Faculty of Science

LABORATORY SAFETY MANUAL

(Material adapted from Texas A&M Laboratory Safety Manual)

Contents

CHAPTER 1 - INTRODUCTION

It is the aspiration of University of Regina and the Faculty of Science to provide and maintain a safe environment for its faculty, staff, students, and visitors. Therefore, it is important that the Faculty of Science administrative team is committed to working with faculty and staff to ensure that campus laboratories are a safe place in which to work and learn.

With over 70 laboratories in the Faculty of Science, laboratory safety is an enormous aspect of overall campus safety. It is the responsibility of all who work or study in laboratories to do so in a safe and environmentally responsible manner. Ultimately, this Laboratory Safety Manual was established so it could be used as a resource for faculty and laboratory personnel. Further, anyone simply interested in lab safety could benefit from using this manual, as it provides a general overview of many things that are dealt with in every day labs.

This manual is intended to comply with federal, provincial, and local regulations, as well as industry best practices. As mentioned above, this manual is intended to provide a general overview of safe practices and procedures when working in the many different labs that we have in the Faculty. It should be noted however, that due to the many different disciplines of research within the faculty and the broad range of research topics, this manual cannot possibly cover every possible scenario. Therefore, your Science Safety Advisor, members of the Science Safety Committee and Health, Safety and Wellness are also useful resources when it comes to topics not covered in this manual or to get clarification on only briefly discussed themes.

Finally, because of the broad range of research (and changing studies) in the Faculty, this manual is meant to be ever evolving so it continues to provide a comprehensive look at the safety procedures that need to be followed.

SECTION 1: CONTACT INFORMATION

1.1 EMERGENCY

To reach emergency responders (police, fire department, or ambulance), dial 9- 911 from any campus phone line. If dialing from an outside line (i.e., cell phone), dial 911.

1.2 NON-EMERGENCY

- Science Safety Advisor: 306-585-4769 (office) OR 306-551-3361 (cell)

- Health, Safety and Wellness: 306-337-2370

- Biological and Laboratory Safety Advisor: 306-585-5198

- Chemical and Radiation Safety Advisor: 306-337-3184

- Campus Security: 306-585-4999

SECTION 2: FACULTY OF SCIENCE and HEALTH, SAFETY AND WELLNESS - PROGRAMS and SERVICES

The programs and services provided by the Faculty of Science include the following:

a. Develop policies and protocols concerning safety and health issues.
b. Disseminate information concerning safety regulations, policies, protocols, and practices to members of the Faculty of Science.
c. Evaluate facilities through laboratory safety inspections. These evaluations help assure compliance with safety and health regulations, protocols, and practices in order to maintain safe work environments.
d. Inspect/test safety equipment such as fume hoods and safety showers.
e. Coordinate testing/certification of biological safety cabinets, laminar flow hoods, and cryogenic cylinders.
f. Report results of evaluations, tests, etc., along with recommended corrective measures, as necessary, to appropriate personnel for action.
g. Review construction plans for compliance with codes and standards.
h. Respond to emergencies such as gas odors or chemical spills.
i. Measure environmental parameters such as chemical vapors or noise.
j. Develop and provide safety-related training, including Chemical and Laboratory Safety Training, GHS (Global Harmonized System – formerly WHMIS).
k. Investigate reported laboratory accidents, especially those resulting in injury, to evaluate for trends. Recommend action with the purpose of reducing the likelihood of another accident.
l. Provide technical guidance on matters of laboratory safety.
m. Assist laboratory personnel in the development of a Plan of Action for responding to incidents in the laboratory.
n. Participate in safety committees and task forces.
o. Maintain a library of relevant safety regulations and nationally recognized codes and standards.
p. Assist laboratory personnel in evaluating, preventing, and controlling hazards (ex. Risk Assessment Program).
q. Oversee the adoption and implementation of all health and safety policies.
r. Submit reports and other required documentation to pertinent agencies.

SECTION 3: LABORATORY SAFETY IS EVERYONE'S RESPONSIBILITY

Taking on the responsibility for lab safety is the key for research and student success. Therefore, ensuring laboratory safety, is an endeavor of many individuals on the UofR campus, including deans, department heads, faculty and staff. Anyone providing direct or administrative oversight of laboratory facilities is responsible for maintaining safety in those areas. Specific responsibilities (as noted in the UofR's Health and Safety Policy) are as follows.

Administrators will:

a. Provide the support and leadership necessary to ensure a safe and healthy work and study environment.
b. Ensure that adequate resources are available to implement appropriate health and safety measures.

c. Require compliance with legislative requirements (Federal/Provincial acts, regulations, standards and guidelines and Municipal bylaws pertaining to health, safety and the environment).
d. Provide any information, instruction, training or supervision that is necessary to protect the health and safety of students, faculty and staff
e. Stop all unsafe work or learning activities.
f. Require that health and safety considerations form an integral part of the planning, design, construction, purchase and maintenance of all equipment, work activities, buildings and study activities.
g. Require that all health and safety policies, procedures and programs, and the University's HSMS are implemented and enforced.
h. In partnership with Health, Safety & Wellness, monitor and evaluate health and safety performance, and recommend measures to eliminate injury and illness.
i. Require that all incidents are reported and investigated, take action to prevent a recurrence where it is within their authority, participate in hazard identification, and take action to correct unsafe conditions and unsafe acts.
j. Conduct laboratory safety inspections/visits on an annual basis and provide the safety checklist to the lab manager for review. If there are items to attend to, the laboratory manager and the Science Safety Advisor will work together to address these.
k. Coordinate with Facilities Management for fume hood testing. This is done on an annual basis.
l. Coordinate with an outside vendor (currently CONtest) for testing and certification of biological safety cabinets and laminar flow hoods. Generally, these are also done on an annual basis.
m. Organize the proper units (ex. HSW and FM) when it comes to laboratory renovations or construction.

Supervisors will:

a. Plan and execute all activities in a manner that promotes compliance with this policy
b. Formulate applicable specific safety rules and safe work procedures for their areas of supervision.
c. Ensure that individuals in their areas of responsibilities have been given adequate direction, training and instruction, and are competent in the safe performance of their work and learning activities, and that it is performed without undue risk
d. Ensure that work and study areas under their control are regularly inspected to prevent the development of unsafe conditions or practices
e. Report on substandard conditions or procedures to their immediate academic or administrative authority as necessary, and correct such conditions where it is within their authority to do so
f. Stop all unsafe work or learning activities
g. Ensure that all incidents and near miss incidents are reported and investigated, take action to prevent a recurrence where it is within their authority, participate in hazard identification, and take action to correct unsafe conditions
h. Assess safety performance of students and employees as a part of their regular academic and work performance appraisal process

Employees and Students will:

a. Refuse to do unusually dangerous work
b. Plan and execute all activities in a manner that promotes compliance with this policy

c. Practice safe work habits, and observe all safety rules and procedures established in their work and study areas
d. Promptly report hazardous or unsafe equipment, conditions, procedures or behavior to a supervisor or HSE, and make suggestions for their correction or take corrective action where authorized
e. Immediately report to a supervisor or HSE all work/study-related injuries, and obtain medical treatment if necessary without delay

Contractors, subcontractors, suppliers and others providing a service for the University of Regina will:

a. As part of their contracts, agree to comply with all relevant health and safety legislation and University policies, procedures and programs where directed by the University
b. Provide as required a site specific safety plan that speaks directly to the job being completed. This plan shall be completed prior to the commencement of work and must be regularly updated.

University Occupational Health and Safety Committee (OHC) will:

a. Assist in the development and maintenance of University policies on health and safety matters
b. Consult to resolve health and safety matters that cannot be resolved at the local Safety Committee level
c. Provide advice and recommend actions to ensure the health and safety of all members of the University community
d. Promote health and safety awareness
e. Assist in ensuring that this policy is kept current and receive suggestions and recommend actions for policy/program improvements

Local Safety Committees will:

a. Assist the University OHC in the fulfillment of their duties and as outlined within the Local Committee Terms of Reference
b. Assist in the development and maintenance of University policies on health and safety matters
c. consult to resolve health and safety matters within their area of jurisdiction
d. Provide advice and recommend actions to ensure the health and safety of all members within their area of jurisdiction
e. Promote health and safety awareness

Health, Safety and Wellness Unit will:

a. Be the focal point to assist all stakeholders in the coordinated administration of University health and safety policies, procedures, programs and the HSMS
b. Be the University's representative in contacts dealing with the health and safety of students, employees, and with regulatory bodies and agencies administering Federal, Provincial and Municipal health and safety related requirements
c. Advise and support the University OHC and Local Safety Committees in fulfilling their duties
d. Advise and recommend actions to improve the health and safety of the University community
e. Research, develop, provide and/or coordinate education and training on health and safety policies, programs, procedures and initiatives

f. Have the authority to stop work when conditions or practices pose an immediate danger to a member or members of the University community in accordance with the legislation, policies, procedures and programs
g. Ensure that this policy, and all related policies, procedures and programs are kept current, and receive suggestions for policy/program improvements
h. Promote health and safety programs, practices and research

Again, it is everyone's responsibility to provide a safe laboratory to work and learn in. However, it should be noted that providing a safe environment does not stop at directly following policies, but rather building a culture that it is just the right thing to do. By working at changing attitudes to make safety an automatically important subject to broach, it will help the current and future work and personnel here on campus.

CHAPTER 2 - MITIGATING HAZARDS IN THE LABORATORY

The type of work performed in our laboratories is wide-ranging. Therefore, hazards found in laboratories can vary depending on the nature of the work performed.

Laboratory safety may include one or more areas of safety: chemical safety, fire safety, electrical safety, radiation safety, physical/equipment safety, laser safety and biological safety. In this chapter the variety of hazards that may be found in a laboratory and methods for mitigating the risks are discussed.

SECTION 1: GENERAL LABORATORY SAFETY PRACTICES

1.1 SAFE PRACTICES

a. Know the hazards associated with the materials (chemical, electrical, biological, etc.) and equipment in your laboratory. Refer to the appropriate safety information, such as Material Safety Data Sheets (MSDSs), Standard Operating Procedures (SOPs), and equipment operating instructions, and follow the recommend safe practices. Consider the hazards of procedures to be performed and what training, knowledge, safety equipment, etc. are required to do the procedure safely.
b. Develop a plan of action for how to respond to emergencies in your laboratory. Review this plan often so that you will be ready to respond as needed.
c. Use appropriate safety equipment, such as fume hoods and biological safety cabinets, to minimize exposure to hazardous materials. Verify that safety equipment is working properly prior to use.
d. Follow proper operating procedures when using a chemical fume hood. Keep the hood sash at a comfortable working height (less than 18"), and close the sash completely when the hood is unattended.
e. Wear appropriate personal protective equipment (PPE) and clothing. Remove PPE and wash hands before leaving the laboratory.
f. Avoid working alone in a laboratory, especially when conducting hazardous procedures or handling hazardous materials.
g. Keep doors closed and the laboratory secured when it is unattended. Limit unauthorized entry into laboratories, especially when hazardous procedures are being conducted.
h. Do not eat, drink, use tobacco products, chew gum, apply cosmetics, or handle contact lenses in the laboratory.
i. Do not store food and drinks in laboratories or in laboratory refrigerators or freezers. Do not prepare food in the laboratory or wash utensils used for food and drink in laboratory sinks. Refrigerators and freezers used for the storage of food and beverages should be kept in a separate room (break area) with a door separating the laboratory from the break area. Label these units "Food Use Only."
j. Laboratory equipment that could be used for the preparation of food or beverages (such as microwave ovens, hot plates, and ice machines) should be dedicated exclusively for laboratory use. Clearly label such equipment to indicate "Lab Use Only," "No Food or Drink," and/or "Not for Human Consumption."
k. Do not pipet chemicals or biological materials by mouth. Use mechanical pipettes or pipetting devices instead.

l. Do not leave reactions or other potentially hazardous procedures unattended. Protect operations from utility failures and other potential problems that could lead to overheating or other hazardous events.
m. Clean equipment contaminated with chemical, biological or radiological materials immediately upon completion of the task. Have a spill kit on hand and clean up minor spills immediately. Contact Campus Security (585-4999) for major spills as they will alert the Spill Response Team.
n. Avoid using dry ice in enclosed areas. Dry ice can produce elevated carbon dioxide levels.
o. Avoid contaminating equipment with mercury. Replace mercury thermometers with a non-hazardous type. Contact Campus Security immediately if a mercury spill occurs.
p. Keep work areas neat, clean, and free of clutter.
q. Keep hallways, corridors, and exit ways clear of equipment or clutter.

IMPORTANT: If you are unsure about what you are doing, please request assistance. Please stay away from unfamiliar chemicals, equipment, or procedures without proper training and supervision.

1.2 SECURITY

Laboratory security is vital to ensuring safety on campus. Not only should you protect your work area from theft and mischievous activities, but you should also keep unauthorized or unsuspecting persons from potentially becoming exposed to hazardous conditions. Following these steps will help to secure your laboratory:

a. Close and lock laboratory doors when the laboratory is unoccupied.
b. Secure stocks of organisms and hazardous chemicals, especially when the laboratory is unoccupied. Lock refrigerators, freezers, and chemical storage cabinets that are located in areas open to public access.
c. Keep an accurate record of chemicals, stocks, cultures, etc. and any items or equipment that support project activities.
d. Notify Campus Security (585-4999) if materials are damaged or missing from laboratories or if unauthorized entry into a laboratory has been attempted.
e. Inspect all packages arriving into the laboratory. Do not accept suspicious or unexpected packages.
f. At the end of the day, ensure that all hazardous materials, whether chemical or biological have been properly stored and secured.
g. Greet all visitors to the laboratory immediately, and determine their reason for entering your laboratory. Ask them to exit the room if they are not authorized to be there.
h. Implement other security requirements as necessary for your work.
i. Post current Emergency Contact Information in an easily accessible location of the lab.
j. Never prop open a laboratory door, except for a brief time to move items in and out.

1.3 WORKING IN THE LABORATORY

All personnel who work in laboratories, whether an employee or a student, are responsible for being aware of the hazards in that laboratory and for working in a safe manner. This includes:

a. Knowing where emergency contact information is posted;

b. Knowing and following emergency response procedures (including spill response, first aid response, evacuation routes, etc.);
c. Ensuring they have received proper safety training before working with hazardous materials or equipment;
d. Wearing appropriate Personal Protective Equipment; and
e. Reporting unsafe conditions to their supervisor, the Science Safety Advisor or Health, Safety and Wellness.
f. Laboratory personnel should avoid working alone. If procedures require a person to work at a time when others may not be present (such as after hours or on weekends) and when hazardous conditions exist, the person shall:

    1) Follow the Working Alone Procedure (UofR HSW website);
    2) Ensure that a means to contact emergency response personnel is available when working alone in the laboratory; and
    3) Make arrangements for someone to check on him/her at regular intervals (ex. Lone Worker Service).

1.4 HOUSEKEEPING

Maintaining a neat and clean laboratory work area is instrumental to minimizing accidents in the laboratory. The following steps should be taken:

a. Keep aisles clear of clutter to eliminate tripping hazards and to maintain a clear exit path in the event of an emergency, such as a fire in the laboratory or building.
b. Dispose of empty boxes and other unneeded items that take up space.
c. Keep bench tops clear of clutter. Properly store chemicals and sharps when they are not in use or at the end of the work day. A clear work space will reduce the likelihood of accidental contact with hazardous items.
d. Clean up spills, even minor ones, promptly.
e. Replace bench liners regularly or when they become dirty or contaminated.

1.5 SIGNAGE AND CONTACT INFORMATION

Contact information should be posted outside the entrance to every laboratory. This information should at minimum include the principal investigator (Pl) or other person primarily responsible for the laboratory, the Pl's office and laboratory phone numbers, and after-hours emergency contact information.
Depending upon the hazards located in the laboratory, such as biological or radiological, additional signage may be required. This information is critical for emergency personnel responding to an incident in the laboratory. Consult the appropriate section or authority for more information on signage requirements.

SECTION 2: PHYSICAL SAFETY

There are a variety of physical hazards that can be found in a laboratory environment. Many of these hazards are similar to those found in every home, and if common sense is applied, risks are fairly easy to minimize. This section will focus on common physical hazards and how to reduce the risk associated with them.

2.1 AEROSOL PRODUCTION

Liquid or solid particles suspended in air are referred to as aerosols. Aerosols containing infectious agents and hazardous materials can pose a serious health risk. If inhaled, small aerosol particles can readily penetrate and remain deep in the respiratory tract. Also, aerosol particles can easily contaminate equipment, ventilation systems, and human skin. Because they may remain suspended in the air for long periods of time after they are initially discharged, steps should be taken to minimize the production of and exposure to aerosols.

The following may produce aerosols:

- Centrifuge
- Blender
- Shaker
- Magnetic stirrer
- Sonicator
- Pipette
- Vortex mixer
- Syringe and needle
- Vacuum-sealed ampoule
- Grinder, mortar, and pestle
- Test tubes and culture tubes
- Heated inoculating loop
- Separatory funnel
- Animals
- Hot plate (if chemicals are spilled onto the hot surface)
- Chemical or biological spills

Follow these guidelines to eliminate or reduce the hazards associated with aerosols:

a. Conduct procedures that may produce aerosols in a certified biological safety cabinet or a chemical fume hood.
b. Keep tubes stoppered when vortexing or centrifuging.
c. Allow aerosols to settle for five to ten minutes before opening a centrifuge, blender, or tube.
d. Place a cloth soaked with disinfectant over the work surface to kill any biohazardous agents.
e. Slowly reconstitute or dilute the contents of an ampoule.
f. When combining liquids, discharge the secondary material down the side of the container or as close to the surface of the primary liquid as possible to avoid splattering the material.
g. Avoid splattering by allowing inoculating loops or needles to cool before touching biological specimens.
h. Use a mechanical pipetting device.

2.2 ELECTRICAL SAFETY

Electrical safety is an important component of laboratory safety. When using electrical equipment in a laboratory, the guidelines below should be followed:

a. Check electrical cords and switches for damage prior to using equipment or appliances. Damaged cords (cords with frayed or exposed wires or with damaged or missing plug prongs) should be repaired promptly or the equipment should be locked/tagged out until the cord can be repaired.
b. Use extension cords only when necessary. Do not use extension cords in place of permanent wiring. Contact the Coordinator, Science Operations to request new outlets if your work requires equipment in an area without an outlet.
c. Use extension cords that are the correct size or rating for the equipment in use. The diameter of the extension cord should be the same or greater than the cord of the equipment in use.
d. Do not run electrical cords above ceiling tiles, through walls or across thresholds.
e. Keep electrical cords away from areas where they may be pinched and areas where they may pose a tripping or fire hazard (e.g., doorways, walkways, under carpet, etc.)
f. Avoid plugging more than one appliance in each outlet. If multiple appliances are necessary, use a single approved power strip with surge protection and a circuit breaker. Do not overload the circuit breaker.
g. Avoid "daisy-chaining" or "bird-nesting."
h. Use ground fault circuit interrupters when using electrical equipment near water sources.
i. Keep access to electrical panels clear of obstructions.

2.3 MECHANICAL/EQUIPMENT SAFETY

There are four fundamental elements of equipment safety:

1) Use the correct equipment for the job.
   Equipment should be used for its intended purpose only. Never modify or adapt equipment without guidance from the equipment manufacturer. Do not defeat, remove, or override equipment safety devices! Doing so can result in injury or even death. (Example: Defeating a fume hood sash lock.)
2) Know how to properly operate equipment.
   This may require documented, specific training. Also the user must be familiar with applicable safeguards and maintenance requirements.
3) Inspect equipment for damage and for required safety features prior to use.
   Ensure that equipment meets the following requirements:

   a. Controls and safeguards are adequate and functional (e.g., interlocks that shut-off equipment automatically and guards that protect moving parts and belts).
   b. The location is safe (and well-ventilated, if necessary).
   c. Equipment works properly.

IMPORTANT: Disconnect any equipment that is unsafe or does not work properly, and remove it from service (lock out/tag out). Notify other users of the problem.

4) Use equipment properly. Do not use the equipment in ways it was not designed or intended to be used. Refer to other sections in this chapter and manual for specific information on operating laboratory equipment, such as fume hoods, heating devices, vacuums, etc.

2.4 NOISE/AUDITORY SAFETY

Many laboratory environments are noisy due to the number and type of equipment used in them. While some equipment is inherently noisy, others only become noisy when there is a problem, such as a loose belt.

In noisy environments, precautions should be taken to protect personnel from hearing loss. Ear plugs or other hearing protection may be necessary. If equipment is operating at a louder than normal noise level, maintenance may need to be scheduled. HSW can recommend hearing protection devices based on noise levels in the workspace and on individual needs. HSW also has instruments to measure noise levels in the work area. These measurements may be used to determine if noise attenuating materials or hearing protection needs to be implemented.

2.5 GLASS & METAL SHARPS

Careful handling and disposal of metal and glass sharps can minimize the risk of cuts and puncture wounds, not only for laboratory personnel, but for other university employees as well.

Laboratory Glassware

Follow these practices for using laboratory glassware safely:

a. Prevent damage to glassware during handling and storage.
b. Inspect glassware before and after each use. Discard or repair any cracked, broken, or damaged glassware.
c. Thoroughly clean and decontaminate glassware after each use.
d. When inserting glass tubing into rubber stoppers, corks, or tubing, follow these guidelines:

    1) Use adequate hand protection, such as a glass tubing insertion tool.
    2) Lubricate the tubing.
    3) Hold hands close together to minimize movement if the glass breaks

e. When possible, use plastic or metal connectors instead of glass connectors.
f. Heat and cool large glass containers slowly to reduce the risk of thermal shock.
g. Use Pyrex or heat-treated glass for heating operations.
h. Never use laboratory glassware to serve food or drinks or wash laboratory glassware in the same sink in which food and beverage utensils are washed.
i. Use thick-walled and/or round-bottomed glassware for vacuum operation. Flat-bottomed glassware is not as strong as round bottomed glassware.
j. Use a mesh glass sleeve around glassware or tape glassware that is under pressure (ex. on rotary evaporators). This will contain the glass in one place should it break.
k. Use a standard laboratory detergent to clean glassware.

When handling glassware, follow these safety guidelines:

a. When handling cool flasks, grasp the neck with one hand and support the bottom with the other hand.
b. Lift cool beakers by grasping the sides just below the rim. For large beakers, use two hands: one on the side and one supporting the bottom.
c. Never carry bottles by their necks.
d. Use a cart or specially designed secondary container to transport large and/or heavy bottles.
e. Do not pick up broken glass with bare or unprotected hands. Use a brush and dust pan to clean up broken glass. Remove broken glass in sinks by using tongs for large pieces and cotton held by tongs for small pieces and slivers.

Metal Sharps

Metal sharps should be carefully stored and handled properly. Follow these guidelines:

a. Do not uncap a needle by placing the cap in your mouth.
b. Never re-cap a used syringe needle by hand or mouth, and never manipulate (bend, break, shear, remove from syringe, etc.) a needle. Immediately place used/contaminated sharps in a sharps disposal container.
c. Do not leave sharps, including razor and scalpel blades, lying unprotected on bench tops. Place in a secondary container when not in use or when being transported.
d. If a needle/syringe must be reused,

    1) Use self-sheathing syringes or other safety devices for re-capping sharps whenever possible.
    2) Place the uncapped syringe/needle in cork or foam, or place it in a tray or other type of secondary container when not in use and when being transported.

For information on glass waste and sharps disposal procedures, see Chapter 4 - Laboratory Waste Disposal.

2.6 TEMPERATURE

Equipment that produce extreme temperatures are often used in laboratories. Whether the equipment is a -80 freezer, a walk-in cooler or freezer, cryogenic liquids, a hotplate, an oven, or an autoclave, caution should be taken whenever extreme temperatures may be encountered. Not using appropriate protective equipment, such as temperature resistant gloves, when using this equipment can lead to injuries.

Before using temperature generating equipment, become familiar with proper procedures and handling techniques. Pay special attention to the personal protective equipment required for that equipment. Posting signs that warn of the hazard may help reduce the likelihood of someone accidentally touching an extremely hot or cold surface - such as a hot plate - especially if it is not obvious that the equipment is on.

2.7 PRESSURIZED SYSTEMS

Pressurized systems have the potential to cause extensive damage and injury if extreme precaution is not taken. Pressurized systems include compressed gases, liquid cryogenic cylinders, and vacuum systems, among others. When working with pressurized systems, remember:

a. Do not conduct a reaction in, or apply heat to, a closed system apparatus unless the equipment is designed and tested to withstand pressure.
b. Pressurized systems should have an appropriate relief valve set at the maximum allowable working pressure (MAWP).

Safety points to remember:

a. Limit exposure to pressurized systems to minimize risk.
b. Identify and assess all hazards and consequences prior to beginning operations.
c. Use remote manipulations whenever possible.
d. Minimize pressure, volume, and temperature.
e. Design pressurized systems conservatively relative to the operating temperature and pressure.
f. Use material with a predictably safe failure mode.
g. Ensure that the components of the pressurized system will maintain structural integrity at the maximum allowable working pressure.

IMPORTANT: Do not use glass containers for pressurization, unless the glass item is designed to be pressurized and is rated for pressurization by the manufacturer.

h. Only use equipment designed for use under pressure. Avoid material that may become brittle at extreme temperatures.
i. Operate within the original design parameters.
j. Ensure safety mechanisms (e.g., pressure relief valves, fail-safe devices) are in place.
k. Use quality hardware.
l. Use protective shield or enclosures.
m. Use tie-downs to secure tubing and other equipment.
n. Do not leave a pressurized system unattended.

SECTION 3: EQUIPMENT SAFETY

3.1 COMPRESSED GASES

Compressed gases in the laboratory present chemical and physical hazards. The gases may be toxic, corrosive, flammable, or explosive (reactive). If compressed gases are accidentally released, they may cause the following:

- Depleted oxygen atmosphere, potentially resulting in asphyxiation (includes inert gases)
- Fire or explosion
- Adverse health effects from chemical exposure

- Physical damage to facilities or injuries to personnel as a result of the sudden release of potential energy

Cylinders that fall or are knocked over or dropped can be very dangerous and can cause serious injuries. If a valve is knocked off a compressed gas cylinder, the cylinder can become a high speed projectile.

IMPORTANT: As a “projectile”, a compressed gas cylinder can travel through walls and can cause structural damage and/or severe injury.

Guidelines to ensure safe storage of gas cylinders:

a. Check the label. The cylinder must be clearly marked with its contents and with any hazard warnings. Do not rely on color to identify container contents.
b. Secure all cylinders to a wall or bench using brackets or clamping devices designed for such. Cylinders may also be stored in gas cylinder racks or floor stands. (A cylinder dolly should not be used for storage.)

    1) Fasten cylinders individually (not ganged or grouped).
    2) Fasten cylinders with a sturdy chain or strap; bungee cords and rope are not acceptable as a means of securing compressed gas cylinders.

c. Store cylinders in a well ventilated area that is cool and dry. Ignition sources such as heat, sparks, flames, and electrical circuits should be kept away from gas cylinders.
d. When not in use (i.e., the regulator has been removed), gas cylinders should be stored with a safety cap attached.
e. Minimize the number of hazardous gas cylinders in a laboratory.
f. Store cylinders of flammables and oxidizing agents at least 20 feet apart, or separate these items with a fire wall.
g. Do not store cylinders with corrosive materials.
h. Do not store cylinders on the tops of shelves or cabinets.
i. Keep flammable gases away from doorways or exit routes.
j. Separate full cylinders from empty cylinders. Label empty cylinders "Empty."
k. Do not store gas cylinders in hallways or public areas. Cylinders should be stored in a secure area.
l. Close valves, and release pressure on the regulators when cylinders are not in use.
m. Dispose of old lecture bottles. Return lecture bottles to the supplier or dispose of them as hazardous waste.

Handling and working with compressed gas cylinders:

a. Never move a gas cylinder unless the cylinder safety cap is in place.
b. When working with particularly hazardous gases use special procedures and work in approved gas storage cabinets.
c. The gas cylinder should be chained or otherwise secured to an approved cylinder cart or dolly when being transported. Do not move a cylinder by rolling it on its base.
d. Only use regulators approved for the type of gas in the cylinder. Do not use adapters to interchange regulators. Also, never try to repair or modify a gas regulator or its pressure gauges.
e. Do not use Teflon tape when attaching the regulator.

f. When opening a cylinder valve, follow these guidelines:

1) Direct the cylinder opening away from people.
2) Open the valve slowly. Never open a cylinder valve without a regulator.

g. For a leaking cylinder:

1) Close the valve if it is open and contact the supplier to pick it up.
2) If the valve is already closed, leave the laboratory and shut the door behind you. Contact the Science Safety Advisor or HSW immediately.

h. Do not use oil or other lubricant on valves and fittings.
i. Do not use oxygen as a substitute for compressed air.
j. Do not lift cylinders by the safety cap.
k. Do not tamper with the safety devices on a cylinder. Have the manufacturer or supplier handle cylinder repairs.
l. Do not change a cylinder's label or color. Do not refill cylinders yourself.
m. Do not heat cylinders to raise internal pressure.
n. Do not use compressed gas to clean your skin or clothing.
o. Do not completely empty cylinders. Maintain at least 30 psi pressure.
p. Do not use copper (>65% copper) connectors or tubing with acetylene. Acetylene can form explosive compounds with silver, copper, and mercury.
q. Always wear impact resistant glasses or goggles when working with compressed gases.
r. Do not subject compressed gas cylinders to cryogenic temperatures.

3.2 CRYOGENIC LIQUIDS

Cryogenic fluids are extremely cold liquefied gases, such as liquid nitrogen or liquid oxygen, and are used to obtain extremely cold temperatures. Most cryogenic liquids are odorless, colorless, and tasteless. When cryogenic liquids are exposed to the atmosphere, however, they create a highly visible and dense fog.

Cryogens pose numerous hazards. A person who is exposed to cryogens can have significant health consequences. All cryogens, with the exception of oxygen, can displace breathable air and can cause asphyxiation. Cryogens can also cause frostbite on exposed skin and eye tissue.

IMPORTANT: Be aware of the tremendous expansion and threat of asphyxiation when a cryogenic liquid vaporizes at room temperature.

There is also an increased risk of fire in areas where liquid cryogens are stored and used. For example, cryogenic vapors from liquid oxygen, liquid hydrogen or other flammable cryogens may cause a fire or explosion if ignited. Materials that are normally noncombustible (e.g., carbon steel) may ignite if coated with an oxygen-rich condensate. Liquefied inert gases, such as liquid nitrogen or liquid helium, are capable of condensing atmospheric oxygen and causing oxygen entrapment or enrichment in unsuspected areas. Extremely cold metal surfaces are also capable of entrapping atmospheric oxygen.

Because the low temperatures of cryogenic liquids may affect physical properties of materials such as stainless steel or aluminum, take care to select equipment materials accordingly.

Follow these guidelines when working with cryogenic liquids:

a. Before working with cryogenic liquids, acquire a thorough knowledge of cryogenic procedures, equipment operation, safety devices, and material properties. Cryogenic training (like all training) should be documented.
b. Reject delivery of unsafe cylinders.
c. Keep equipment and systems extremely clean.
d. Avoid skin and eye contact with cryogenic liquids. Wear appropriate personal protective equipment, such as a laboratory coat, temperature resistant gloves, and chemical splash goggles. Also, do not inhale cryogenic vapors.
e. Pre-cool receiving vessels to avoid thermal shock and splashing.
f. Use tongs to place and remove items in cryogenic liquid.
g. When discharging cryogenic liquids, purge the line slowly. Only use transfer lines specifically designed for cryogenic liquids.
h. Rubber and plastic may become very brittle in extreme cold. Handle these items carefully when removing them from cryogenic liquid.
i. Store cryogenic liquids in double-walled, insulated containers (e.g., Dewar flasks) which are designed for this use.
j. Tape exposed glass on cryogenic containers. In the event the container breaks or implodes, the tape will reduce fragmentation and violent dispersal of glass shards.
k. Do not store cylinders of cryogenic liquids in hallways or other public areas.

3.3 VACUUM SYSTEMS

All vacuum equipment is subject to possible implosion. Take precautions to minimize damage and injuries that can result from an implosion. When using a vacuum system, follow these guidelines and requirements to ensure system safety:

a. Ensure that pumps have belt guards in place during operation.
b. Ensure that service cords and switches are free from defects.
c. Always use a trap on vacuum lines to prevent liquids from being drawn into the pump, vacuum line, or water drain. An in-line High Efficiency Particulate Air (HEPA) filter is required whenever biohazardous or recombinant DNA materials are used in a vacuum system.
d. Replace and properly dispose of vacuum pump oil that is contaminated with condensate. Used pump oil must be disposed of as hazardous waste.
e. Place a pan under pumps to catch oil drips.
f. Do not operate pumps near containers of flammable chemicals.
g. Do not place pumps in an enclosed, unventilated cabinet. Dangerous carbon monoxide gas and heat can build up in enclosed spaces.
h. Conduct all vacuum operations behind a table shield or in a fume hood. Also, glassware may be wrapped with tape to minimize the effects of an implosion.
i. Use only heavy-walled round-bottomed glassware for vacuum operations. The only exception to this rule is glassware specifically designed for vacuum operations, such as an Erlenmeyer filtration flask.
j. Wrap exposed glass with tape to prevent flying glass if an implosion occurs.
k. Carefully inspect vacuum glassware before and after each use. Discard any glass that is chipped, scratched, broken, or otherwise stressed.

l. Wear appropriate PPE, including safety glasses or goggles and a face shield when approaching a system under pressure.
m. Glass desiccators often have a slight vacuum due to contents cooling. When possible, use molded plastic desiccators with high tensile strength. For glass desiccators, use a perforated metal desiccator guard.

CAUTION: Do not underestimate the pressure differential across the walls of glassware that can be created by a water aspirator.

Cold Trap

A cold trap is a condensing device used to prevent moisture contamination in a vacuum line. Follow these guidelines for using a cold trap:

a. Locate the cold trap between the system and vacuum pump.
b. Ensure that the cold trap is of sufficient size and cold enough to condense vapors present in the system.
c. Check frequently for blockages in the cold trap.
d. Use isopropanol/dry ice or ethanol/dry ice instead of acetone/dry ice to create a cold trap. lsopropanol and ethanol are cheaper, less toxic, and less prone to foam.
e. Do not use dry ice or a liquefied gas refrigerant bath as a closed system. These can create uncontrolled and dangerously high pressures.

Vacuum Systems and Biohazardous Materials

Refer to the Biological Safety Manual for more information on using vacuum systems with biohazardous materials.

3.4 CENTRIFUGES

A centrifuge is a common piece of laboratory equipment, and using a centrifuge properly is essential to preventing accidents which could result in serious injury or destruction of the equipment. The hazards associated with centrifuges can be related to the equipment itself, the materials used in the centrifuge, or improper use of the centrifuge. It is vital that the centrifuge operator has been thoroughly trained on how to safely use the centrifuge and on how to properly maintain it.

Guidelines for Centrifuge Use

a. Centrifuge operators must be trained in the proper use, handling, storage, and maintenance of the equipment.
b. Use a centrifuge only if it has a disconnect switch that deactivates the rotor when the lid is open. Replace older models that do not have this safety feature.
c. Always keep the lid closed and locked during operation and shut down. Do not open the lid until the rotor is completely stopped or attempt to brake the head rotation by hand;

IMPORTANT: Attempting to defeat safety mechanisms and/or to brake the rotor by hand could result in severe injury.

d. Use the centrifuge in a well ventilated area.
e. Low-speed and small portable centrifuges that do not have aerosol- tight chambers may allow aerosols to escape. Use a safety bucket to prevent aerosols from escaping or use the centrifuge in a biological safety cabinet or fume hood.

Safe Operating Techniques

The following safe operating techniques should be followed for proper centrifuge operation:

a. Inspect the inside of each tube cavity or bucket prior to using the centrifuge. The rotor and tubes should be clean and dry. Remove any glass or other debris from the rubber cushion.
b. Before loading the rotor, examine the tubes for signs of stress, and discard any tubes that are damaged.
c. Ensure that centrifuge tubes are not filled more than three-fourths full. Overfilling can result in leaks or spills. Also, do not fill tubes to the point where the rim, cap, or cotton plug becomes wet.
d. When balancing the rotors, match the tubes, buckets, adapters, and inserts against each other, and consider any added solution. Tubes, etc. should be spaced or distributed evenly around the rotor, and the density of the contents of the tubes should also be similar.
e. Do not use aluminum foil to cap a centrifuge tube. Foil may rupture or detach.
f. Ensure that the centrifuge has adequate shielding to guard against accidental ejection.
g. Stop the rotor and discontinue operation if you notice anything abnormal such as a noise or vibration.

High Speed Centrifuges

High-speed centrifuges pose additional hazards due to the higher stress and force applied to their rotors and tubes. It is necessary to understand the basic mechanics of the equipment and to know how to maintain it properly to ensure overall safety and reduce risk. In addition to the safety guidelines outlined above, follow these guidelines for high-speed centrifuges:

a. Be sure the centrifuge rotor and tubes are clean and dry prior to use.
b. The centrifuge should be cleaned periodically to help prevent corrosion or other damage. Routinely wash rotors with a mild dish soap to prolong rotor life. Rinse and let air dry.
c. Clean any spills in the centrifuge immediately, especially if the materials are corrosive.
d. Frequently inspect the rotor and other parts for corrosion, wear, or other damage; turn the spindle by hand. Rotors or parts exhibiting corrosion or other damage should be removed from use and evaluated by a service technician.
e. Check the expiration date of both the rotor and centrifuge. Always follow the manufacturer's retirement date for rotors and other centrifuge parts.
f. Do not exceed manufacturer recommendations for safe operating speeds.
g. Keep a record of rotor usage and follow the manufacturer’s recommendations on when to replace the rotor.
h. For centrifuges that have been refrigerated, wipe away any excess moisture and allow the open unit to dry.
i. Filter the air exhausted from the vacuum lines.

3.5 ELECTROPHORESIS

Electrophoresis equipment may be a major source of electrical hazard in the laboratory. The presence of high voltage and conductive fluid in this apparatus presents a potentially lethal combination.

Many people are unaware of the hazards associated with this apparatus; even a standard electrophoresis operating at 100 volts can deliver a lethal shock at 25 milliamps. In addition, even a slight leak in the device tank can result in a serious shock.

Protect yourself from the hazards of electrophoresis and electrical shock by taking these precautions:

a. Use physical barriers to prevent inadvertent contact with the apparatus.
b. Use electrical interlocks.
c. Frequently check the physical integrity of the electrophoresis equipment.
d. Use warning signs to alert others of the potential electrical hazard.
e. Use only insulated lead connectors.
f. Turn the power off before connecting the electrical leads.
g. Connect one lead at a time using one hand only.
h. Ensure that your hands are dry when connecting the leads.
i. Keep the apparatus away from water and water sources.
j. Turn the power off before opening the lid or reaching into the chamber.
k. Do not disable safety devices.
l. Follow the equipment operating instructions.

3.6 HEATING SYSTEMS

Common hazards associated with laboratory heating devices include electrical hazards, fire hazards, and hot surfaces. Devices that supply heat for reactions or separations include the following:

- Open flame burners.
- Hot plates
- Heating mantles
- Oil and air baths
- Hot air guns
- Ovens
- Furnaces
- Ashing systems

Follow these guidelines when using heating devices:

a. Before using any electrical heating device:

    1) Ensure that heating units have an automatic shutoff to protect against overheating.
    2) Ensure that heating devices and all connecting components are in good working condition.

b. Use caution when heating chemicals, as heated chemicals can cause more damage more quickly than would the same chemicals at a lower temperature.

   Note: Generally, reaction rates double for each 10° C increase in temperature.

c. Use heating baths equipped with timers to ensure that they turn on and off at appropriate times.
d. Use a chemical fume hood when heating flammable or combustible solvents. Arrange the equipment so that escaping vapors do not contact heated or sparking surfaces.
e. Use non-asbestos thermal-heat resistant gloves to handle heated materials and equipment.
f. Perchloric acid digestions must be conducted in a perchloric fume hood.
g. Minimize the use of open flames. Never leave an open flame unattended.

3.7 REFRIGERATORS/FREEZERS

Using a household refrigerator to store laboratory chemicals is extremely hazardous for several reasons. Many flammables solvents are still volatile at refrigerator temperatures. Refrigerator temperatures are typically higher than the flashpoint of most flammable liquids. In addition, the storage compartment of a household refrigerator contains numerous ignition sources including thermostats, light switches, heater strips, and light bulbs. Furthermore, the compressor and electrical circuits, located at the bottom of the unit where chemical vapors are likely to accumulate, are not sealed.

Laboratory-safe and explosion-proof refrigerators typically provide adequate protection for chemical storage in the laboratory. Laboratory-safe refrigerators, for example, are specifically designed for use with flammables since the sparking components are located on the exterior of the refrigerator. Explosion-proof refrigerators are required in areas that may contain high levels of flammable vapors (e.g., chemical storage rooms with large quantities of flammables).

Follow these rules for using refrigerators and freezers in the laboratory:

a. Never store flammable chemicals in a household refrigerator.
b. Do not store food or drink in a laboratory refrigerator/freezer.
c. Ensure that all refrigerators are clearly labeled to indicate suitable usage.
   1) Laboratory-safe and explosion-proof refrigerators should be identified by a manufacturer label.
   2) "No Flammables" labels are available from the Science Safety Advisor and must be applied to any household style refrigerator or freezer used in a laboratory.
   3) Refrigerators used to hold food should be labeled "For Food Only" and should be located outside of the laboratory.

SECTION 4: BIOLOGICAL AND ANIMAL SAFETY

Many laboratories in the Faculty of Science use biological materials, including biological pathogens, toxins and allergens derived from biological agents, and recombinant DNA materials. Some laboratories work with animals in their research. In these laboratories, Biological and/or Animal Safety is integral to overall laboratory safety.

For research involving biological materials or animals, oversight by the Office of Research Services may be required. For information regarding animal use in research or teaching, the President's Committee on Animal Care (PCAC) can be contacted.

Specific information on Biological Safety may be obtained from the Biosafety Officer in Health, Safety and Wellness. There is also a Biological Safety Advisory Committee (BSAC) that can be contacted.

SECTION 5: RADIOLOGICAL AND LASER SAFETY

Radioactive materials and lasers pose unique hazards, and their use is regulated by federal law. Refer to the later section in this manual for more information.

CHAPTER 3 - CHEMICAL SAFETY

SECTION 1: OVERVIEW

Almost everyone within the Faculty of Science works with or around chemicals and chemical products every day. Chemical safety is inherently linked to other safety issues including engineering controls, laboratory procedures, personal protective equipment, electrical safety, fire safety, and hazardous waste disposal. Many chemicals have properties that make them hazardous: they can create physical hazards (fire, explosion) and/or health hazards (toxicity, chemical burns, and dangerous fumes). However, there are many ways to work with chemicals which can both reduce the probability of an accident to a negligible level and minimize the consequences should an accident occur.

Risk minimization depends on safe practices, appropriate engineering controls for chemical containment, the proper use of personal protective equipment, the use of the least quantity of material necessary, and substitution of less hazardous chemicals. Before beginning an operation, one should ask "What would happen if . . .?" The answer to this question requires an understanding of the hazards associated with the chemicals, equipment and procedures involved. The hazardous properties of the material and intended use will dictate the precautions to be taken. For further information on the practice of risk assessments (which the Faculty would like to have all researchers do before carrying out any experiments) please contact the Science Safety Advisor or HSW.

It is important to distinguish the difference between hazard and risk. The two terms are sometimes used as synonyms. In fact, the term "hazard" is a much more complex concept because it includes conditions of use. The hazard presented by a chemical has two components:

(1) its inherent capacity to do harm by virtue of its toxicity, flammability, explosiveness, corrosiveness, etc.; and

(2) the ease with which the chemical can come into contact with a person or other object of concern.

The two components together determine "risk" - the likelihood or probability that a harmful consequence will occur. Thus, an extremely toxic chemical such as strychnine cannot cause poisoning if it is in a sealed container and does not contact the handler. In contrast, a chemical that is not highly toxic can be lethal if a large amount is ingested.

It should be noted that not all chemicals are considered hazardous. Examples of nonhazardous chemicals include pH neutral buffers, sugars, starches, agar, and naturally occurring amino acids. This chapter will focus on hazardous chemicals.

SECTION 2: HAZARD COMMUNICATION PROGRAM

The Faculty of Science does not have a specific written hazard communication program other than following the rules of WHMIS (which will ultimately become GHS). It is important to follow the below requirements as well:

a. Employee training (including recognition of signs of exposure)

- i. Chemical and Laboratory Safety, Fire Safety, Biological Safety - Provided by HSW
- ii. Work Area Specific - Provided by individual's supervisor (Pl, laboratory manager, etc.)

b. Employee supervision

c. Labeling requirements

- i. Primary container labels - Must have the original manufacturer's label, which includes the chemical name, hazards, and manufacturer's-information.
- ii. Secondary container labels - Must identify the chemical as it is on the Material Safety Data Sheet (MSDS) and the hazards.

EXEMPTIONS – Research and teaching laboratories can use workplace labels if the chemical is only going to be in the certain container for 24 hours. In this case, the container requires a label to just somehow identify the contents.

d. Availability of MSDSs

e. Provision of personal protective equipment (PPE)

f. Work area chemical inventories

g. Record keeping requirements

h. Emergency response procedures

SECTION 3: HAZARD IDENTIFICATION

An integral part of hazard communication is hazard identification. Everyone who works with hazardous chemicals should know how to read and interpret hazard information. Signs, labels, placards, and symbols alert employees to the known hazards in a particular location.

The National Fire Protection Association (NFPA), whose codes and standards are recognized in Canada, use a diamond as a method of identifying chemical hazards. NFPA uses a scale of 0 - 4 to rate each hazard, with 0 indicating "no hazard" and 4 indicating the most extreme hazard. The following is a detailed explanation of the NFPA hazard classification codes:

a. Health (Blue):

4 - Can cause death or major injury despite medical treatment 3 - Can cause serious injury despite medical treatment
2 - Can cause injury. Requires prompt medical treatment 1 - Can cause irritation if not treated
0 - No hazard

b. Flammability (Red):

4 - Very flammable gases or liquids
3 - Can ignite at normal temperatures 2 - Ignites with moderate heat
1 - Ignites with considerable preheating 0 - Will not burn

c. Reactivity (Yellow):

4 - Readily detonates or explodes
3 - May detonate or explode with strong initiating force or heat under confinement
2 - Normally unstable, but will not detonate
1 - Normally stable. Unstable at high temperature and pressure. 0 - Normally stable and not reactive with water.

d. Specific Hazard (White): Oxidizer - OX
Acid - ACID
Alkali - ALK
Corrosive - COR
Use No Water - W
Radioactive

Many chemicals fall under more than one hazard class. Extra care should be taken when handling or storing chemicals with multiple hazards. Also note, that other labeling systems may be used.

SECTION 4: CHEMICAL SAFETY GUIDELINES

Always follow these guidelines when working with chemicals:

a. Assume that any unfamiliar chemical is hazardous and treat it as such.
b. Know all the hazards of the chemicals with which you work. For example, perchloric acid is a corrosive, an oxidizer, and a reactive. Benzene is an irritant that is also flammable, toxic, and carcinogenic.
c. Never underestimate the potential hazard of any chemical or combination of chemicals. Consider any mixture or reaction product to be at least as hazardous as - if not more hazardous than – it's most hazardous component.
d. Never use any substance that is not properly labeled. It may not be what you think it is!
e. Date all chemicals when they are received and again when they are opened (ex. Ether).
f. Follow all chemical safety instructions, such as those listed in Material Safety Data Sheets or on chemical container labels, precisely.
g. Minimize your exposure to any chemical, regardless of its hazard rating, and avoid repeated exposure.
h. Use personal protective equipment (PPE), as appropriate for that chemical.
i. Use the buddy system when working with hazardous chemicals. Don't work in the laboratory alone.

SECTION 5: MATERIAL SAFETY DATA SHEETS

Before using any chemical, read the appropriate Material Safety Data Sheet (MSDS). An MSDS is a document that details information about chemicals and along with the container label is a good source of information for chemical safety. It provides the following information:

a. Identity of the chemical

b. The manufacturer's name and address
c. Hazardous ingredients
d. Exposure limits

    i. Permissible Exposure Limit (PEL) or Recommended Exposure Limit (REL) - This is the amount of a chemical that a person can be exposed to, averaged over an eight hour period, before it causes him/her harm.
    ii. Short Term Exposure Limit CSTEU - This is the amount of a chemical that a person can be exposed to, averaged over a 15 minute period, before it causes him/her harm.
    iii. Immediately Dangerous to Life and Health lIDLHl - This is the amount of chemical that immediately puts a person a risk of serious injury or death. If this level is reach or exceeded, the area should be evacuated immediately!

e. Physical characteristics, such as:

    i. Boiling point
    ii. Vapor pressure

f. Chemical hazards, including the following:

    i. Flammability
    ii. Explosiveness
    iii. Reactivity

g. Health hazards, including chemicals that are:

    i. Toxins (both acute and long-term)
        1. Carcinogens
        2. Reproductive Toxins
        3. Teratogens
        4. Mutagens
        5. Neurotoxins
    ii. Irritants

h. Routes of Entry
i. Emergency and first-aid procedures
j. Proper leak, spill, and disposal techniques
k. Proper storage and handling procedures
I. Other special provisions

Material Safety Data Sheets.

Each person working with chemicals should have access to the MSDS for all chemicals they use. "Access" may be:

- A current hard copy kept in a work area file or binder.
- An electronic copy.

If a chemical container is too small to have all of the required information on it, one should at least put a number on the container that can be referenced in the inventory of chemicals that the lab has, which can then be used to access information on that particular chemical's MSDS.

SECTION 6: SAFE HANDLING GUIDELINES

Employees should treat all chemicals and equipment with caution and respect. When working with chemicals, remember to do the following:

a. Wear appropriate personal protective equipment (PPE) for the chemical hazard.
b. Remove and use only the amount of chemicals needed for the immediate job at hand.
c. Properly seal, label, and store chemicals in appropriate containers. Keep the containers clearly marked and in a well-ventilated area.
d. Segregate and store chemicals by their hazard class.
e. Check stored chemicals for deterioration and for damage to the containers.
f. Learn how to dispose of chemicals safely and legally. Follow University of Regina waste disposal requirements. (See Chapter 4 - Laboratory Waste Disposal.)
g. Clean up spills and leaks immediately (or Call the Spill Response Team/Campus Security if the spill is too large to handle alone).
h. Develop a Plan of Action for how to respond in an emergency. Review this plan regularly to be familiar with it.
i. Do not store chemicals near heat, in sunlight, or near substances which might initiate a dangerous reaction.
j. When transporting chemicals between the work area and other areas, use secondary containment (such as a tray, rack, cart or rubber carrier) to protect against spills, leaks or container breakage. Always use a secondary container when transporting hazardous or highly odorous chemicals on an elevator.
k. Never pour any chemicals down the sink. Use proper hazardous waste disposal procedures for all excess or unused chemicals.

SECTION 7: CHEMICAL STORAGE GUIDELINES

Proper chemical storage is as important to safety as proper chemical handling. Often, seemingly logical storage ideas, such as placing chemicals in alphabetical order, may cause incompatible chemicals to be stored together.

7.1 GENERAL STORAGE GUIDELINES

Follow these guidelines for safe chemical storage:

a. Read chemical labels and the MSDS for specific storage instructions.
b. Store chemicals in a well-ventilated area; however, do not store chemicals in a fume hood.
c. Date all chemicals when they are received and again when they are opened.
d. Maintain an inventory of all chemicals in storage. A copy of the inventory should be maintained at a location outside of the laboratory.
e. Return chemical containers to their proper storage location after use.

f. Store glass chemical containers so that they are unlikely to be broken. Glass containers should never be stored directly on the floor.
g. Store all hazardous liquid chemicals below eye level of the shortest person working in the laboratory.
h. Never store hazardous chemicals in a public area or corridor. Hazardous chemicals must be kept in a secured area.

7.2 SEPARATING AND STORING HAZARDOUS CHEMICALS

In addition to the guidelines above, there are storage requirements for separating hazardous chemicals. Follow these guidelines to ensure that hazardous chemicals are stored safely:

a. Group chemicals according to their hazard category (i.e., corrosives, flammables, toxins, etc.), not alphabetically, and separated by some sort of physical barrier. An alphabetical storage system may place incompatible chemicals next to each other.
b. Separate acids from bases and inorganic acids or bases from organic acids or bases. Store these chemicals near floor level.
c. Isolate perchloric acid from all other chemicals and from organic materials. Do not store perchloric acid on a wooden shelf or spill paper.
d. Separate highly toxic chemicals and carcinogens from all other chemicals. This storage location should have a warning label and should be locked.
e. Time-sensitive chemicals, such as those that form peroxides (ex. Ether), should not be kept longer than twelve months from purchase or six months after opening. If stratification of liquids, precipitate formation, and/or change in color or texture is noted, contact HSW immediately.
f. Picric acid must be stored under a layer of liquid, as picric crystals are highly explosive. If picric acid dries out (forming yellow crystals), do not touch the container! Contact HSW immediately.
g. If flammables need to be chilled, store them in a laboratory-safe refrigerator, not in a standard (household style) refrigerator.
h. Chemicals may be stored in the cabinets underneath a chemical fume hood provided the cabinetry is designed for that use.

    i. Cabinetry designed for flammable storage vents into the fume hood exhaust duct.
    ii. Cabinetry designed for corrosives storage vents directly into the fume hood. Flammable chemicals should never be stored in this type of cabinets!
    iii. Some cabinetry is only designed for general storage or with a drying rack. These cabinets are not meant to be used for hazardous chemical storage.

i. Flammables should be stored in a well ventilated area and large quantities in a flammable storage cabinet. Contact HSW for more information on allowable storage of flammable liquids.

Contact the Science Safety Advisor (or the HSW Chemical Safety Advisor) for inquiries regarding incompatible chemicals.

SECTION 8: HYGIENE AND CHEMICAL SAFETY

Good personal hygiene will help minimize exposure to hazardous chemicals. When working with chemicals, follow these guidelines:

a. Wash hands frequently and before leaving the laboratory. Also, wash hands before eating, drinking, smoking or applying makeup.
b. Wear appropriate personal protective equipment (PPE). Always wear protective gloves when handling any hazardous chemicals.
c. Remove PPE before leaving the laboratory and before washing hands.
d. Remove contaminated clothing immediately. Do not use the clothing again until it has been properly decontaminated.
e. Follow any special precautions for the chemicals in use.
f. Do not eat, drink, smoke or apply makeup around chemicals.
g. Tie back long hair when working in a laboratory or around hazardous chemicals.
h. Do not keep food, beverages, or food and beverage containers anywhere near chemicals or in laboratories where chemicals are in use.
i. Do not use laboratory equipment, including laboratory refrigerators/freezers, to store or serve food or drinks.
j. Do not wash food and beverage utensils in a laboratory sink.
k. Do not sniff or taste chemicals.
l. Do not touch door knobs, telephones, computer keyboards, etc. with contaminated gloves.

SECTION 9: TYPES OF CHEMICAL HAZARDS

9.1 CORROSIVES

Corrosive chemicals destroy or damage living tissue by direct contact. Some acids, bases, dehydrating agents, oxidizing agents, and organics are corrosives. Examples of the different types of corrosive chemicals are listed below:

a. Inorganic Acids - Hydrochloric acid, Nitric Acid, Sulfuric acid
b. Organic Acids - Acetic Acid, Propionic acid
c. Alkaline, or basic, corrosives - Sodium hydroxide, Potassium hydroxide
d. Corrosive dehydrating agents - Phosphorous pentoxide, Calcium oxide
e. Corrosive oxidizing agents - Halogen gases, Hydrogen peroxide (concentrated), Perchloric acid
f. Organic corrosive - Butylamine

Health Consequences

Extreme caution should be taken when handling corrosive chemicals, or severe injury may result.

a. Concentrated acids can cause painful and sometimes severe burns.
b. Inorganic hydroxides can cause serious damage to skin tissues because a protective protein layer does not form. Even a dilute solution such as sodium or potassium hydroxide can saponify fat and attack skin.

c. At first, skin contact with phenol may not be painful, but the exposed area may turn white due to the severe burn. Systemic poisoning may also result from dermal exposure.
d. Skin contact with low concentrations of hydrofluoric acid (HF) may not cause pain immediately but can still cause tissue damage if not treated properly. Higher concentrations of HF (50% or greater) can cause immediate, painful damage to tissues.

Safe Handling Guidelines for Corrosives:

To ensure safe handling of corrosives, the following special handling procedures should be used:

a. Always store corrosives properly. Segregate acids from bases and inorganics from organics. Refer to the Chemical Storage section of this chapter for more information.
b. Always wear a laboratory coat, gloves and chemical splash goggles when working with corrosives. Wear other personal protective equipment, as appropriate.
c. To dilute acids, carefully add the acid to the water, not the water to the acid. This will minimize any reaction.
d. Corrosives, especially inorganic bases (e.g., sodium hydroxide), may be very slippery; handle these chemicals with care and clean any spills, leaks, splashes, or dribbles immediately.
e. Work in a chemical fume hood when handling fuming acids or volatile irritants (e.g., ammonium hydroxide).
f. A continuous flow eye wash station should be in every work area where corrosives are present. An emergency shower should also be within 55 feet of the area.

Corrosive Example: Perchloric Acid (Not used on campus at this point, but an example of how complicated the reactions can be under varying conditions.)

Perchloric acid is a corrosive oxidizer that can be dangerously reactive. At elevated temperatures, it is a strong oxidizing agent and a strong dehydrating reagent. Perchloric acid reacts violently with organic materials. When combined with combustible material, heated perchloric acid may cause a fire or explosion. Cold perchloric acid at less than 70% concentration is not a very strong oxidizer, but its oxidizing strength increases significantly at concentrations higher than 70%. Anhydrous perchloric acid (>85%) is very unstable and can decompose spontaneously and violently.

Important side note: Heated digestions with perchloric acid require a special fume hood with a wash-down system. A perchloric acid fume hood should also be used when handling highly concentrated (greater than 70%) perchloric acid.

Finally (for clarification purposes), while Perchloric Acid has been used as an example for a corrosive, it should be noted that the University of Regina and the Faculty of Science do not have any fume hoods with a wash down system. As a result, if there is any experiment that might need perchloric acid, please contact the Science Safety Advisor or HSW to properly risk assess the procedure to see if alternative chemicals or processes could be used.

9.2 FLAMMABLES

A flammable chemical is any solid, liquid, vapor, or gas that ignites easily and burns rapidly in air. Consult the appropriate MSDS before beginning work with flammables.

Flammable chemicals are classified according to flashpoint, boiling point, fire point, and auto-ignition temperature.

a. Flash Point (FP) is the lowest temperature at which a flammable liquid's vapor burns when ignited.
b. Boiling Point (BP) is the temperature at which the vapor pressure of a liquid is equal to the atmospheric pressure under which the liquid vaporizes. Flammable liquids with low BPs generally present special fire hazards.
c. Fire Point is the temperature at which the flammable liquid will burn.
d. Auto-ignition Temperature is the lowest temperature at which a substance will ignite without an ignition source.

Flammable liquids are classified according to how easily they burn.

Conditions for a Fire

Improper use of flammable liquids can cause a fire. The following conditions must exist for a fire to occur:

a. Flammable material (i.e., fuel) must be present in sufficient concentration to support a fire.
b. Oxygen or an oxidizer must be present.
c. An ignition source (i.e., heat, spark, etc.) must be present.

When working with flammables, always take care to minimize vapors which act as fuel.

Safe Handling Guidelines for Flammables

a. Handle flammable chemicals in areas free from ignition sources.
b. Never heat flammable chemicals with an open flame. Use a water bath, oil bath, heating mantle, hot air bath, hot plate, etc. Such equipment should be intrinsically safe, with no open sparking mechanisms.

NOTE: When using an oil bath, make sure the temperature is kept below the oil flash point.

c. Use ground straps when transferring flammable chemicals between metal containers to avoid generating static sparks.
d. Work in an area with good general ventilation and use a fume hood when there is a possibility of dangerous vapors. Ventilation will help reduce dangerous vapor concentrations, thus minimizing this fire hazard.
e. Restrict the amount of stored flammables in the laboratory, and minimize the amount of flammables present in a work area.

NOTE: The NFPA has established formal limits on the total amounts of flammable liquids that may be stored or used in laboratories. (NFPA 30 and 45)

f. Only remove from storage the amount of chemical needed for a particular experiment or task.

9.3 SOLVENTS

Organic solvents are often the most hazardous chemicals in the work place. Solvents such as ether, alcohols, and toluene, for example, are highly volatile and flammable. Perchlorinated solvents, such as carbon tetrachloride (CCl_4), are non-flammable. But most hydrogen-containing chlorinated solvents, such as chloroform, are flammable. When exposed to heat or flame, chlorinated solvents may produce carbon monoxide, chlorine, phosgene, or other highly toxic gases.

Always use volatile and flammable solvents in an area with good ventilation or preferably in a fume hood. Never use ether or other highly flammable solvents in a room with open flames or other ignition sources present, including non-intrinsically safe fixtures.

Solvent Exposure Hazards

Health hazards associated with solvents include exposure by the following routes:

- Inhalation of a solvent may cause bronchial irritation, dizziness, central nervous system depression, nausea, headache, coma, or death. Prolonged exposure to excessive concentrations of solvent vapors may cause liver or kidney damage. The consumption of alcoholic beverages can enhance these effects.
- Skin contact with solvents may lead to defatting, drying, and skin irritation.
- Ingestion of a solvent may cause sever toxicological effects. Seek medical attention immediately.

The odor threshold for the following chemicals exceeds acceptable exposure limits. Therefore, if you can smell it, you may be overexposed - increase ventilation immediately! Examples of such solvents are:

- Chloroform
- Benzene
- Carbon tetrachloride
- Methylene chloride

NOTE: Do not depend on your sense of smell alone to know when hazardous vapors are present. The odor of some chemicals is so strong that they can be detected at levels far below hazardous concentrations (e.g., xylene).

Some solvents (e.g., benzene) are known or suspected carcinogens.

Reducing Solvent Exposure

To decrease the effects of solvent exposure, substitute hazardous solvents with less toxic or hazardous solvents whenever possible. For example, use hexane instead of diethyl ether, benzene or a chlorinated solvent.

Solvent Example: DMSO

Dimethyl sulfoxide (DMSO) is unique because it is a good solvent with many water-soluble as well as lipid-soluble materials. Due to these properties, dimethyl sulfoxide is rapidly absorbed and distributed throughout the body.

DMSO can facilitate absorption of other chemicals - such as grease, oils, cosmetics - that may contact the skin.

- While DMSO alone has low toxicity, when combined with other, more toxic chemicals it can cause the more toxic chemical to be absorbed more readily through the skin.
- Some medications, such as liniment, also contain DMSO.

While relatively stable at room temperature, DMSO can react violently to other chemicals when heated.

Wear impervious clothing and personal protective equipment (laboratory coat, gloves, etc.) to prevent skin exposure. Use chemical splash goggles and/or a face shield if splashing may occur.

9.4 TOXINS AND IRRITANTS

The toxicity of a chemical refers to its ability to damage an organ system (kidneys, liver), disrupt a biochemical process (e.g., the blood-forming process) or disrupt cell function at some site remote from the site of contact. Any substance, even water, can be harmful to living things under the right conditions.

The biological effects - whether beneficial, indifferent or toxic - of all chemicals are dependent on a number of factors, including:

Dose (the amount of chemical to which one is exposed), Duration of exposure (both length of time and frequency) and Route of entry:

- Ingestion
- Absorption through the skin
- Inhalation
- Injection

NOTE: Inhalation and dermal absorption are the most common methods of chemical exposure in the workplace.

The most important factor in toxicity is the dose-time relationship. In general, the more toxin to which an individual is exposed, and the longer they are exposed to it, the stronger their physiological response will be. However, an individual's response can also depend on several other factors, including:

- Health
- Gender
- Genetic predisposition
- An individual's exposure to other chemicals
- Previous sensitization

NOTE: When a person becomes sensitized to a chemical, each subsequent exposure may often produce a stronger response than the previous exposure.

Chemical mixtures

NOTE: Combining a toxic chemical with another chemical can increase the toxicity of either or both chemicals.

IMPORTANT: Minimize exposure to any toxic chemical.

General Safe Handling Guidelines

a. Read the appropriate MSDS.
b. Be familiar with the chemical's exposure limits.
c. Use a chemical fume hood.
d. Always wear appropriate PPE.
e. Never eat, drink, or use tobacco products around toxins or store them near any hazardous chemicals.
f. Avoid touching your face or other exposed skin with contaminated gloves or other contaminated materials.
g. Store toxic gases in a gas exhaust cabinet.

Acute Toxins vs. Chronic Toxins

The dose-time relationship forms the basis for distinguishing between acute toxicity and chronic toxicity.

The acute toxicity of a chemical is its ability to inflict bodily damage from a single exposure. A sudden, high-level exposure to an acute toxin can result in an emergency situation, such as a severe injury or even death. Examples of acute toxins include the following:

- Hydrogen cyanide
- Hydrogen sulfide
- Nitrogen dioxide
- Ricin
- Organophosphate pesticides
- Arsenic

IMPORTANT: Do not work alone when handling acute toxins. Use a fume hood to ensure proper ventilation or wear appropriate respiratory protection if a fume hood is not available.

Chronic toxicity refers to a chemical's ability to inflict systemic damage as a result of repeated exposures, over a prolonged time period, to relatively low levels of the chemical. Such prolonged exposure may cause severe injury. Examples of chronic toxins include the following:

- Mercury
- Lead Formaldehyde

Some chemicals are extremely toxic and are known primarily as acute toxins. Some are known primarily as chronic toxins. Others can cause either acute or chronic effects.

The toxic effects of chemicals can range from mild and reversible (e.g. a headache from a single episode of inhaling the vapors of petroleum naphtha that disappears when the victim gets fresh air) to serious and irreversible (liver or kidney damage from excessive exposures to chlorinated solvents). The toxic effects from chemical exposure depend on the severity of the exposures. Greater exposure and repeated exposure generally lead to more severe effects.

Types of Toxins

Carcinogens are materials that can cause cancer in humans or animals. Several agencies including OSHA (Occupational Safety & Health Administration), CCOHS (Canadian Centre for Occupational Health and Safety), and IARC (International Agency for Research on Cancer) are responsible for identifying carcinogens.

There are very few chemicals known to cause cancer in humans, but there are many suspected carcinogens and many substances with properties similar to known carcinogens.

Examples of known carcinogens include the following:

- Asbestos
- Benzene
- Tobacco smoke
- Hexavalent Chromium Aflatoxins

Zero exposure should be the goal when working with known or suspected carcinogens. Workers who are routinely exposed to carcinogens should undergo periodic medical examinations.

Reproductive toxins are chemicals that can adversely affect a person's ability to reproduce. Teratogens are chemicals that adversely affect a developing embryo or fetus. Heavy metals, some aromatic solvents (benzene, toluene, xylenes, etc.) and some therapeutic drugs are among the chemicals that are capable of causing these effects. In addition, the adverse effects produced by ionizing radiation, consuming alcohol, using nicotine and using illicit drugs are recognized.

While some factors are known to affect human reproduction, knowledge in this field (especially related to the male) is not as broadly developed as other areas of toxicology. In addition, the developing embryo is most vulnerable during the time before the mother knows she is pregnant. Therefore, it is prudent for all persons with reproductive potential to minimize chemical exposure.

Sensitizers may cause little or no reaction upon first exposure. Repeated exposures may result in severe allergic reactions.

Examples of sensitizers include the following:

- lsocyanates
- Nickel salts
- Beryllium compounds
- Formaldehyde
- Diazomethane Latex

NOTE: Some people who often use latex-containing products may develop sensitivity to the latex. A sensitized individual's reaction to latex exposure can eventually include anaphylactic shock, which can result in death. To minimize exposure to latex, use non-latex containing gloves, such as nitrile gloves.

Irritants cause reversible inflammation or irritation to the eyes, respiratory tract, skin and mucous membranes. Irritants cause inflammation through long-term exposure or high concentration exposure. For the purpose of this section, irritants do not include corrosives. Examples of irritants include the following:

- Ammonia Formaldehyde
- Halogens
- Sulfur dioxide
- Poison ivy
- Phosgene Dust
- Pollen Mold

Mutagens can alter DNA structure. Some mutagens are also carcinogens. Examples of mutagens are:

- Ethidium bromide
- Nitrous acid
- Radiation

Neurotoxins are chemicals that affect the nervous system. Examples of neurotoxins include:

- Methanol
- Many snake and insect venoms
- Botulinum toxin

9.5 REACTIVES AND EXPLOSIVES

Reactive chemicals may be sensitive to either friction or shock, or they may react in the presence of air, water, light, heat or other chemicals. Some reactive chemicals are inherently unstable and may quickly decompose on their own, releasing energy in the process. Others form toxic gases when reacting. Explosive chemicals decompose or burn very rapidly when subjected to shock or ignition. Reactive and explosive chemicals produce large amounts of heat and gas when triggered, and thus are extremely dangerous.

Follow these guidelines when handling and storing reactive and explosive chemicals:

a. Read the appropriate MSDS and other pertinent fact sheets on the chemical. Be familiar with chemical specific handling and storage requirements.
b. Follow Standard Operating Procedures and have a “Plan of Action” established for how to handle emergency situations.
c. Isolate the chemical from whatever causes a reaction.
    i. Store reactives separate from other chemicals.
    ii. Store reactives in a cool/dry area.
    iii. Keep reactive chemicals out of sunlight and away from heat sources.
d. Know where emergency equipment is located and how to use it.

Examples of reactive compounds include the following:

- Benzenesulfonyl azide
- Lead (II) azide
- Lead perchlorate
- Potassium chlorite
- Perchloric Acid (Anhydrous)
- Copper (II) fulminate
- Diethyl ether
- Isopropyl ether (Peroxide former)
- Picric acid (Peroxide former)
- Zinc peroxide (Peroxide)
- Benzvalene
- Butadiene (Polymerizable compound)
- Vinyl chloride (Polymerizable compound)

SECTION 10: PROTECTING ONESELF WHEN WORKING WITH CHEMICALS

For information on ways to protect oneself when working with chemicals, including information on personal protective equipment, engineering controls and how to respond to chemical spills and exposures, see Chapter 5 of this manual, which is titled, "How to Protect Yourself."

SECTION 11: CHEMICAL WASTE DISPOSAL

Chemical waste must be disposed of as hazardous waste. For information on chemical waste disposal, see Chapter 4 - Laboratory Waste Disposal.

SECTION 12: TRANSPORTING HAZARDOUS MATERIALS

The Transport Canada regulates the shipment of hazardous materials. Anyone who packages, receives, unpacks, signs for, or transports hazardous chemicals must be trained and certified in the Transportation of Dangerous Goods (TDG) program. Warehouse personnel, shipping and receiving clerks, truck drivers, and other employees who pack or unpack hazardous materials must receive this training as well. Contact HSW for more information on shipping and receiving hazardous chemicals.

SECTION 13: CHEMICAL INVENTORY

The University of Regina uses a web-based chemical inventory program (Vertere) to track its chemicals. Vertere requires that all chemicals at the University of Regina be provided with a unique barcode label. Information on the use of the program can be found in How to use the Inventory Program (PDF) https://www.uregina.ca/hr/hsw/assets/docs/pdf/Vertere%20Instructions.pdf. Access to the inventory program is provided by Health, Safety and Wellness to faculty, staff and other authorized users. To obtain a username and password, please contact HSW.

CHAPTER 4 - LABORATORY WASTE DISPOSAL

Disposal of hazardous materials is regulated by various federal and provincial agencies. Laboratory waste very often includes hazardous chemical, biological or radiological materials. Thus, proper disposal of laboratory waste is not only prudent, it is mandatory. Environmentally sound disposal methods prevent harm to the water, land and air. This, by extension, prevents harm to people as well. Proper disposal techniques also protect waste handlers from harm.

Laboratory waste disposal can be broken down into five categories - hazardous (chemical) waste, biological waste, radioactive waste, glass waste, and metal (sharps) waste.

SECTION 1: HAZARDOUS CHEMICAL WASTE

The term "hazardous waste" refers to hazardous chemical waste. If waste chemicals contain infectious materials or biological hazards, the waste must be treated first as biological waste. Once the biological hazard has been eliminated, then the waste can be treated as hazardous waste. Any waste containing radioactive materials must be treated as radiological waste.

Disposal of hazardous waste is governed by Environment Canada as well as the Ministry of Environment in Saskatchewan. The U of R complies with hazardous waste disposal regulations by following the U of R's Hazardous Materials Management Policy (20.105.05). For more information on hazardous waste disposal regulations and definitions, refer to this document on the website.

Laboratory personnel can ensure compliance with the Hazardous Waste Management Program by following a few simple steps:

1) Never dispose of chemicals improperly. Improper disposal includes:

    a. Pouring chemicals down the drain
    b. Leaving uncapped chemical containers in the fume hood to evaporate off the chemical
    c. Disposing of chemicals in the regular trash.

2) Collect waste in a leak proof container that is in good condition, that can be securely closed, and that is appropriate for the given chemical.

NOTE: If a large waste container (>10 gallons) is warranted, contact HSW for assistance.

3) When reusing a container to collect chemical waste, completely deface or remove the original label.
4) Label the container:

    a. The words "Hazardous Waste" must be written on the container or a Hazardous Waste Disposal Tag must be affixed to the container. (See "Hazardous Waste Disposal Tags and Waste Collection" below.)
    b. Identify the contents of the waste container on the container itself and on the tag (if attached). Example: Nitric Acid Waste, or Phenol Waste.

5) Do not mix incompatible waste chemicals in a single container. Use separate waste containers for different waste streams.
6) Do not overfill the waste container.

   a. For liquid hazardous waste:
      i. Do not fill jugs and bottles past the shoulder of the container.
      ii. Fill closed head cans (10 L), especially flammables, to no more than 6 L.
      iii. The filling of drums is usually left to the Storekeeper at Science Stores.
   b. For solid hazardous waste materials, do not fill past shoulder, do not fill beyond the weight capacity of the container and leave at least two inches head space for closure.
7) Keep waste containers closed. Waste containers should only be open when adding or removing material.

1.1 HAZARDOUS WASTE DISPOSAL TAGS AND WASTE COLLECTION

When the waste container is ready for disposal, it should be tagged with a Hazardous Waste Disposal Tag. These tags may be obtained from HSW (or they can be found near the Science Stores window). Fill out the tag following the guidelines below:

1) Completely fill out both the upper and lower sections of the tag. (This information is essential for record keeping.)
2) The "REQUESTOR" is the person in charge of the laboratory.
3) Use full chemical names or common names. Chemical formulas or abbreviations are not acceptable.
4) List all chemical components, including water. Long lists may be continued on another tag.
5) Indicate the percent concentration of potentially explosive materials such as picric acid.
6) Place additional hazard information if necessary.
7) Affix the tag to the container using the adhesive on the back.

NOTE: The HSW team try to make themselves available Wednesday mornings for anyone that might have waste to drop off. Therefore, if you have waste that needs to be disposed of, please contact HSW (the Chemical and Lab Safety Advisor) ahead of time to let them know what you have and they will meet you at Science Stores (the location where a room is dedicated to Hazardous Waste).

1.2 DISPOSING OF EMPTY CHEMICAL CONTAINERS

Empty chemical containers may be disposed of in the regular trash provided the following requirements are met:

1) Containers must not contain free liquid or solid residue.
2) Containers must be triple rinsed.
3) Product labels must be defaced or removed.
4) Container lids or caps must be removed.
5) Render metal containers and plastic jugs unusable by punching holes in the bottom of the containers before disposing of them in the regular trash. (It is not necessary to break empty glass containers.)

IMPORTANT: Containers that do not meet the requirements mentioned here must be treated as hazardous waste.

Refer to the Hazardous Materials Management Policy for more information on hazardous waste disposal procedures and regulations as well as information on waste reduction and minimization.

SECTION 2: BIOLOGICAL WASTE

The Biosafety Advisory Committee (BSAC) is responsible for the oversight and administration of the Biosafety Program which is designed to ensure the safe management of biological materials in education, research, and community health at the University. The Biological Safety Officer (with HSW) is responsible for the day-to-day operations of the Biosafety Program. Biohazardous materials include organisms or substances derived from biological materials or organisms that may be harmful to humans, animals, plants or the environment. Biohazardous waste includes any waste materials that contain biohazardous materials, such as:

1) Waste (including blood) from and bedding or litter used by infectious animals
2) Bulk human blood or blood products and waste materials contaminated with human blood
3) Microbiological waste (including pathogen-contaminated disposable culture dishes and disposable devices used to transfer, inoculate, and mix pathogenic cultures)
4) Biological pathogens Sharps
5) Any recombinant (rDNA) materials and products of genetic manipulation

IMPORTANT: All biohazardous material must be decontaminated prior to disposal.

Biohazardous waste mixed with hazardous chemical or radioactive waste must be treated to eliminate the biohazard prior to disposal. After treatment, the waste can be managed as either hazardous chemical waste or as radiological waste.

There are strict safety requirements regarding segregation, labeling, packaging, treatment (including documentation), and transportation of biohazardous waste. The guidelines below should be followed:

1) Do not mix biological waste with chemical waste or other laboratory trash.
2) Segregate hazardous biological waste from nonhazardous biological waste.
3) Clearly label each container of untreated biohazardous waste and mark it with the Biohazard Symbol.
4) It is recommended to label nonhazardous biological waste as "NONHAZARDOUS BIOLOGICAL WASTE."

For information on biological waste treatment methods and disposal requirements, refer to the Biosafety Program link: https://www.uregina.ca/hr/hsw/assets/docs/pdf/Laboratory-Safety/2012-biosafety-program.pdf

SECTION 3: GLASS WASTE

Glassware should never be disposed of in the regular trash. Pasteur pipettes and broken glass can break through trash bags and cut individuals who handle trash. Follow these guidelines when disposing of broken glass:

- Do not pick up broken glass with bare or unprotected hands. Use a brush and dust pan to clean up broken glass. Remove broken glass in sinks by using tongs for large pieces and cotton held by tongs for small pieces and slivers.
- Glass contaminated with biological agents must be decontaminated by thermal or chemical treatment before disposal.
- Glassware contaminated with chemical or radiological materials must also be decontaminated prior to disposal. If decontamination is not possible, the glass should be disposed of as hazardous or radioactive waste.

Place non-contaminated broken glass in a rigid, puncture resistant container such as a plastic 5 gallon pail. There are glass waste containers available through Science Stores. Mark the container "Non-contaminated Broken Glass." Once the container is three-quarters full, seal it shut. The container should then be placed in the dumpster by laboratory personnel. Custodial staff are not responsible for disposing of glass waste containers.

NOTE: If broken glass is commingled with metal sharps, it must be treated as sharps waste and encapsulated before for disposal.

SECTION 4: METAL SHARPS

All materials that could cause cuts or punctures, must be contained, encapsulated, and disposed of in a manner that does not endanger other workers. Needles, blades, etc. are considered biohazardous even if they are sterile, capped, and in the original container. The following guidelines apply to handling and disposing of sharps:

1) Metal sharps must be segregated from all other waste.
2) Sharps that have been used with chemical or biological materials should be decontaminated prior to disposal whenever possible.
3) Sharps that have radiological contamination must be disposed of as radiological waste.
4) Dispose of sharps in a rigid container (available at Science Stores).
5) When the container is three-quarters full, contact HSW for disposal instructions.

NOTE: Laboratory personnel are responsible for sharps disposal. Custodial staff are not responsible for encapsulating and/or disposing of metal sharps waste.

SECTION 5: RADIOACTIVE WASTE

The University's Radiation Safety Policy requires adherence to the Canadian Nuclear Safety Commission (CNSC) requirements, as well as to the provincial regulations which govern the use of lasers and x-rays. The Radiation Safety Officer (with HSW) is responsible for the day-to-day requirements of the Radiation Safety Program.

For information on biological waste treatment methods and disposal requirements, refer to the Biosafety Program link: https://www.uregina.ca/hr/hsw/assets/docs/pdf/Policies/radiation-safety-policy.pdf

CHAPTER 5 - HOW TO PROTECT YOURSELF

SECTION 1: ADMINISTRATIVE CONTROLS

Protecting oneself when working in a hazardous environment begins with Administrative Controls, which includes administrative actions, documented training, and pre-planning.

1.1 ADMINISTRATIVE ACTIONS

Departments are expected to enforce safety standards through administrative actions in a variety of ways. For instance, appropriate safety signage is a way departments can promote safety in laboratories. Signs indicating the hazards present in the laboratory are posted just outside the laboratory. As well, emergency contact information is included on these signs to make is easier for emergency responders to obtain needed information quickly. Signs pointing to the location of safety equipment in or near the laboratory can minimize the consequences of an incident by enabling employees to quickly locate needed equipment. If there is a need for a sign by a laboratory or a sign needs to be updated, please contact the Science Safety Advisor.

Departments should also ensure that all laboratory employees receive proper training for the hazards in their work areas and that such training is properly documented and filed.

1.2 EMPLOYEE SAFETY TRAINING

Before entering a laboratory, all new laboratory employees, including teaching assistants, must receive training on the hazards they will encounter in their work area. This training is usually “tied” to the Key Request Policy that says that keys will not be issued to a lab until the individual has completed proper training.

General Training

The HSW unit at the UofR offers a variety of different training for those that will be entering and working a laboratory setting. The different types of training include: Chemical and Laboratory Safety, WHMIS (which will become GHS), Radiation Safety, Transportation of Dangerous Goods (TDG), and Fire Safety or Emergency Warden Training (if you are volunteering to be a safety warden in your building.

Most of these courses have both an online and practical component to the training. The online portion can be done according to each individual’s schedule. The practical portion is instructed by a member of the HSW unit and therefore there are sections to enroll into.

Work Area Specific Training

Work area specific training is provided by the principal investigator, laboratory manager and/or laboratory supervisor. This training should focus on the specific hazards in the employee's work area, such as chemical hazards, equipment hazards, biological hazards, etc. Work area specific training should also include the location of MSDSs, the proper use of personal protective equipment, the location and proper use of safety equipment (fume hoods, biological safety cabinets, etc.), the location and use of emergency equipment (showers, eyewashes, fire extinguishers, spill kits, etc.) and the proper response to emergency situations (fires, chemical spills, etc.).

Training should also be provided for new hazards that are introduced into the work area. If new information becomes available for an existing hazard, additional training on that information should be provided.

Training Documentation

Employee safety training must be documented and records maintained. Completion of all training offered by HSW is documented and records are kept by that unit. HSW also sends out a hard copy certificate upon successful completion of the training and this record should be maintained by the employee.

Documentation of Work Area Specific Training should include the date of training, specific topics covered, the name of the person providing the training and the signature of the trainee.

1.3 STUDENT SAFETY

Student Training and Acknowledgement Forms

Students enrolled in laboratory courses will receive appropriate safety information and instruction if class work involves hazardous chemicals. The instructor will provide this training.

In the future, the Faculty of Science may look at having students sign acknowledgement of training forms to make sure a record is available to show training is completed (as is currently done with employees).

Instruction on safe and proper use of laboratory equipment should also be provided to students as needed. Student training should be documented through written course instructions.

Departmental Oversight of Student Safety

It would further be ideal if departments with teaching laboratories should periodically conduct self-evaluations to ensure teaching assistants are enforcing safety rules and students are complying with them. These evaluations should be documented, as should any discrepancies found and steps taken to correct them.

PRE-PLANNING

Many laboratory hazards can be minimized by pre-planning. Before beginning work on a new project, the associated hazards should be considered carefully. What are the sources of danger? Are there chemical, equipment or electrical hazards? Consider also the risk of an accident or exposure occurring and what the impact of that incident would be. Also, conduct a thorough safety review of new apparatus. Risk assessments for all research programs (even to the experiment level) are also something that HSW and the Faculty of Science are working at being part of the pre-planning process.

Once the hazards have been identified, steps to minimize risk should be implemented. This includes utilizing engineering controls (such as fume hoods) and personal protective equipment. If the hazard is chemical, another option would be to substitute a less hazardous chemical. Or perhaps the project can be designed in such a way as to separate incompatibles, such as electrical equipment and water.

Careful planning is essential to a safe laboratory!

SECTION 2: LABORATORY VENTILATION EQUIPMENT

Ventilation in a laboratory is a very important aspect of laboratory safety. General room exhaust is not sufficient to protect the laboratory worker who uses hazardous chemicals, works with biological agents or uses equipment that generates excess heat. Additional engineering controls are required. This chapter discusses different types of laboratory ventilation.

2.1 CHEMICAL FUME HOODS

Chemical fume hoods provide primary containment in a chemical laboratory. They exhaust toxic, flammable, noxious or hazardous fumes and vapours by capturing, diluting and removing these materials. Fume hoods also provide physical protection against fire, spills and explosions.

For optimum performance and most effective protection, chemical fume hoods should be located away from doorways, supply air vents and high-traffic areas. Air currents created by passers-by can cause turbulence in a fume hood, which can result in contaminated air being drawn back out of the hood and into the room.

Similarly, a supply air vent located directly above a fume hood can also cause turbulence in the hood.

The Faculty of Science (and University of Regina) requires that all chemical fume hoods be ducted to the outside of the building and operate with an average face velocity that is consistent with industry standards. The Faculty of Science operates older (30+ years) and newer (<5 years) hoods and therefore the acceptable range for the average face velocity of a general purpose chemical hood can be anywhere from 100 feet per minute (fpm) down to as low as 60 fpm. However, the main concern for the faculty and the UofR is containment and therefore the actual number for the face velocity of the hood is less important as compared to just making sure all activities that will be conducted in that particular hood are safe for the user (ie. as long as the noxious or hazardous fumes are exhausted/contained the fpm doesn't matter). As a clarification though, most fume hood vendors only guarantee containment at no lower than 55 fpm.

The face of the hood is the opening created when the hood sash - the movable glass window at the front of the hood - is in the open position.

Types of Fume Hoods

Standard Fume Hoods (aka Constant Air Volume (CAV) fume hoods)

These hoods exhaust a constant volume of air. The velocity of the air passing through the face of a standard fume hood is inversely related to the open face area. Thus, if the sash is lowered, the inflow air velocity increases.

IMPORTANT: Face velocity that is too high may cause turbulence, disturb sensitive apparatus or extinguish Bunsen burners.

Variable Air Volume Fume Hoods

Just as their name suggests, variable air volume (VAV) hoods are designed to vary the amount of air being exhausted from the fume hood based on the sash position. By varying the exhausted air, these hoods are able to maintain a constant face velocity, no matter where the sash is positioned. VAV hoods are often equipped with an audio/visual alarm to notify the user if the hood is not operating properly.

Special Fume Hoods

Special fume hoods are necessary when working with certain chemicals and operations. Examples of special fume hoods include the following:

Perchloric acid fume hoods: Anyone working with perchloric acid must use a perchloric acid fume hood. These special fume hoods are equipped with a water spray system to wash down the entire length of the exhaust duct, the baffle and the wall of the hood. Perchloric acid vapors can condense on the hood ductwork, forming dangerous, explosive metal perchlorates. Also, perchloric acid can react with organic materials to form organic perchlorates, which are also explosive. For this reason, organic solvents should never be used or stored in a perchloric acid fume hood and the hood should be labeled "Perchloric Acid Use Only; No Organic Chemicals". The water wash down system, used periodically or after each use of the hood, removes any perchlorates or organic materials that may have accumulated in the hood exhaust system. The wash down system should be activated only when the exhaust fan has been turned off, so that complete coverage can be achieved.

Radioisotope hoods: These hoods are labeled for use with radioactive materials.
The interiors of these hoods are resistant to decontamination chemicals. These hoods are also often equipped with High Efficiency Particulate Air (HEPA) filtration.

Ductless hoods: Ductless hoods are designed with a filtration system. Generally, however the filters are not appropriate for use with all chemicals. Also, it is difficult to know when the filters need to be replaced, even if a strict change-out schedule is followed.

Note: The Faculty of Science does not have any of these special fume hoods.

Fume Hood Safety Considerations

The potential for glass breakage, spills, fires and explosions is great within a fume hood. To ensure safety and proper fume hood performance, follow these guidelines:

a. Know how to properly operate a fume hood before beginning work.
b. Fume hoods provide the best protection when the fume hood sash is in the closed position.

c. Inspect the fume hood before starting each operation, including any airflow monitors. Do not use the hood if it is not functioning properly; call the Science Safety Advisor to arrange for the hood to be checked.
d. Keep traffic in front of the fume hood to a minimum and walk slowly when passing by the hood, especially when work is being conducted in the hood. This will reduce the likelihood of creating turbulence in the hood.
e. Use the appropriate type of hood for the work being conducted. For example, when using perchloric acid, use a perchloric acid fume hood.
f. Keep the area in front of the hood clear of obstructions. This will allow room for laboratory workers to move about and will allow sufficient airflow to the hood.
g. Place equipment and chemicals at least six inches behind the fume hood sash. This practice reduces the chance of exposure to hazardous vapors.
h. Do not allow equipment and chemicals to block baffle openings. Blocking these openings will prevent the hood from operating properly.
i. Keep loose paper out of the fume hood. Paper or other debris that enter the exhaust duct of the hood can interfere with the hood's ventilation.
j. Do not store excess chemicals or equipment in fume hoods.
k. Elevate any large equipment within the hood at least three inches to allow proper ventilation under the equipment.
l. When working in a fume hood, set the sash at the lowest working height, about 12 - 15 inches from the base of the hood opening. Close the sash completely when no one is standing at the hood working in it. The only time the sash should be completely open is while setting up equipment.

IMPORTANT: A fume hood's sash is designed to protect the user from dangerous chemical gases and vapors, chemical splashes and potentially flying debris. The sash should be positioned to protect the user's face, neck and upper body. The lower the sash position, the more area of the user's body will be protected.

m. Do not defeat sash stops by removing them or altering their design or function.
n. Wear personal protective equipment, including protective eyewear, as appropriate. The hood does not replace PPE.
o. Keep laboratory doors closed. Laboratory ventilation systems are designed to operate with the doors closed.
p. Do not alter/modify the fume hood or associated duct work.
q. Clean up spills in the hood immediately.

IMPORTANT: If a power failure or other emergency occurs (e.g., building fire or fire within the fume hood), close the fume hood sash and ensure safe shutdown of the lab, paying special attention to equipment that may be reenergized when power is restored.

Fume Hood Inspections

Fume hoods should and will be tested at least annually by Facilities Management. Any defects will be reported to the Science Safety Advisor or HSW. Fume hoods should also be tested in the following circumstances:

When an employee requests an inspection. After major repair work. After a fume hood is moved.

Fume hood testing includes measuring the velocity of airflow through the face of the hood as well as a general inspection of the hood's condition (sash, lighting, noise level, etc.). If you suspect a problem with your fume hood, contact the Science Safety Advisor.

2.2 OTHER LABORATORY VENTILATION SYSTEMS

Biological Safety Cabinets (BSCs)

BSCs provide containment for pathogenic materials and are not intended for use as a chemical fume hood. When used and maintained correctly, Class II biosafety cabinets protect the user from exposure to harmful biological agents and also protect the product from contamination by filtering the air inside the cabinet through High Efficiency Particulate Air (HEPA) filters. Before using a biological safety cabinet, laboratory personnel should be thoroughly trained on how to properly use and maintain the cabinet.

Follow these instructions for safe use of a biological safety cabinet:

a. Only biosafety cabinets that are certified. BSCs must be certified upon installation, upon being moved, after major repair and at least annually.

    i. The Faculty of Science organizes the annual inspections.
    ii. BSCs that are not certified annually or that fail certification will be tagged "Not Safe For Use With Pathogens."

b. Locate biosafety cabinets away from doorways and high traffic areas. As with chemical fume hoods, rapid movement in or near the cabinet can create turbulence, causing contaminants to be drawn out of the cabinet and into the general laboratory area.
c. Restrict entry into the laboratory when work is being conducted in the BSC.
d. Turn off UV light before beginning work in a BSC.
e. Disinfect the biosafety cabinet prior to beginning and after completing work in the cabinet.
f. Allow cabinet to operate without activity at least 15-20 minutes before and after use. This will allow all the air in the cabinet to circulate through the HEPA filters, removing any contaminants that may be present.
g. Keep the BSC clear of clutter and loose paper. Only place items that are needed in the cabinet.
h. Keep clean items and dirty items segregated in the BSC.
i. Provide a waste container inside of the cabinet and keep it covered.
j. Always wear appropriate personal protective equipment.
k. Keep face away from the BSC opening.
l. Never use a Bunsen burner in a biosafety cabinet. Dangerous levels of gas can build up in the cabinet. Also, heat from the open flame can damage the HEPA filters.
m. Clean up spills in the BSC immediately.

For more information on the biological safety cabinets contact the Science Safety Advisor.

Glove Boxes

Glove boxes are designed to be leak-tight and can be used with highly toxic or air-reactive chemicals and materials. Some glove boxes may also be appropriate for use with some radioactive materials. The leak-tight design provides a controlled atmosphere, protecting both the product and the worker by preventing vapors/moisture, gases and particulates from entering or leaving the box.

Laminar Flow Hoods

Also known as clean benches, laminar flow hoods provide a continuous flow of HEPA filtered air across the work surface. This design helps prevent contamination of the product, but does not offer any protection to the worker. Laminar flow hoods should only be used with non-hazardous materials. Laminar flow hoods are certified annually at the same time as the BSCs.

Snorkel Hoods

Snorkel hoods are small fume exhaust duct connections. They are designed with flexible ducts and are able to be positioned directly over a work area at the bench. For best performance, the snorkel hood should be placed within six inches of the item needing ventilation. Snorkel hoods should only be used to exhaust heat and nuisance odors. They should never be used with highly toxic or flammable chemicals. These are only found in Science Stores.

SECTION 3: PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment (PPE) includes all clothing and work accessories designed to protect employees from workplace hazards. Protective equipment should not replace engineering, administrative or procedural controls for safety - it should be used in conjunction with these controls. Employees must wear protective equipment as required and when instructed by a supervisor.

IMPORTANT: Personal protective equipment is used to prevent exposure or contamination. PPE should always be removed before coming in contact with other individuals or before going in or near elevators, break rooms, classrooms, bathrooms, etc. Do not launder personal protective equipment at home.

3.1 ARM AND HAND PROTECTION

Arms and hands are vulnerable to cuts, punctures, burns, bruises, electrical shock, chemical spills and amputation. Forms of hand protection available to employees include but are not limited to:

Disposable exam gloves
Chemical resistant gloves (rubber, nitrile, neoprene, etc.)
Non-asbestos heat-resistant gloves

Always wear the appropriate hand and arm protection. Double your hand protection by wearing multiple gloves when necessary (e.g., two pairs of disposable gloves for work involving biological hazards). For arm protection, wear a long-sleeved shirt, a laboratory coat, chemical-resistant sleeves, or gauntlet-length gloves.

Follow these guidelines to ensure arm and hand safety:

a. Inspect and test new gloves for defects.
b. Always wash your hands before and after using gloves.
c. Wash reusable chemical-protective gloves with soap and water before removing them.
d. Do not reuse disposable gloves. Turn disposable gloves inside-out as you remove them to avoid contaminating your hands.
e. Do not wear gloves near moving machinery; the gloves may become caught.
f. Do not wear gloves with metal parts near electrical equipment.

IMPORTANT: Gloves are easily contaminated. Avoid touching surfaces such as telephones, door knobs, etc. when wearing gloves.

3.2 BODY PROTECTION

Hazards that threaten the torso tend to threaten the entire body. A variety of protective clothing, including laboratory coats, long pants, rubber aprons, coverall, and disposable body suits are available for specific work conditions, including the following:

Rubber, neoprene and plastic clothing protect employees from most acids and chemical splashes.
Laboratory coats, coveralls and disposable body suits protect employees and everyday clothing from contamination by chemicals, biological materials, dirt and grime, etc.
Welding aprons provide protection from sparks.

Please make sure to use the proper body protection (ex. lab coat) for the activities you intend to take part in.

Launder reusable protective clothing separate from other clothing. Do not launder protective clothing at home or in any public facilities outside of the university. A laundry service that specializes in biological or chemical contaminants may be used.

Note: The Faculty of Science currently provides a service where all lab coats used within the faculty are collected and sent out for cleaning. Please contact the Coordinator, Science Operations for more information.

3.3 HEARING CONSERVATION

If you work in a high noise area, preventing hearing loss is of utmost importance. Whenever possible, attempts should be made to control noise levels through engineering controls or operational changes before resorting to hearing protection. Equipment that is operating more loudly than usual may just need maintenance. Also, installing noise attenuating devices in an inherently noisy environment may alleviate noise levels. If, however, the noise level cannot be controlled sufficiently, hearing protection should be employed.

If you suspect that your laboratory environment exceeds acceptable noise levels, contact your Science Safety Advisor. Instruments for measuring decibel levels can be used to check your area. From there, recommendations on possible ways to reduce the noise level or on types of hearing protection that would be appropriate for the situation can be suggested.

3.4 EYE AND FACE PROTECTION

Employees must wear protection if hazards exist that could cause eye or face injury. Eye and face protection should be used in conjunction with equipment guards, engineering controls and safe practices.

NOTE: Unless it is documented that there is no potential for eye injury to occur, safety glasses are required in laboratories. Chemical splash goggles should be worn when handling chemical materials.

Always wear adequate eye and face protection when performing tasks such as grinding, buffing, welding, chipping, cutting, pouring chemicals or pipetting. Safety glasses or goggles should be worn in case of impact hazard. Chemical splash goggles provide the most effective eye protection against chemical splashes as well as protection against impact.

Follow the information below regarding eye protection:

a. If you wear prescription glasses, goggles or other safety protection should be worn over the glasses.
b. Safety glasses with side-shields provide protection to eyes and are four times as resistant as prescription glasses to impact injuries.
c. Goggles protect against impacts, sparks, chemical splashes, dust, etc., but not all goggles provide the same type of protection. There are specific goggles for:

    i. Wood-working or other impact hazards
    ii. Chemical splash hazards
    iii. Laser hazards
    iv. UV hazards
    v. Welding hazards

d. A face shield is designed to protect the face from some splashes or projectiles, but does not eliminate exposure to vapours .

NOTE: Goggles or safety glasses with side shields must be worn under a face shield.

3.5 FOOT PROTECTION

To protect feet and legs from falling objects, moving machinery, sharp objects, hot materials, chemicals, or slippery surfaces, employees should wear closed- toed shoes, boots, foot-guards, leggings or safety shoes as appropriate. Safety shoes are designed to protect people from the most common causes of foot injuries - impact, compression and puncture. F oot protection is particularly important in laboratory work.

IMPORTANT: Do not wear sandals, open-toed shoes, open-backed shoes or Crocs in laboratories, shops or other potentially hazardous areas.

Chemically resistant shoes may be necessary when working with certain materials, such as corrosives. Special foot protection is also available for protection against static electricity, sparks, live electricity, and slipping.

3.6 HEAD PROTECTION

Accidents that cause head injuries are difficult to anticipate or control. With some exceptions, head protection is generally not needed in a laboratory environment. However, if hazards exist in the laboratory that could cause head injury, employees should try to eliminate the hazards, but they should also wear head protection.

RESPIRATORY PROTECTION PROGRAM

The Faculty of Science uses engineering, administrative and procedural controls to protect people from dangerous atmospheres, including harmful mists, smoke, vapors, oxygen deficient environments, and animal dander. When these controls cannot provide adequate protection, respiratory protection is necessary.

People who use respiratory protection must be physically capable of using and wearing the equipment. In some cases, a physician must determine if an employee is healthy enough to use a respirator. In addition, all people required to wear respirators must be formally trained and instructed in proper equipment usage. Please contact the Science Safety Advisor to set up this appointment.

Choosing the right respirator for the job is equally important to knowing how to use it. There are many types of respirators and each type protects against different hazards. HSW will help individuals select the best respirator for their needs.

IMPORTANT: Respirators are available in different sizes. Always fit test a respirator to select the correct size.

Health Safety and Wellness can provide training and fit testing for personnel who need respiratory protection.

SECTION 4: EMERGENCY NOTIFICATION SYSTEM

The University of Regina's enhanced **Emergency Notification System** (ENS) is designed to ensure effective and timely warnings are delivered to faculty, staff, students and visitors to campus in the event of a life threatening situation when people must take immediate action to stay safe on campus.

The ENS leverages existing infrastructure, such as computer monitors and television screens across the main and College Avenue campuses, to display emergency messaging through a system called Alertus. The ENS is not linked to the Fire Alarm System and will not activate when the fire alarm sounds.

Throughout common areas, classrooms, dormitories and other occupant spaces, Alertus Emergency Mass Notification wall-mounted beacons with integrated flash sounder signaling and message display, are installed to display emergency messaging. Alertus will also automatically push messages to other communication channels such as computers connected to the University of Regina Novell system.

Decisions to activate the ENS are made on a situation-by-situation basis by Campus Security.

A potential message may read:

Tornado warning issued for Regina.
Remain indoors.
Take shelter in interior rooms or stairwells without windows

For more information on the ENS system, please contact HSW or see the FAQs website:
https://www.uregina.ca/hr/hsw/emergency-management/ens-faqs.html