or ignite flammables stored nearby. They can release flammable, toxic, or strong oxidizing gas, release metal oxide fumes, and formation of corrosive acids. They are especially dangerous to fire fighting personnel since water is one of the most common fire fighting tools.

Pyrophorics- Pyrophoric material can ignite spontaneously in the presence of air.

Peroxide Forming Materials- Peroxides are very unstable and some chemicals that can form them are commonly used in laboratories. This makes peroxide-forming materials some of the most hazardous substances found in a lab. Peroxide-forming materials are chemicals that react with air, moisture, or impurities to form peroxides. The tendency to form peroxides by most of these materials is greatly increased by evaporation or distillation. These chemicals are extreme sensitive to shock, sparks, heat, friction, impact and light. (See appendix IV for more information on time sensitive chemicals)

Compounds containing the functional groups: acetylide, azide, diazo, halamine, nitroso and ozonide are other shock sensitive materials.

Use and Storage of Reactives

Minimize the amount of material used in an experiment to reduce the risk from these types of materials.

Substitute a less hazardous chemical for highly reactive chemicals and order only the amount needed to do the work.

Water Reactive Materials

Store water reactive chemicals in an isolated area away from any water sources, such as sinks, emergency showers, and chillers.

Pyrophorics

Store pyrophorics in an isolated part of the lab in a clearly marked cabinet. Be sure to routinely check the container and have the material disposed of through EHS if the container is corroded or damaged.

Peroxide Forming materials-Please refer to the procedures in Appendix IV

Other Shock Sensitive Materials

Store separately from other materials. Never allow picric acid to dry out. It is extremely explosive when dry. Always store in a wetted state.

Health Hazards Associated with Reactives

Reactives are grouped together because of their common hazards when used and stored. The health hazards can vary depending on the individual characteristics of the chemical. Always review the Material Safety Data Sheet for additional hazard information.

First Aid

If someone is seriously injured the most important step to take is to remove them from the contaminated area if safely possible and contact emergency responders by dialing 911. Explain the situation and the chemical(s) involved and the location clearly and accurately.

Personal Protective Equipment

Wear appropriate personal protective equipment when working with reactives based on the recommendations in the Material Safety Data Sheet.

5. Compressed Gas Cylinders

Compressed gas cylinders can pose both a chemical and physical hazard. If a valve were to break off a cylinder, the cylinder would have enough force to go through a brick wall. For this reason, non-returnable cylinders should not be purchased. Disposal can be difficult and the College is not set up to safety remove the pressure and decontaminate compressed gas cylinders.

Use and storage
The use and storage of compressed gas cylinders should always be in well ventilated areas. Always use the appropriate regulator on a cylinder. Do not try to adapt or modify a regulator to fit a cylinder it is not designed for. Regulators are designed to fit only specific cylinder valves to avoid improper use.

Inspect regulators, pressure relief devices, valves, cylinder connections, and hose lines frequently for damage.

Never use a damaged cylinder or one that cannot be positively identified.

Do not use oil or grease on a cylinder component of an oxidizing gas because of fire hazard.

Never transfer gases from one cylinder to another to avoid incompatibility reactions

Never completely empty cylinders during lab operations. Leave approximately 25psi of pressure. This will prevent any residual gas in the cylinder from becoming contaminated.

Place all cylinders so the main valve is accessible and close the main valve when not in use.

Remove regulators from unused cylinders and always put the safety cap in place to protect the valve.

Always secure cylinders in an upright position with chains or straps, empty or full, to prevent them from falling over.

Oxygen cylinders should be stored in an area at least 20 feet away from any flammable or combustible materials or stored in a separate area.

When transporting a cylinder, use a cylinder cart, have the safety cap in place, and strap the cylinder in an upright position. Never roll, drag, or slide cylinders. **Always wear appropriate personal protective equipment.**

Always bond and ground cylinders containing flammable gases

Clearly mark empty cylinders and store them separately.

Do not drop or strike a cylinder against anything.

Use only wrenches or other tools supplied by the cylinder supplier to open valves. Open valves slowly. Stand clear of the regulator and valve outlet while opening the valve

Only compatible gases should be stored together.

Do not store compressed gas cylinders in areas where the temperature can exceed 125 degrees F.

Store flammable and oxidizing gases separately.

Do not allow anyone to ride in an elevator with gas cylinders or cryogenic liquids. Station individuals at each floor elevator entrance to keep people from entering the elevator with the cylinder while in transport.

PRESSURE REGUALTORS

The pressure regulator must be closed before attaching and before opening the compressed gas tank

Never lubricate or use sealing tape on regulator or tank valve

Never use adaptors

Always use the regulators approved for the specific gas

CHECK FOR LEAKS

Check entire gas train for leaks on a regular basis

Apply soapy water (1:10 dish soap to water) to all joints and connections

Bubble will indicate leaks

If a leak is detected, may need to evacuate or call outside help

BIOLOGICAL AND ANIMAL HAZARDS

Major causes of infections in the laboratory are:

- Oral Aspiration through mouth pipetting
- Accidental syringe injections
- Animal contact and bites
- Spray from syringes
- Centrifuge accidents

Other hazards exist with broken containers which may need to be decontaminated, inoculating loops that must be fired immediately before and after use, and microscope mirrors that should never use direct or reflected sunlight.

Blood typing- Blood typing should be done with parental or student permission, depending on age and only sterile, disposable lancets are to be used. Continuous supervision is essential.

Other Hazards associated with working with Animals

1. Old preserved animal skins may have been treated with arsenic or mercury compounds
2. Scalpels or other cutting devices must have only one cutting edge
3. When using or cleaning up potentially hazardous materials, personal protective equipment must be used.
4. Be aware of potentially serious allergic reactions to biological material including plants and animals.
5. Mammals, birds, terrapins, etc. are potential carriers of diseases.
6. If an experiment requires eating, do the experiment in an area where edibles can be prepared.
7. Killing agents such as ether or injectables must be handled with care. Ether should be stored in explosive proof refrigerators.

Biological Waste handling practices

Cultures/Stocks of Infectious waste, Blood and Blood Products, Pathological Waste, Contaminated Liquids and Equipment, Fermentation Broths, and Tissue Cultures must be:

- Autoclaving- steam must penetrate, periodic validation
- Chemical decontamination of working surfaces and equipment
- Incineration-Place all waste in biohazard bags and contact EHS department for removal
- Always wear appropriate personal protective equipment, gloves, safety glasses or goggles if splash hazard exist, and lab coat/apron.

CHAPTER 4

Spill Response Procedures

Note: An important part of the Chemical Hygiene Plan is the review of all possible spills ahead of time. Necessary spill materials need to be readily available and all lab personnel need to know how to use them. If a chemical spill occurs that is beyond our capability to handle with the spill supplies located in the laboratories and it presents an imminent hazard to the building occupants, please evacuate the building and contact Public Safety, the Berea Fire Department, and the 24 hour emergency clean up contractor at 1-800-805-4582 or 513-681-6246

If a Chemical Spill Occurs:

1. Immediately alert others in the area. Consult the MSDS for spill control procedures specific to the chemical. CAUTION: Some materials become corrosive, irritating and otherwise hazardous on contact with water.
2. Remove any contaminated clothing. Brush off any solid residues before washing skin. Flush skin with water for no less than five minutes. Do not wash contaminated clothing with other clothes.
3. If it appears that the spill is too large to be easily contained and cleaned up, call 3350 or 3333 and request help.

Spills of Volatile, Flammable, or Toxic Material

1. If a volatile, flammable, or toxic material is spilled, immediately warn everyone to extinguish flames and turn off spark-producing equipment such as brush motors. Shut down all equipment and vacate the room until the spill is cleaned up. The following substances are particularly hazardous and cleanup should be handled only by someone with proper training:
   Aromatic amines
   Bromine
   Carbon disulfide
   Nitro compounds
   Cyanides
   Ether
   Organic halides

   Note: If there is no fire hazard and the material is not volatile or toxic, clean it up as soon as possible. To facilitate cleaning up of liquids, use an adsorbent material that will neutralize the liquids. For example; trisodium phosphate and sand followed by sodium bicarbonate solution

or powder for acids or a sodium thiosulfate solution for bromine etc. Commercial adsorbents like oil-dry and Zorb-all, vermiculate or other clay adsorbents are also available.

2. Many small spills (< 100ml) can be absorbed with paper towels, sand, or an adsorbent. However, paper towels can increase the surface area and evaporation rate of flammable liquids increasing the fire hazard. Spilled material must be collected and contained as soon as possible to reduce exposure. Most solid spills can be brushed up and disposed of in appropriate solid waste containers, but care must be exercised to avoid reactive combinations. Do not leave paper towels or other materials used to cleanup a spill in open trashcans.

Acid Spills
Concentrated Acetic, Formic, Nitric, Phosphoric, Perchloric, Sulfuric; dilute Hydrochloric are examples of some of the acids that can be found in storage. For large spills (500ml or more) use spill control pillows to soak up as much acid as possible. Place used pillows in plastic bags for disposal. Neutralize remaining acid with acid spill cleanup kit, following the instructions on the kit. Small spills can be treated directly with the spill cleanup kit. CAUTION: Most spill pillows cannot be used with HF (Hydrofluoric Acid). Please follow the instructions on the MSDS for spill cleanup.

Acid Chlorides
Acid chlorides are potent lachrymators. Use calcined adsorbent products such as oil-dry or zorv-all or dry sand. Avoid contact with skin and inhaling chloride vapors.

Alkali metal
Avoid water! A spill of an alkali metal should be smothered with powered graphite or Met-L-X extinguisher (Type D) and removed to a safe location where it can be disposed of by reaction with a dry secondary alcohol. Consult the MSDS and/or the manufacturer for additional control procedures.

Caustics
Solutions of Ammonium, Calcium, Potassium or Sodium Hydroxide are examples of caustic material that can be spilled. For large spills (more than 500 ml), use spill control pillows. Place used pillows in plastic bags for disposal. Neutralize remaining spill with caustic spill kit. Small spills can be handled with the spill kit.

Concentrated Hydrochloric Acid
Cover the spill with a vapor barrier absorbent blanket. Open windows and turn on the fume hoods. Use spill control pillows if necessary. Local evacuation may be necessary to prevent exposure to corrosive fumes.

Hydrogen Peroxide 30% for small spills dilute with water and sponge up spill. For large spills dilute with water and use spill control pillows according to the dispenser box instructions. Any concentrations above 30% pose serious problems. Consult the MSDS and /or manufacturer for instructions. The use of concentrations over 30% in a laboratory require SOP's be developed that include spill procedures.

Mercury

Mercury vapor is highly toxic. Spilled Mercury should be immediately cleaned up using an aspirator bulb or a vacuum device. Use the Mercury cleanup unit located in the bunker. Make sure and follow the instructions in the kit. Mercury spilled into floor cracks can be made non-volatile by amalgamation with zinc dust. Do not use domestic vacuum cleaners to clean up mercury spills. Call the EHS Department for assistance with Mercury spills. All waste material must be contained and disposed as hazardous waste.

White Phosphorus
A spill of white phosphorus should be blanketed with wet sand or wet adsorbent. If any material is splattered on the skin, flush the skin with cold water and remove adhering phosphorus. Copper sulfate solution provides a visual aid in removing particles because it produces a dark color in contact with elemental phosphorus.

Note: The above information offers general instructions for different types of hazardous chemical spills. Please refer to the MSDS to obtain specific chemical data for more complete spill response information.

Please include spill response information in your Lab Specific SOP. Appendix IX.

CHAPTER 5

Controlling Chemical Exposures

The lab Standard requires the employer to determine and implement control measures to reduce employee exposure to hazardous chemicals. Attention must be given to the selection of control measures for chemicals that are known to be extremely hazardous. There are three major routes of entry for a chemical to enter the body: inhalation, absorption, and ingestion. Three types of controls for the prevention of these various routes of entry include engineering controls, personal protective equipment and administrative controls. Each route of entry that a chemical can take to enter the body can be controlled in a number of ways as explained below.

Inhalation Hazards

Inhalation of chemicals is the most common route of entry a chemical can take to enter the body. To avoid inhalation exposures, hazard reduction methods such as substituting a less volatile or less toxic chemical or substituting a liquid or solid chemical for a gaseous one are the best means of control. If substitution is not practical, engineering controls such as ventilation should be used to lessen the chance of exposure. The use of well-functioning local exhaust ventilation such as Laboratory Chemical Hoods, biological safety cabinets, vented glove boxes and other local exhaust systems are often required to minimize exposure to hazardous chemicals. Dilution ventilation may be used to reduce exposure to nonhazardous nuisance orders. For extremely toxic chemicals such as those classified as poison gases by State or Federal agencies (e.g., arsine, phosgene) the use of a closed system, vented gas cabinets, fail-safe scrubbing, detection or other stricter controls may be required.

If both substitution and engineering controls are unavailable, the use of personal protective equipment may be required to reduce inhalation exposures. If laboratory employees are required to wear respirators, the requirements of the OSHA Respirator Standard (1910.134) must be met and a written respirator program must be implemented. This standard requires training on the proper use of respirators and fit testing to ensure that the respirator fits properly. The Lab worker or his/her supervisor should contact the EHS Department if respiratory protection is to be utilized to control exposures to hazardous chemicals.

In addition the following principles should be utilized to reduce the risk of exposure to hazardous chemicals:

- Minimization of exposure time for individual employees
- Restricted access to an area where a hazardous chemical is used
- Proper signage on lab doors to indicate special hazards within.

Skin/Eye Contact Hazards
The more obvious means of preventing skin and eye contact is the wearing of personal protective equipment such as eye protection, face shields, gloves, appropriate shoes, lab apron or coats, and other protective equipment as appropriate to the hazard. Since the chemical resistivity of the different types of protective equipment varies significantly, the lab Manager should consult Appendix VI. or other references to ascertain that the protective equipment material is resistant to the chemical being protected against. Safety showers/eyewash equipment is required where corrosive chemicals are used. Such equipment must be prominently labeled and not obstructed.

Ingestion Hazards
Laboratory Workers can easily ingest chemicals into the body via contaminated hands if they are not washed prior to eating, smoking or sticking part of the hand or writing tool that has been in contaminated hands, into the mouth. Some controls for preventing this route of exposure are isolating the hazardous substance so minimal contact is required (e.g., use a glove box). Also, administrative controls such as forbidding mouth pipetting, encouraging good personal hygiene and designating a well marked nonchemcial area where eating, drinking and the application of makeup is permitted. Also, the wearing of gloves can reduce this type of exposure.

Exposure Assessment

At the request of faculty, staff, or students, an exposure evaluation can be scheduled. Records of exposure evaluation will be kept in the EHS Department files and copied to the department and the effected employees and any other appropriate authorities at the college.
The EHS Department will measure employee exposure to any substance regulated by a standard that requires monitoring if there is reason to believe that exposure levels routinely exceed the action level or the PEL if no action level is established. The following substances may be included in a monitoring program:

Asbestos
Vinyl Chloride
Inorganic arsenic
Lead
Cadmium
Benzene
Cotton dust
1, 2-Dibromo-3-chloropropane
Acrylonitrile
Ethylene oxide
Formaldehyde
Methylenedianiline
1.3-Butadiene
Methylene chloride

Chapter 6

Laboratory Chemical Hoods and Other Engineering Controls

Laboratory Chemical Hood Face Velocities

All Laboratory hoods at Berea College should have face velocities between 80 to 150 feet per minute with the sash at a "working height" of approximately 12 inches. As a general rule laboratory chemical hoods should not be operated with the sash open and should have the sash closed when not being used. The Environmental Health and Safety Department will conduct a Laboratory chemical hood inspection each semester. The EHS Department will also coordinate a comprehensive audit and certification program that will be conducted by an outside consultant every other year. Each hood will be marked with a sticker showing face velocity and date of inspection. Laboratory chemical hoods with face velocities within the 80 to 150 feet per minute range may be used for chemical manipulations.

Hoods Needing Repair

Laboratory chemical hoods with face velocities below 80 feet per minute or above 150 linear feet per minute must be marked with a sign indicating that the hood may not be used for chemical manipulations. A work order to repair these hoods should be processed as soon as possible. Work orders can be issued through the campus e-mail system. Contact the building manager if you need help issuing a work order. Once the hood is repaired, the EHS Department will need to recheck the face velocity**. Do not use a hood that is not working or is shut down for maintenance.**

Safe Work Practices for Laboratory chemical Hoods

When using a Laboratory chemical hood, one must remember that the hood does not provide absolute containment or absolute protection from the materials in the hood. However, for most exposures, a properly designed hood in a well-ventilated room can provide adequate protection from the materials in the hood if certain work practices are followed. The work practices listed below are recommended by the American Conference of Governmental Hygienists in their text: "Industrial Ventilation: A Manual of Recommended Practices."

A chemical laboratory hood cannot provide complete safety against all events that may occur in the hood, especially for toxic airborne contaminants with an exposure limit in the low part

per billion range. For ordinary exposures, a properly designed hood in a well-ventilated room can provide adequate protection. To maximize hood efficiency the following work practices must be followed; more stringent practices may be necessary in some circumstances.

1. All exposures that may generate air contaminants at levels above the exposure limit must be conducted in a hood.

2. Keep all apparatus at least 6 inches back from the face of the hood.

3. Do not put your head in the hood when contaminants are being generated.

4. Do not use the hood as a waste disposal mechanism.

5. Excessive storage of chemicals or any apparatus in the hood will impair the performance of the chemical laboratory hood. Store flammable chemicals in an approved flammable storage safety cabinet. Store corrosive chemicals in a corrosive storage cabinet.

6. Be sure the switch is in the "on" position whenever the hood is in use and test hood often for airflow (for example using a chemwipe)

7. Using hazardous solids (powders) in a hood may not be appropriate.

8. Keep the slots in the hood baffle free of obstruction by apparatus or containers.

9. Minimize foot traffic past the face of the hood.

10. Keep laboratory doors and windows closed unless the laboratory is designed to have the doors open.

11. Do not remove hood sash or panels except when necessary for apparatus set-up. Replace sash panels before operating.

12. Do not place electrical receptacles or other spark sources inside the hood when flammable liquids or gases are present. No permanent electrical receptacles are permitted in the hood.

13. Use appropriate barricade if there is a chance of explosion or eruption.

14. If hood sash is supposed to be partially closed for the operation, the hood should be so labeled and the appropriate closure point clearly indicated.

15. Do not heat perchloric acid above ambient temperatures unless you use a specially designed chemical hood exhaust system. These systems will have dedicated exhausts and a water wash down system, and may be used for perchloric acid digestions only.

16. All Laboratories should have spill supplies located in a well-marked area.

CHAPTER 7

Accident and Incident Reporting And Medical Consultation

Accidents and Incidents

All employee or student accidents, which result in an injury or excessive exposure to a hazardous chemical, must be reported promptly to the Laboratory manager/Instructor, Public Safety (ext. 3333) and to the EHS Department (ext. 3350 or 3426). Such reportable occurrences include accidental ingestion, inhalation, or accidental inoculation of a hazardous chemical or animal medication or a physical reaction to a chemical.

All incidents or near misses should be reported to the Laboratory Manager for investigation. The information from the investigation should be used to establish corrective actions to prevent a possible injury or exposure. The Chemical Hygiene committee should review accident and incident information and make recommendations for correction.

The Laboratory Manager is responsible for completing an incident report for either an accident or incident. See Appendix III. for a copy of this report. Both the Laboratory manager and EHS Department should maintain these reports indefinitely.

Medical Consultation

An opportunity for Laboratory workers to receive medical consultation must be provided under the following circumstances:

- If an employee develops any symptoms thought to arise from chemical overexposure.
- After an event such as a major spill, leak or explosion which may have resulted in an overexposure.
- The Laboratory Manager or Institutional Chemical Hygiene Officer identifies an overexposure as the result of an evaluation.

Employees or students workers receiving pay that require medical evaluation should follow the accident reporting procedure as outlined in the first section of this chapter. The employee should seek medical attention as soon as possible. The employee should contact the College

Worker's Comp Coordinator at ext. 3051 to complete a Worker's Compensation first Report of Injury form.

Note: Any medical examination required by this plan must be provided without cost to the employee, without loss of pay and at a reasonable time and place. Records of any medical examinations will be maintained at the medical facility providing service.

CHAPTER 8

Prior Approval

Prior approval to proceed with a laboratory task shall be approved by the Department Chair and/or Laboratory Manager whenever:

1. A new laboratory procedure or test is to be carried out

2. It is possible that the Permissible Exposure limits (PEL) or the Threshold Limit Value (TLV) could be exceeded.

3. There is a change in a procedure or test, even if it is very similar to prior practices. A change means:
   A 10% or greater increase or decrease in the amount of one or more chemicals.
   A substitution or deletion of any of the chemicals in a procedure, which could increase the risk of the procedure.
   Any change in other conditions under which the procedure is to be conducted.

4. There is the possibility of unexpected results.

5. Prior approval is required for any student conducting independent research. The student must follow the guidelines outlined in chapter 1 under Workplace Practices and Administrative controls.

6. Prior approval is required for the acquisition and use of hazardous and toxic chemicals.

If there is any question concerning the need for approvals at various levels, Please contact the Environmental Health and Safety Department.

CHAPTER 9

Employee Information and Training

Background

All individuals who work in laboratories who may be exposed to hazardous chemicals must be apprised of the hazards of chemicals present in their work area. **This information and the training outlined below must be provided before initial assignment and before new exposure situations. Equipment necessary for the safe handling of hazardous substances must also be provided. IT IS THE RESPONSIBILITY OF THE PRINCIPAL LABORATORY MANAGER TO ENSURE THAT ALL LABORATORY WORKERS HAVE BEEN PROPERLY TRAINED.**

Responsibilities

The Department of Environmental Health and Safety will provide general Chemical Hygiene plan/Laboratory Safety training at the beginning of each school semester. Additional classes can be scheduled through the EHS Department as needed. This class informs lab workers of the general Berea College safety policies and procedures and will define the roles and responsibilities of all people in the laboratory.
Specific training required for a particular laboratory is the responsibility of the Laboratory Manager and /or employee supervisor. The supervisor must determine the frequency of refresher information and training.

Information

Laboratory workers must be informed of the location and availability of the following:

- The OSHA Lab Standard- (see Appendix 1)
- The Chemical Hygiene plan
- Reference materials on chemical safety such as Material Safety Data Sheets
- Permissible exposure limits for OSHA regulated substances, or if there is no applicable OSHA standard, the recommended exposure limits or threshold limit value may be provided.
- Signs and symptoms associated with exposure to the hazardous chemicals found in the lab.

Training

Laboratory worker training must include:

1. Detection methods that may be used to detect the presence or release of a hazardous chemical. Examples of detection methods include visual appearance, odor, detector papers, and an understanding of chemical monitoring devices.
2. Physical and Health hazards of chemicals.
3. Hazardous waste training
4. The work practices, personal protective equipment, and emergency procedures to be used to ensure that the employee may be protected from overexposure to hazardous chemicals.
5. Medical consultations and examinations.

The manufacturer's material safety data sheets (MSDS) will generally contain much of the above information needed to comply with the information and training requirements of the OSHA Lab Standard. Copies of MSDS may be obtained from the chemical supplier. Also, a copy of a MSDS can be obtained through the EHS Department if you provide the name of the chemical and the supplier or manufacturer. The EHS Department also has several reference books for hazardous chemicals.

Individual Departments or Laboratories should maintain their own files of reference materials and Material Safety Data Sheets.

(See Appendix VII for a list of Chemical MSDS sites and References)

CHAPTER 10

CHEMCIAL HYGIENE OFFICER

Chemical Hygiene Officer

The Laboratory Manager shall serve as the "Chemical Hygiene Officer" for her/his laboratories. The designated Chemical Hygiene Officer has the primary responsibility for the safety and health of her/his laboratories. The Chemical Hygiene Officer is also responsible for conducting an annual review of the Chemical Hygiene Plan that applies specifically to his/her laboratory(s).

The Director of the Department of Environmental Health and Safety is designated as the "Institutional Chemical Hygiene Officer" for Berea College. This position is responsible for coordinating an annual review of the General Chemical Hygiene plan, serves as a resource to the individual Laboratory Managers, and coordinates the Chemical Hygiene Committee.

CHAPTER 11

Special Provisions For Select Carcinogens, Reproductive Toxins and Acutely Toxic Chemicals

Provisions shall be made for additional employee protection when working with particularly hazardous substances. These substances include "select carcinogens" (see Appendix VIII for a list of select carcinogens), reproductive toxins, and substances, which have a high degree of acute toxicity. The following provisions must be included:

1. Establishment of a designated area
2. Use of containment devices such as laboratory hoods or glove boxes
3. Procedures for the safe removal of contaminated waste
4. Decontamination procedures

In addition to the general safety guidelines mentioned in the first section and throughout the plan, special precautions are needed when handling genotoxins, reproductive toxins, and chemicals with a high degree of acute toxicity. A minimum set of guidelines that should be followed is listed below. The Lab Manager should ensure that these and other precautions designed to minimize risk of exposure to these substances are taken.

- Quantities of these chemicals used and stored in the laboratory must be minimized, as should their concentrations in solution or mixtures.

- Work with genotoxins, reproductive toxins and acutely toxic chemicals must be performed within a certified functioning laboratory chemical hood, biological safety cabinet, ventilated glove box, sealed system, or other system designed to minimize exposure to these substances. Work with these types of chemicals should not exceed the permissible exposure level (PEL)

- Certain chemicals are known or suspected to harm fetuses or reproductive health of adults. Some examples of reproductive toxins are: anesthetic gases, arsenic and certain arsenic compounds, benzene, cadmium, and certain cadmium compounds, carbon disulfide, ethylene glycol monomethyl, and ethyl ethers, ethylene oxide, lead compounds, mercury compounds, toluene, vinyl chloride, xylene, and formamide. The first trimester of a pregnancy is a period of high susceptibility. Often a woman does not know that she is pregnant during this period. Individuals of childbearing potential are warned to be especially cautious when working with these types of chemicals. These individuals must use appropriate protective equipment (especially gloves) to prevent skin contact. Pregnant women and women intending to become pregnant should consult a qualified physician before working with reproductive toxins. Other sources of information include Material Safety Data Sheets, the Laboratory Manager, and

representatives form the Department of Environmental Health and Safety. Notify the Instructors or Laboratory Managers of all incidents of exposure or spills.

- Compressed gas cylinders that contain acutely toxic chemicals such as arsine, chlorine, and nitrogen dioxide must be kept in well-ventilated areas.

- The Laboratory manager should evaluate the ventilation efficiency of the designated Laboratory Hood periodically. The interval of evaluating systems may vary from weekly to annually.

- All laboratory workers who work in a laboratory, which has an area, designated for use with genotoxins, reproductive toxins and acutely toxic chemicals must be trained about the harmful effects of these substances and well as signs and symptoms regarding exposure to these substances. Training should include safe handling and storage of these types of chemicals. This training is the responsibility of the Laboratory Manager and must be done prior to use of any of these chemicals.

- Each Laboratory utilizing these substances must designate an area for this purpose and must mark the area with an appropriate hazard warning.

- Laboratory workers working with these chemicals must have access to appropriate protective equipment and clothing and must be trained on how to properly use the safety equipment.

- Detection equipment may be required in laboratories where chemicals (especially poisonous gases) with a high degree of acute toxicity are utilized.

- The work area must be thoroughly and appropriately decontaminated and cleaned at regular intervals determined by the Laboratory Manager.

- Special precautions to avoid release and exposure to highly toxic chemicals, genetoxins and reproductive toxins must be utilized. For instance, volatile substances should be kept cool and contained. Gases should have properly functioning valves, check valves, regulators, containment that can withstand pressures buildup and appropriate piping. Dispersive solids should be kept in closed containers, used in places with minimum air currents, and appropriate contact materials should be used to avoid static charging.

If this chapter is applicable to your lab please include your lab specific information in Appendix IX. (See Appendix VIII for a list of substances considered carcinogens by OSHA.)

CHAPTER 12

Planning for Emergencies

Planning and practicing for emergencies is an essential component of laboratory safety. Workers in labs should have the knowledge necessary to assess their risks from a small spill or release of a chemical or a small trash can fire, if they have received the proper training. The most important part of the training is being able to differentiate between an incidental situation and an emergency. Practice in emergency procedures and evacuation drills will provide lab workers with the insight they need to make the right decision for action. Contact the EHS department (3246 or 3350) for information on fire extinguisher training.

An incidental release is one that does not cause an imminent health or safety hazard to the lab worker. Lab workers should prepare for and handle their own incidental spills or releases. **The following is a list of life threatening situations**. If any of these situations occur the emergency procedures of the following section need to be followed.

1. High concentrations of toxic substances
2. Situation that is life or injury threatening
3. Imminent danger to life and health environments
4. Situation that presents an oxygen deficient atmosphere
5. Condition that poses a fire or explosion hazard
6. A situation that requires immediate attention because of the danger posed to employees in the area
7. A chemical spill or release that cannot safely be managed with existing laboratory resources and presents an immediate hazard to building occupants.

If any of the above listed conditions exist, immediately evacuate the building, and contact public safety at 3333. If possible call 911 to reach outside emergency assistance. In the event of a significant chemical spill call the following **24 hour emergency phone for cleanup assistance 800-805-4582 or 513-681-6242.** Be prepared to give as much detail as possible concerning the chemicals involved and the location.

Emergency Procedures For Selected Emergencies

Fires and Other Life threatening Situations

The four actions below must be taken by whoever discovers a fire that cannot be put out safely by someone who knows how to use a fire extinguisher or other life-threatening situation.

Actual emergency conditions may require the procedures to be followed in a different order, depending on the layout of the laboratory, time of day, the number of people present and the location of the emergency relative to doors and alarm stations or telephones.

1. Alert personnel in the immediate vicinity
   Tell the nature and extent of the emergency
   Give instructions to sound the alarm, call for assistance
2. Turn off heat source
   Confine the fire or emergency without endangering yourself
   Shut hood sash if possible
   Close doors to prevent spread of vapors, gases, or fire.
3. Evacuate the building or hazardous area. Use the evacuations alarm system. Follow posted evacuation procedures. Assemble at designated meeting points and practice evacuation and assembly in drills.
4. Summon aid from a safe location. Call 911 and give location and type of emergency.

Phones with emergency numbers posted nearby shall be located in all laboratories. Also, all laboratories shall post an evacuation map showing the location of the lab and primary evacuation routes.

Clothing fire and Severe Thermal Burns

Thermal burns from a clothing fire or large splash of hot material can be life threatening if they are deep, extensive or located on critical areas of the body. Severe burns of the hands, feet, face and genital areas are considered critical.

To extinguish a clothing fire:

- Stop the person on fire from running!
- Drop the person on the floor. Standing will allow flames to spread upward to the eyes and nose.
- Roll the person to snuff out the flames.
- Cool the person. Remove smoldering clothing. Use cold water or ice packs to cool burns and minimize injury.
- Get medical assistance immediately

Chemical Splash to the Eyes or skin

The most important emergency measure if chemicals are splashed to the eyes or skin is immediate flushing with water in the emergency eyewash and/or shower. Most splashes need at least 15 minutes of washing. Get medical assistance immediately after flushing.

Please include Lab Specific Procedures for emergencies in your Laboratory SOP Filed in Appendix IX.

CHAPTER 13

Chemical Purchase, Inventory, Storage and Disposal

Chemical Purchases

Chemical purchases should be limited to the smallest amount needed to complete the project or experiment. While the cost usually goes down with the larger amount of specific chemical purchased, disposal cost can easily be 10 times the cost of the original purchase. This cost significantly increases if the chemical is a time sensitive material like furan or diethyl ether. Chemicals purchased for special research projects and student projects should be correctly disposed of after completion of the project if there is no longer use for the chemical. Chemical purchases should be based on a three year inventory turn over period. Time sensitive materials should be removed from inventory within one year or sooner based on manufacturer recommendations.

The existing inventory should be checked before any new chemicals are ordered. Older chemicals should be used first. Older chemicals should be immediately removed from inventory if they are considered no longer effective.

Chemical substances with greater hazardous nature than potential usefulness should be carefully evaluated for use in undergraduate teaching laboratories. The toxicity, carcinogenicity, teratogenicity, flammability, explosive, or reactive properties should be considered. Any chemical or mixture of chemicals with a health, flammability, or reactivity rating of 4 (EXTREME HAZARD) based on the HMIS or NFPA rating system should be carefully evaluated for use in teaching or research in Berea College laboratories. Special protocols for handling, storage and disposal must be developed and implemented for work with chemicals that are identified as extremely hazardous before they are purchased. These protocols will be in addition to requirements outlined in the Chemical Hygiene Plan and must be approved by the Chairman of the Department and the Environmental Health and Safety Department (EHS) The EHS department retains the right to prohibit the purchase and storage of extremely hazardous chemicals. When possible, a safer, less reactive chemical should be identified and substituted for the more hazardous chemical. Also, more environmentally sound “green” chemical substitutes should be identified and used in place of the more hazardous substances.

Chemical Inventory

All chemical containers must be clearly labeled with the name, grade, and the supplier of the chemical. All chemicals used in laboratories should be inventoried into the Chemical Inventory Data Base. Inventorying a chemical into stock requires:

2. Color Tagging- Color tagging the chemical into its proper storage compatibility group is part of the inventory process. Compatibility grouping is necessary to lessen the likely hood of chemical containers breaking and reacting with each other to cause fire, explosion, or toxic gas generation.

Group Name	**Color Code**
General Organic	No code
General Inorganic	No code
Flammable/Combustible	Red
Flammable Solid	Copper
Inorganic Acids	Rose
Organic Acids	Lavender
Bases	Green
Oxidizer	Yellow
Health Hazard	Blue
Reactive	Orange
Indicators	No Code
Standards	Lime Green
Stains and Dyes	Aqua
Culture Media	No Code

3. Inventory ID Number –Each individual Chemical container will be marked with a unique Bar Code Number. This number will be used to track the container through all storage locations and will reference the date of purchase, and expiration date. This number will also be used to remove the container from the inventory system when it is empty or if it must be removed from service.
4. Special Storage requirements- At times, certain reactive chemicals because of their incompatibility with other chemicals within a group will require storage in special areas. Chemicals of this type shall be clearly marked with storage precautions.
5. Inventory Requirements- The inventory shall contain at least a common chemical name of the substances, the number of containers of the material, approximate quantity of the material present in each container, the date the container was received and the expiration date if applicable. The CAS Number should also be included in the inventory information.
   Special procedures must be followed for chemicals considered peroxidizable. See Appendix IV for the inventory procedure for these compounds. A printed copy of the Chemical Hygiene Plan along with a recent list of chemicals in inventory must be located in the following designated areas.

a. Agriculture Building-Second floor Building Manager Office
b. Science Building- Second floor Science Library (Building Manager Office)

5. Delete Forms- Please complete a "delete container" form for a chemical container that is empty. Please tape the form to the container and leave in a Laboratory Hood for collection by EHS Personnel. If you wish to keep the container, complete the delete form, clean the container with the appropriate solvent, remove the original label, and place a new label on the container identifying the new contents. CONTAINER CONTENTS MUST ALWAYS BE CORRCTLY IDENTIFIED! Return the delete form to the EHS Department or place the delete sheet in a Lab hood for pickup by EHS Personnel. (See Appendix III for a sample Delete form)

6. Material Safety Data Sheet- A Material Safety Data Sheet (MSDS) for each compound on the inventory list must be accessible to all persons using the area. MSDS for the Science building are located in the Science Building Library.

7. All new chemical containers must be inventoried before they are used in a laboratory area. All Departments must maintain an up to date inventory for their area.

Chemical Storage

To minimize hazards, the accumulation of chemicals should be minimized. If possible, only order chemicals that can be consumed in a year or less. Many chemicals have a short shelf life. For example, some chemicals can form peroxides and can become unstable in a short amount of time after the container is opened.

All chemicals in storage should be contained in tightly closed, sturdy and appropriate containers. The container must be clearly labeled with the name, grade, and supplier of the chemical, and contain the date the material was first opened.

All chemicals should be stored by the proper classification group. Large containers should be stored on low shelves, preferably in trays large enough to contain the contents in the event of a spill or leak.

Flammable Liquid Storage

1. Store flammable liquids in cabinet designed to store flammable liquids. Fire hazard chemicals in quantities greater that 500 ml, should be stored in metal safety cans designed for such storage. Never disable the spring- loaded closure and always keep the flame arrestor screen in place.
2. Store only compatible materials inside a cabinet.
3. Do not store paper, or cardboard or other combustible material in a flammable storage cabinet.
4. Do not overload cabinets.

General Rules For Chemical Storage

1. Do not store Flammables with oxidizers
2. Do not store strong acids and bases together
3. Use the color system to group like materials together
4. Highly toxic chemicals or severe poisons should be stored in special security areas
5. Do not store Nitric Acid with other acids
6. Do not store chemicals on the floor and if possible do not store corrosive or reactive chemicals above eye level.
7. Ethanol should be stored in a locked cabinet and should always be under the control of the Lab Manager or EHS Director.
8. Do not store more than 45 liters of flammable materials in an area that is not designated as a special Flammable Storage Area.

Note: Please review the MSDS for the chemical or compound to determine the proper storage method.

Chemical Checkout Procedure

Only Instructors, Teaching Assistants, and Research Assistants are allowed to check out chemicals from the chemical storage area. The CHEMICAL SIGN-OUT SHEET must be completed before removing any chemicals from the chemical storage bunker (See Appendix III for a sample form). The following information must be filled out:

1. Date
2. Chemical Name (No Formulas)
3. Barcode #
4. Course #
5. Destination of chemical (building and Room number)
6. Name of Person getting chemical

Waste Disposal and Collection

Dispose of waste materials promptly. Keep each different class of chemical in a separate clearly labeled disposal container.

An area where laboratory waste is collected is called a Satellite Storage Area. These areas are regulated by the Environmental Protection Agency. The following rules must be followed:

a. The container must be identified and labeled as "Hazardous Waste".
b. The container must be sealed at all times except when adding waste to or taking waste out of a container.
c. The waste must be under the supervision of the Laboratory manager and must be labeled with the following information: **Academic Term, year, course, Instructor's name, and a complete list of chemicals in the container with the approximate amounts (percent composition for mixtures).**

General Rules for Waste collection

1. Never put chemicals into the sink or down a drain unless the waste is deactivated or neutralized and they are allowed by local regulation in the sanitary sewer. Never put chemicals down the drain without approval from the EHS Department.
2. All broken glass should be placed in a broken glass container. Broken thermometers should be placed in a special container marked for thermometers if they contain Mercury.
3. Contact the EHS Department for disposal procedures for peroxides and peroxidizable compounds. Follow the procedures outlined in Appendix IV.
4. All used Laboratory chemicals and chemical waste generated by Berea College laboratories shall be stored in the Bunker (13C) located in the Science Building.
5. All chemical waste generated by the College shall be disposed of according to EPA rules and Regulations.
6. The College is presently designated as a small quantity generator and can store waste on site for only 180 days. Days in storage start counting when the waste container is full and is placed in the bunker.

Bio Hazard Waste

Biohazard waste is generated from the treatment or cleanup of blood or body fluids from an injury or treatment of an injury or waste generated from the use of biological specimens in a laboratory. This waste shall be contained in red biohazard bags and placed in containers labeled for Biohazards. Laboratory workers should always wear gloves when handling biohazard waste. Contact the EHS Department for collection and disposal of biohazard waste.

Always use a bleach mixture (10% Bleach solution in water) or a disinfectant spray designated for biohazard materials when cleaning up blood or body fluid spills.

Note: Biological Specimens preserved in formaldehyde must be disposed of as hazardous waste.

CHAPTER 14
Equipment Used in the Physics and Geology Shops

These areas are designated for the preparation of lab specimens, apparatus, repairs of equipment and instrumentation and other lab related needs. Due to the potential hazards of the equipment/ tools located in these areas, all work is to be performed only by qualified individuals under the direct supervision of the faculty/staff instructor. Any individual working in either the Physics or Geology shop must be trained in the appropriate safety work procedures for all equipment/tools used in these areas before any work is performed. Below is the list of general safety rules that must be followed when working with equipment or tools in these Departments:

1. Safety Training is mandatory. Do not operate any equipment without having previously been trained and authorized to use that particular piece of equipment.

2. Safety glasses or goggles must be worn at all times.

3. Remove all rings, Bracelets, necklaces, neckties, jewelry, or loose articles of clothing that can pose a danger of becoming entangled in moving parts of equipment.

4. Long hair must be tied back securely from the face.

5. Before oiling, repairing or working on equipment, disconnect the power at the equipment and at the breaker box. The equipment must then be locked out. Do not perform repair work unless working under the direction and supervision of a staff or faculty member. (See EHS Department for lockout/tagout procedure)

6. Never work alone; someone must always be in calling distance.

7. Always make sure all machine guards are in place and in working order.

LASERS (Non-ionizing Radiation)

Lasers emitting visible and infrared radiation will present a hazard to the retina of the eye in the form of burns. Lasers emitting invisible radiation of ultraviolet and far infrared represent a cornea hazard where exposure can also cause the formation of cataracts. In general, the skin is less sensitive to laser light. In the case of visible and infrared large power lasers, may result in the sunburn or blisters. The following information is safety guidelines to follow when working with lasers:

1. Always wear goggles that offer protection against the specific wavelength of the laser in use. **No available spectacles protect against all laser wavelengths.**
2. Never look directly at the beam or pump source.

3. Never view the beam pattern directly. Use an image converter or other safe, indirect means. To decrease reflecting hazard, do not aim by looking along the beam.
4. Do not allow any objects to cause reflections to be present in or along the beam. Even buttons on clothing and polished screw heads can be dangerous.
5. Keep a high general illumination level in areas where lasers are in operation. Low light levels cause dilation of the pupils, thereby increasing the hazard.
6. Display warning signs in laser areas.

VACUUMS

Any glass equipment to be evacuated, such as suction flasks, should be specially designed with heavy walls. Dewar flasks and large vacuum vessels should be taped or otherwise screened or contained in a metal jacket to prevent flying glass in the case of an implosion. Household thermos bottles have thin walls and cannot be substituted for Dewar flasks.

The use of research apparatus such as a rotary vacuum or any apparatus under reduced or elevated pressures shall be used only by individuals who have been trained in the proper operation techniques involved in its use or under the direct supervision of a qualified college employee.

GLASSWARE

All glassware has the potential to break and cause injury. The use of glassware in conjunction with chemicals has even a higher potential of causing injury or death to an individual. It is imperative that all glassware procedures be followed:

1. All glassware used in a laboratory experiment shall be used for its intended procedures.
2. No glassware shall be used for domestic use. For example drinking, eating, or decoration.
3. All glassware shall be properly cleaned before storage.
4. Laboratory glassware shall remain in its designated area.
5. Follow all safety procedures or instruction for the glassware in use:
    a. All graduated cylinders should be equipped with a large rubber disc around the neck of the cylinder.
    b. Suction bulbs should always be used when pipetting. Never pipette by mouth.
    c. When separating volatile liquids with a separatory funnel, pressure must be released frequently during the extraction process.
    d. When heating liquids in test tubes, superheating can occur, resulting in a violent ejection of hot liquid. The test tube should be pointed away from the body or other persons nearby, and the liquid should be agitated gently by shaking the test tube. Only heat resisting tubes should be used for heating liquids.
    e. All glassware or apparatus supports, clamps, or the like should be carefully checked and tested before beginning the experiment. Allowances must be made for the expansion of the glass if the apparatus is to be heated. In the case of flasks containing large quantities of liquids, it is good practice to place a tray underneath which is more that capable of holding the entire contents.

References

A Comprehensive Guide to the Hazardous Properties of Chemical Substances. Pradyot Patnaik, 1992.

Chemical Safety in the Laboratory. Stephen K. Hall,1994.

Chemical Hygiene Program, University of Kentucky, 2003.

CRC Handbook of Laboratory Safety, Fourth Edition. A.K. Furr, Ed. 1995.

Procedures for Specific Classes of Hazardous Materials. University of Texas Laboratory Safety Manual. Environmental Health and Safety Department. 1996.

Prudent Practices in the Laboratory. National Research Council. 1995.

Laboratory Health and Safety Notebook, The Laboratory Safety Institute, James A. Kaufman, 2006