2021

LABORATORY SAFETY MANUAL

*BIOLOGICAL AND RADIATION SAFETY ARE COVERED IN SEPARATE MANUALS AVAILABLE FROM EHS

Prepared by Environmental Health and Safety

University Emergency Contact Numbers

Emergency Contacts	Telephone
St. John's Campus	864 - 4100
Health Sciences Centre	864 - 4100
Marine Institute Security Services	9-911* 778 - 0456
Grenfell Campus	637- 2888
Ocean Sciences Centre CEP	9-911* 864-4100

* When utilizing 911, a follow-up call should be made to CEP or Security Services

Environmental Health and Safety

General Contacts	Telephone	Email
Environmental Health and Safety Office		health.safety@mun.ca
Director, Environmental Health and Safety	864-6126	health.safety@mun.ca
Coordinator, Chemical Management and Assurance	864-3769	labsafety@mun.ca
Radiation and Biosafety Officer	864-8250	rso@mun.ca

Website: http://www.mun.ca/health_safety

1 Introduction

1.1 Commitment to Health and Safety

Memorial University of Newfoundland (university) is committed to providing a safe and healthy environment for all persons associated with the university, including faculty, staff, students, visitors, and the community. The cooperation of all parties involved is required to ensure that the university conducts teaching and research safely with regard to workers, the community, and the environment. Environmental Health & Safety (EHS) has an administrative responsibility for assisting laboratory personnel in developing safe work practices and for compliance with federal, provincial, and local regulations.

1.2 Cooperation

Though the university is committed to providing a safe and healthy environment for all persons associated with the university, this cannot occur unilaterally. A top-down approach to health and safety is ultimately less likely to succeed than a cooperative effort from all affected parties. Your cooperation is also required to ensure that the university stays compliant with applicable federal, provincial, and local regulations related to health and safety in the workplace environment and the natural environment.

1.3 Responsibilities

1.3.1 Unit Chair / Head

Principal Investigators, laboratory personnel, individual department / unit, and EHS all share responsibility for laboratory safety. Specific duties of each include the following:

- Ensure the unit's compliance with health and safety standards.
- Provide timely notification to EHS that a faculty member, who used hazardous materials, plans on terminating their research activities, to expedite clearance of the laboratory for the next investigator.
- Shall appoint a health and safety committee from a cross-section of the unit's employees to address health and safety concerns.
- Ensure that Principal Investigators/Supervisors conduct annual inspections of their labs and submits completed inspection report.

1.3.2 Principal Investigator/Supervisor

- Complete a Laboratory Commissioning form in consultation with EHS and the unit chair/head prior to the commencement of work as well as before any changes to the scope of work conducted within the laboratory.
- Perform a risk assessment and ensure all high hazard activities have a written safe work procedure (SWP) and that all required personal protective equipment (PPE) is available. If activities change or new activities are added, ensure that risk assessment is updated with additional SWP's as required.
- Prepare a Laboratory Safety Plan (LSP) (LSMS F2) form, to complement the Laboratory Safety Manual (LSM).
- Ensure that laboratory personnel meet the training requirements of the federal, provincial and local regulations including chemical hazard information, safety rules and good work practices.
- Provide initial training to laboratory personnel, upon employment, on the contents of the Laboratory Safety Plan. Document this training on the Laboratory Safety Training Record (LSMS F3) form or similar. Maintain training records for one year in the laboratory safety notebook.
- Provide ongoing health and safety training as required to all laboratory personnel on the contents of the laboratory safety plan. Document this training on the form provided LSMSF3-R1 or similar. Maintain training records within the primary laboratory to facilitate review during inspections.
- Conduct lab inspections annually using the laboratory inspection form. Inspections must be documented using this form and submitted to the Unit Chair/Head or designate.
- Ensure that employees and students wear the required personal protective equipment (PPE).
- Maintain up to date safety data sheets (SDS) for hazardous products used in the laboratory and make these available to the laboratory staff.
- Post appropriate hazard information signs at the entrance(s) to the laboratory.
- Complete a Laboratory Decommissioning (LSMS F1) form, in consultation with EHS and the unit chair/head prior to their departure from MUN or discontinuance of the use of hazardous materials to ensure that hazardous materials have been properly prepared for disposal or reassignment to another PIs and that laboratory surfaces are appropriately decontaminated.

1.3.3 Laboratory Workers and Students

- Participate in completion of risk assessment, as required.

- Review the LSP, the chapters of the Laboratory Safety Manual relevant to your teaching or research, and other information provided by your supervisor.
- Complete appropriate training and orientation programs provided by EHS.
- Follow health and safety guidelines when handling hazardous materials, including the proper use of PPE.
- Notify Supervisor of accidents, spills, or conditions that may warrant further investigation and/or monitoring.
- Review laboratory materials to ensure that you have properly labelled and prepared all hazardous materials for disposal by EHS or use by other workers before you leave the research group.
- Read SDS for all chemicals you are working with and make note of particular hazards and necessary precautions.

1.3.4 Environmental Health & Safety

- Provide general health and safety training for laboratory personnel, as required.
- Provide Hazard Identification and Risk Management training, as required
- Inspect laboratories regularly for health and safety hazards and for compliance with Provincial and Federal regulations.
- Investigate potential health and safety hazards identified by laboratory personnel, as required.
- Monitor personnel for over-exposures to chemical, biological, physical, and radioactive hazards, when necessary.
- Advise laboratory personnel on proper disposal of waste chemicals and other hazardous materials.
- Consult with faculty, staff, students, and unit health and safety committees on health and safety matters.
- Ensure the timely implementation and maintenance of the university's Laboratory Safety Management System (LSMS).
- Coordinate and prepare audit schedules and perform reviews/audits.
- Follow up documentation of compliance and compliance monitoring.

1.3.5 The Laboratory Safety Committee

- Plan, review and monitor performance against the university's Laboratory Safety Manual on a quarterly basis.
- Approve the university's LSMS.

- Review and approve resources to develop, operate and maintain the university's LSMS and other relevant policies, legal requirements and corporate requirements essential for the program.
- Review regulatory and other requirements audits and inspections and establish corrective actions including assurance of closure of action items.
- Establish specific Laboratory Safety program objectives, targets, programs and initiatives.

2 Compliance with Laboratory Safety Standards

2.1 Compliance

The health and safety of workers and building occupants is the most important factor to consider in laboratory work. In addition to these health and safety concerns, compliance with Newfoundland and Labrador's Occupational Health and Safety Regulation, the Canadian Nuclear Safety Commission, Public Health Agency of Canada, Canadian Food Inspection Agency and the Environmental Protection Act is required.

2.2 Health and Safety Regulations and Standards

Sources of health and safety standards and key compliance issues include:

Standard	**Key Compliance**
Occupational Health and Safety Act and associated regulations	Minimum health and safety requirements that must be maintained
MUN Laboratory Safety Manual	Training of Staff, SDS, Emergency Plan
EPA Hazardous Waste Regulations	Lids, labels, mixing incompatibles, secondary containment
CNSC Radiation Regulations	Radiation source control, dose limits, waste, training, personnel monitoring, labelling, and hazard information signs
PHAC/CFIA Biosafety Standards	Biohazardous material use and storage, waste, training, labelling and transport.
Fire/Life Safety Codes	50 liters open storage flammables limit, clear laboratory egress, hallway storage

2.3 Laboratory Health and Safety Compliance

EHS conducts regular inspections of laboratories. Inspections are announced to the lab owner with follow up visits being either announced or unannounced. Inspections are conducted using a laboratory inspection checklist and non-compliances (major or minor) categorized as health and safety observations according to Memorial's Hazard Identification and Risk Management Health and Safety Element.

While all individuals working in a lab are expected to carry out their work in a manner that is compliant with the terms of the LSMS, oversight of compliance is a shared responsibility between the lab owner and the Administrative Head of the unit.

2.3.1 Types of Non Compliance

Non-compliances are grouped into two categories, major and minor. The university's Hazard Identification and Risk Management element includes a risk severity and scoring matrix that is used to determine the potential severity of the non-compliances identified and the action required including timeframe to implement controls.

2.3.1.1 Major

Major non-compliances are items that when evaluated using the risk severity and scoring matrix result in a residual risk of high or very high.

2.3.1.2 Minor

Minor non-compliances are items that when evaluated using the risk severity and scoring matrix result in a residual risk of moderate, low and very low.

2.3.2 Procedures for Non Compliance

2.3.2.1 Minor Non-Compliance

When a minor non-compliance health and safety observation occurs EHS will prepare an inspection report and submit it to the lab owner / supervisor and unit head. Report will include health and safety observation, regulatory reference for non complicance and recommended action including timeframe.

If the lab owner has not replied within the identified time frame or the same non-compliance health and safety observation is observed during the follow-up inspection, the issue(s) will be escalated to the Director of EHS, the Chair of the University Laboratory Safety Committee and the appropriate Vice-President(s) of the situation.

2.3.2.2 Major Non-Compliance or Continued Minor Non-Compliance

When a major non-compliance health and safety observation occurs the issue will be immediately escalated to the lab owner / supervisor and unit head, Director of EHS, the Chair of the Laboratory Safety Committee, and the appropriate Vice-President(s) stating the health and safety observation and regulatory reference for the non complicance.

Continued minor non-compliances can result in a major non-compliance as well and would follow the same reporting protocol as a major non-compliance.

Senior Adminstration will determine the appropriate actions to take which may include, but are not limited to suspension or revocation of purchasing privileges, suspension or revocation of the laboratory.

Furthermore, in addition to the aforementioned sanctions, disciplinary measures may be taken, subject to the processes outlined in the applicable collective agreements.

3 General Laboratory Procedures

3.1 Types of Laboratories

Currently Memorial has a combination of closed space and open plan laboratories.

3.1.1 Closed Labs

Designed for a single research group with walls separating the laboratories and support spaces. Spaces are self-contained, with each PI having their own equipment, facilities and research group.

3.1.2 Shared Labs

Shared laboratories describe any floor plan which uses large, open spaces with few walls and minimal use of small, enclosed rooms. Space is occupied by more then one PI. For a shared laboratory to work successfully for all researchers, there needs to be a concerted effort in managing resources, booking systems and cleaning/maintenance of the shared resources. Please refer to the Shared Laboratory Hazard Communication for common principals to follow in shared spaces.

In addition to the roles and responsibilities outlined in Section 1.3, the PIs working within the lab must work together to ensure that roles and responsibilities are established to ensure:

- testing of emergency eyewash and shower equipment is completed weekly;
- all lab occupants are aware of the hazards located in the lab and the control methods;
- means of communication is established between groups to ensure that individuals activities don't impact other lab occupants;

- a system is implemented to ensure new lab personnel obtain general EH&S training, as well as lab-specific training and orientation;
  - It is highly recommended (if not mandatory based on the specific lab) that general health and safety awareness training (including WHMIS, biosafety and radiation safety awareness) is completed and kept up to date by all personnel who access open plan laboratories.
- signage is used to label experiments in progress and/or equipment use;
- hazardous materials are not left unattended;
- frequent lab clean ups are conducted and removal of unneeded supplies, equipment, hazardous waste, etc are scheduled in a timely manner; and
- health and safety rules are consistently enforced across the entire lab.

3.2 Initial Commissioning of Laboratory

All Memorial laboratories must be commissioned through EHS prior to the commencement of work as well as before any changes to the scope of work conducted within the laboratory (e.g. addition of an x-ray emitting device (XED) or commencing work with biohazardous or radioactive materials). Refer to EHS's Chemical Relocation and Laboratory Commissioning and Decommissioning webpage for detailed information.

Complete the laboratory commissioning form and submit to unit chair / head and EHS as soon as possible to initiate the commissioning process.

EHS staff will review the application and visit the laboratory in order to provide advice on the requirements based on the scope of work.

Before authorization for independent work in any Memorial laboratory, new staff/students must:

- Complete all requisite health and safety training (e.g. WHMIS, radiation safety, biosafety, x-ray safety, etc.)
- Review the laboratory safety plan, which shall include:
  - hazards posed by materials in the lab, as well as appropriate safe handling, storage and emergency protocols. Read labels and SDS before moving, handling or opening chemicals. Never use a product from an unlabeled container, and report missing or damaged labels to your supervisor.
  - agents, processes and equipment in the laboratory. If you are unsure of any aspect of a procedure, check with your supervisor before proceeding.
  - The location and operation of safety and emergency equipment such as fire extinguishers, emergency eye wash and shower facilities, first aid and spill response kits, fire alarm pull stations, telephone and emergency exits.
  - Emergency spill response procedures for the materials present in the lab.
  - Emergency reporting procedures and telephone numbers.
  - Designated and alternate evacuation routes.

3.3 General Laboratory Safety (requirements for all Memorial laboratories)

- List of emergency telephone numbers and hazard identification must be posted on the outside of the exterior door of the laboratory using the Laboratory Hazard Information Template.
    - Specific hazard signage (e.g. radiation, biohazard, laser, x-ray) is required when these hazards are present within the laboratory.
- Access to laboratories shall be restricted to authorized individuals only. Appropriate health and safety training (e.g. WHMIS, radiation safety, biosafety, etc.) shall be in place before an individual is authorized for unsupervised access.
    - Trainees as well as new staff and students must be supervised in the laboratory until appropriate health and safety training has been completed.
- No running, jumping, or horseplay in laboratory areas shall be permitted.
- A full equipment list shall be readily available as per the Laboratory Equipment Register.
- Do not block access to emergency safety equipment such as fire extinguishers, eyewashes, showers, first aid kits or utility controls such as breaker boxes or gas shut-off valves.
- Do not block exits or normal paths of travel: keep hallways, walkways and stairs clear of unnecessary materials.
- Laboratories shall be kept clean, free from obstructions, and free of unwanted chemicals, biological specimens and materials that cannot be easily decontaminated. Do NOT leave reagent bottles, empty or full, on the floor.
- Areas for paper/computer work shall be physically or operationally separated from laboratory work areas.
- Ensure that the weight of stored material does not exceed the load-bearing capacity of shelves or cabinets.
- Ensure that wall-mounted shelving has heavy-duty brackets and supports and is attached to studs or solid blocking. Regularly inspect clamps, supports, shelf brackets and other shelving hardware.
- Do not stack materials so high that stability is compromised.
- Use a CSA approved step or stepladder to access higher items; never stand on a stool or a chair.
- Work only with materials once you know their flammability, reactivity, toxicity, safe handling and storage and emergency procedures. Refer to vendor specific SDS for hazardous products or infectious material before starting work.
- Report accidents and near-misses promptly to your supervisor and through Memorial's Incident Management System (MIMS).
- Conduct procedures involving the release of volatile toxic or flammable materials in a chemical fume hood.

Perform a safety check at the end of each experiment and before leaving the lab. Make sure to:

- Turn off gas, water, electricity, vacuum and compression lines and heating apparatus.
- Return unused materials, equipment and apparatus to their proper storage locations.
- Label, package and dispose of all waste material properly. Remove defective or damaged equipment immediately, and arrange to have it repaired or replaced.
- Decontaminate any equipment or work areas that may have been in contact with hazardous materials.
- Leave behind protective clothing (lab coats, gloves, etc.) when leaving the laboratory.
- Close and lock the laboratory door if you are the last one to leave.

3.3.1 Unattended Experiments

Prior to starting a procedure that will be left unattended, a risk assessment must be completed, and documented, of the procedure and reviewed by the lab supervisor to ensure all hazards are controlled. (i.e. fire, explosion, flooding, unauthorized access etc…).

- Unattended procedures should be visited periodically.
- Contact information for the person conducting the experiment in case of emergency must be posted.

3.3.2 Personal Health and Hygiene

- Clothing worn in any laboratory where hazardous materials are present should adequately cover the body (e.g. closed toe/heel shoes, full length pants) and does not leave skin exposed (refer to section 4 for additional requirements).
- Long hair shall be restrained (i.e. tied back) when working with chemicals, biohazards, radioisotopes, or moving machinery.
- Open wounds, cuts and scratches shall be covered with waterproof dressings while in the laboratory.
- Pipetting by mouth is prohibited.
- Consumption and storage of food and beverage (including water) is prohibited within all Memorial laboratories. Similarly, application of lip balm or cosmetics and handling of contact lenses is prohibited within the laboratory. Do not use ice from laboratory ice machines for beverages.
- Any food or drink that is used for experimental purposes must be clearly labeled as such.
- Hand washing is required whenever a chemical has contacted the skin and prior to exiting the laboratory. Hand washing amenities (i.e. appropriate soaps, disinfectants, towels, etc) shall be readily available within the laboratory.

3.4 Final Laboratory decommissioning

Prior to a laboratory being vacated, reassigned, renovated or demolished, the lab must be inspected to ensure that it is left in a condition that is safe for the new occupants and/or non lab workers involved in the renovations and/or removal of equipment.

Requirements:

- Start the decommisioing process, including completion of decommissioning form, as soon as you know that space is being vacated, reassigned, renovated or demolished.
- Unwanted chemicals and hazardous waste must be disposed of through the hazardous waste dispoal process.
- Remaining chemicals must be transferred within the chemical management system to another owner.
- Update chemical management system to reflect disposals and transfers.
- Lab should be left clean, tidy, and free of combustible materials.
- Laboratory glassware should be empty and cleaned.
- Complete the laboratory equipment and furniture decontamination form to confirm decontamination of such all lab equipment and furniture i.e. autoclaves, ovens, refrigerators, freezers, incubators, fume hoods, storage cabinets etc…
- Clean lab bench tops (washed down).
- Return compressed gas cylinders to the supplier(s).
- Remove signs, posters, and non-University property.
- Leave documents or statements with unit chair / head for any equipment or materials that the department has agreed to have remain in the laboratory (i.e. safety data sheets (SDS), services manuals, inventory, etc.).
- Submit completed decommissioning form to unit chair / head and EHS.

In cases where an abandoned lab is identified, the unit that the PI reported to will be responsible for the decommissioning and all costs associated with the process.

4 Personal Protective Equipment

The university's requirements regarding PPE is outlined below. Note that hazardous materials include those defined by WHMIS legislation as "hazardous products", as well as radioactive sources as defined by Canadian Nuclear Safety legislation, and biohazardous materials as defined in Memorial's Biological Safety Manual. It is the supervisor's responsibility to determine the appropriate PPE required for the hazards found within the laboratory. All students, staff, faculty and visitors must wear appropriate PPE for the identified hazards as outlined in the sections below and in the lab specific PPE assessment documented in the laboratory safety plan.

4.1 Lab Coats and Appropriate Clothing

- Lab coats are mandatory when working with hazardous materials.
- Lab coats are not to be worn outside the laboratory, especially in rest room or break facilities.
- Lab coats are to be fully fastened closed with sleeve cuffs fully extended while working and removed prior to exit from the laboratory.

Instructions for selection and use of lab coats are as follows:

- select knee-length lab coats with button or snap closures.
- wear a solid-front lab coat or gown with back closures when working with highly toxic or infectious agents.
- wear protective aprons for special procedures such as transferring large volumes of corrosive material.
- lab coats should be kept clean and replaced when necessary. Clothing should be replaced or decontaminated using appropriate decontamination procedures (e.g. bleach treatment/autoclaved for biohazard contamination) whenever contamination is suspected, prior to laundering.

4.2 Eye and Face Protection

All students, staff, faculty and visitors must wear CSA approved eye and/or face protection in areas where hazardous materials, or substances of an unknown nature, are stored, used or handled, when there is a risk of splashes, or other flying materials.

For areas where there are other eye hazards, e.g. UV or laser light (consult appropriate standards such as the Canadian Standard Association (CSA) Z94.3.1-02 or American National Standards Institute (ANSI) Standard Z136 for guidance on selecting protective eye wear for your specific application).

Lab supervisors are responsible for identifying the type of eye protection required based on the hazards associated with the work being completed. Contact lenses are permmited to be worn in labs provided appropriate eye protection is worn and the SDS doesn't indicate they are prohibited.

Guidelines for selection and use of eye and face protection are as follows:

- For light-to-moderate work wear CSA approved safety glasses or goggles.
- For more hazardous operations where there is potential for chemical splashing, explosion, impact or projectile wear CSA approved safety goggles and/or a face shield which are rated for chemical splash protection and/or impact resistance. This is especially important when working with corrosive chemicals. For chemical splash hazards goggles must be indirectly ventilated or non ventilated.

- Chemical goggles must be worn when working with chemicals whose vapours are irritating to the eyes (e.g. ammonia or ammonium hydroxide).

4.3 Hand Protection

In the laboratory, gloves are used to reduce the risk of personal contamination from radiation, chemical products and biohazardous material as well as to protect the hands from physical hazards such as abrasion, tearing, puncture and exposure to temperature extremes.

- Gloves are not to be worn outside the laboratory, especially in rest room or break facilities for risk of contaminating these facilities.
- No single glove material is resistant to all chemicals or physical hazards, nor will most gloves remain resistant to a specific chemical for longer than a few hours. It may be necessary to wear two different types of gloves:
    - For chemical resistance properties, and
    - Its physical resistance properties.

To determine which gloves will provide an acceptable degree of resistance consult the SDS for the product, the university's Glove Selection and Care Guidelines or review of manufacturer's glove selection charts.

4.4 Respirators

A respirator may only be used when engineering controls, such as general ventilation or a fume hood, are not feasible or do not reduce the exposure of a chemical to acceptable levels. Selection of the proper respiratory protective device will depend upon a number of factors, the most important of which relate to the properties of the chemical or material against which protection is needed. Factors to consider include:

- Short Term Exposure Value (STEV)
- Time-Weighted Average Exposure Value (TWAEV)
- Type of material (e.g., acid, solvent, dust, radioactive, carcinogen, asbestos, ammonia, etc.)
- Concentration of the material
- Whether it is Immediately Dangerous to Life and Health (IDLH)

The use of respirators in the laboratory setting is dependent upon the type of potential inhalation hazard present and the engineering controls that are in place to prevent worker exposure to chemical hazards. Respirator use at MUN is subject to prior review by EHS according to the university's Respiratory Protection Program (RPP).

Tasks that may require the use of a respirator in a laboratory include:

- Handling animals;
- Using chemicals outside of a laboratory fumehood;
- Small chemical spills or leaks that can be cleaned up with a proper spill kit;
- Other activities where workers may be exposed to unacceptable levels of an airborne hazard.

The university's RPP is applicable to all laboratories where workers and/or students are required to wear respirators.

Any worker, student, supervisor or principal investigator who believes that respiratory protection is needed must notify EHS for an evaluation of the hazard and enrolment into the RPP. This program involves procedures for respirator selection, medical assessment of respirator users, employee training, fit testing, inspection and maintenance of respirators and record keeping. No one is permitted to use a tight fitting respirator unless they have been trained and fit-tested as per the RPP. Please contact EHS for further information on respiratory protection.

4.5 Footwear

For experimental areas where hazardous materials are handled wear shoes that fully cover the feet to protect against spills. Do not wear open toed/heeled shoes or sandals.

In areas where speciality footwear is required it must be of design, construction and material appropriate to the protection needed.

For work that requires lifting or moving of heavy equipment or other materials, CSA approved footwear is required.

Safety footwear is designed to protect feet against a wide variety of injuries. Impact, compression, and puncture are the most common types of foot injury. Choose CSA approved footwear according to the hazard.

4.6 Hearing Protection

Routine exposure to noise in excess of 85dB requires the use of hearing protection (i.e. ear plugs, ear muffs); for extended exposure to noise in excess of 80dB, hearing protection is advised. EHS can provide noise level monitoring, upon request.

4.7 Health Concerns

Ideally, workplace procedures should be set up to minimize health and safety hazards for all workers. In some situations it may be preferable to change procedures and restrict activities for workers depending on specific health concerns. Laboratory workers with specific health concerns should speak with their supervisor or family doctor

5 Lab Life Safety Equipment

Familiarize yourself with the location of the life safety equipment in your area and consult your supervisor on specific instructions on how to use the equipment. Unobstructed access to emergency life safety equipment such as fire extinguishers, emergency eyewashes/showers, first aid kits, and utility controls such as breaker boxes or gas shut-off valves is required.

5.1 Emergency Eye Wash and Showers

Suitable units for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use where any person may be exposed to injurious corrosive chemicals. This information is identified within section 4 “first-aid measures” of the SDS.

If a 15 minute flush requirement, to the eye and/or skin, is identified for a substance that is located within a work area, an approved emergency eyewash and/or shower must be installed and maintained to the American National Standards Institute (ANSI) Emergency Eyewash and Shower Equipment Standard Z358.1-2014. These units shall not be substitutes for the use of appropriate PPE (appropriate eye protection and clothing).

PI’s, lab owners or designates are responsible for conducting weekly testing of the units, using the Weekly Plumbed Eyewash Station Inspection Form and reporting any issues to the appropriate maintencance unit as indicated on the inspection form.

5.2 Fire Extinguishers

Fire extinguishers must be compatible with the hazards in the area. Additional information is identified within section 5 “fire-figthing measures” of the SDS, Section 12: Fire Safety of this manual or by contacting EHS.

5.3 First Aid Kits

First aid kits are required in all Memorial laboratories, as described in the Occupational Health and Safety First Aid Regulations (OHSFAR).

The required contents of the first aid kit depends on the number of workers it is intended to service and the risk associated with the activities, and is described in the OHSFAR hyperlinked above.

- First aid supplies and services shall be located in convenient proximity to the working areas in a workplace to be served and shall be readily available during all working hours.
- Signs showing the location of the first aid supplies and services shall be posted in conspicuous places in the working areas in a workplace.

The employer shall ensure that there is posted in a conspicuous place in the vicinity of the first aid kit or the first aid room at a workplace a notice containing:

- the name of the particular person in charge of the first aid kit or first aid room;
- the name and qualifications of each person trained to administer first aid; and
- an emergency procedure and a telephone list or other instructions for reaching the nearest police, ambulance, fire station, hospital or physician.

First aid supplies and equipment shall be kept clean and dry.

5.4 Means of Communication

Each lab must be equipped with a telephone, or other acceptable means of two-way communication, as well as a listing of emergency phone numbers.

6 Workplace Hazardous Material Information System (WHMIS)

WHMIS stands for the Workplace Hazardous Materials Information System. It is a comprehensive system for providing health and safety information on hazardous products intended for use, handling, or storage in Canadian workplaces.

WHMIS has aligned with the worldwide hazard communication system known as GHS – the Globally Harmonized System of Classification and Labelling of Chemicals. Aligning with GHS provides many benefits, including:

- Hazard classification criteria are more comprehensive which improves ability to indicate severity of hazards.
- New hazard classes are included.
- Physical hazard criteria are consistent with the Transport of Dangerous Goods (TDG regulations).
- Standardized language (hazard and precautionary statements).
- Standardized SDS format and more comprehensive requirements.

WHMIS is governed by federal and provincial laws and regulations and any person supplying or using hazardous products must comply with its requirements. At MUN, WHMIS legislation applies to any one who works with or in close proximity to hazardous products. Refer to the NL Workplace Hazardous Materials Information System (WHMIS) Regulations for additional information.

Hazardous products are materials and substances that are regulated by WHMIS legislation, based on their hazardous properties and characteristics. WHMIS divides hazardous products into 20 physical and 12 health hazard classes.

The main objectives of WHMIS are hazard identification and product classification. WHMIS consists of three main components:

- Labelling
- Safety Data Sheets (SDS)
- Training

6.1 Regulatory Requirements

6.1.1 Labelling

Labels alert people to the dangers of the product and basic safety precautions. It is imperative that all containers in laboratories are clearly identified.

WHMIS legislation dictates what information is required on a workplace label. Any hazardous material, whether in transit, storage, or use, must be labelled. A label may be a mark, sign, stamp, device, sticker, ticket, tag, or wrapper and must be attached to, imprinted, stencilled, or embossed on the container of the hazardous product.

There are 2 types of labels prescribed under WHMIS regulation: supplier labels and workplace labels.

6.1.1.1 Supplier's Labels

Suppliers are responsible for labelling hazardous products. A supplier label must contain the following information:

- Product identifier (name of product)
- Initial supplier identifier – the name, address and telephone number of either the Canadian manufacturer or the Canadian importer
- Pictograms (hazard symbols)
- Signal word (danger or warning)
- Hazard statements
- Precautionary statements
- Supplemental label information

6.1.1.2 Workplace Labels

A workplace label must appear on all hazardous products when:

- hazardous products are produced, manufactured or prepared (e.g., stock solutions) at the workplace;
- hazardous product is transferred from the original container into another container; and
- original supplier label becomes illegible or damaged or when it is removed;

A workplace label must contain the following information:

- product name (maching the SDS product name)
- safe handling precautions, may include pictograms or other supplier label information.
- reference to the SDS, if available

The product name must include the full name of the product or solution, as it appears on the safety data sheet.

6.1.1.3 Laboratory Sample Labels

Laboratory labels are a subcategory of workplace labels. Most products used in a laboratory will have a supplier label and need no additional labelling. Lab labels are to be created for the same reasons as workplace labels and require the same information as workplace labels:

- Product identifier (product name matching that on the SDS)
- Information on the safe handling of the product
- A statement that the SDS is available

Laboratory samples are samples intended solely to be tested in a laboratory or used for educational or demonstration purposes.

The requirements for laboratory samples that are intended to be used in a laboratory solely by that person who prepared them include:

- The samples must be clearly identified;
- A description of sample's contents must be readily available (e.g. noted in a lab book); and
- Safety Data Sheets for the sample must be readily available.

If laboratory samples are used by multiple users, transported outside of a laboratory (e.g., sent elsewhere for analysis), including within the university then they must have a compliant workplace label affixed. Safety Data Sheets (SDS)

SDS provide more detail than labels. They are technical bulletins that provide chemical, physical, and toxicological information about each hazardous product, as well as information on precautionary and emergency procedures. They must be readily accessible to anyone who works with, or who may otherwise be exposed to, hazardous products.

6.1.2 Principal Investigators and/or Laboratory Supervisors Responsibilities

Principal Investigators (PI) and/or Lab Supervisors shall ensure that workers who work with or in close proximity to hazardous products are informed about all hazards associated with the products. Everyone has the right to review an SDS, whether it is related to their work, or simply because of personal interest.

The following applies to all Memorial laboratories, regardless of the number of hazardous products on-hand.

Each PI / lab supervisor is responsible for ensuring that their SDS database through Memorial's electronic chemical management system:

- Contains the SDS for all hazardous products in the laboratory;
- That the SDS are updated when new information becomes available; and
- That SDS are readily accessible to anyone who works with, or who may be exposed to the product.

6.1.3 SDS Storage Location

In order to simplify SDS management, the university has implemented a chemical management system that provides PIs and Laboratory Supervisors with electronic SDS management for hazardous products (see section 7.1 Chemical Inventory for more details). As per NL WHMIS legislation electronic SDS management is acceptable as long as all reasonable steps are taken to keep the terminal in active working order; SDS are readily available on the request of an employee; and training in accessing the computer-stored SDS is provided to employees working at a worksite where the SDS is available on a computer terminal, and members of the WHS committee or representative.

Where the above is not possible then paper copies of the SDS must be made available. SDS collections may be stored in several ways: a filing cabinet, binders, on a personal computer, or by any other means of storage, provided that all the employees are aware of the location, and are able to gain access to the data sheets at any time. EHS recommends hard copies be placed in alphabetical order in an easily accessible location.

6.1.4 SDS Audit

During laboratory health and safety inspections, EHS will audit the SDS collection. The EHS Advisor will randomly select five WHMIS-hazardous products found in the laboratory and then verify the SDS collection to ensure that it contains the SDS of the five selected products.

6.2 Laboratory Safety Training

Laboratory health and safety training can be divided into two parts: general (core) training and job-specific training.

Training is a major component of the WHMIS legislation and therefore is mandatory for all personnel working with hazardous products at the university, including PIs / lab supervisors, students and visiting researchers.

6.2.1 General (core) Training

Any person working with or in close proximity to hazardous products is required to complete WHMIS - SC 1808. Those who are actively working with hazardous products in the lab must also complete Safety in Science Labs SC 1807.

Both SC 1807 and SC 1808 are pre-requistes for undergraduate courses with a lab component involving hazardous products. These courses are available through Memorial's Self Service.

These courses are also available to faculty, staff, graduate students, etc. through EHS training page.

6.2.2 Job-Specific Training

Job-specific training is the process for identifying hazardous work conditions and providing instruction to employees on safe work procedures by their supervisor or department. The instruction must be hands-on and include a demonstration of the tasks and work processes required in addition to a review of written work procedures. A verbal description alone is not enough. Refer to the university's Health and Safety Management system (HSMS), Training and Competency element.

Job-specific training is the responsibility of Principal Investigators and Laboratory Supervisors. Job specific training must be identified in the LSP - LSMSF2.

6.2.3 Record of Training

Retention of training records must comply with HSMS, Documentation element.

Record of completion for online courses completed through Brightspace are available to be printed under the "Awards" section of the course.

7 Chemical Hazards

7.1 Chemical Inventory

The university has developed an electronic chemical management system which provides all laboratories housing hazardous products the capability to maintain an up to date chemical inventory and all required SDS. The software also assists with the compliance requirements of local, provincial and federal regulators and can provide vital information to emergency first responders to minimize the impact of chemical. All areas using chemicals must maintain a current chemical inventory and conduct an annual chemical inventory verification within the chemical management system.

Access to the chemical management system is through the my.mun.ca portal. Inventories must be updated as new chemicals are procured, used, transferred, or disposed of.

User manuals are located under the "Documentation" section of the chemical management system.

7.1.1 Chemical Compatibility

The storage scheme outlined in the below section - Chemical Segregation, may not suffice to prevent mixing of incompatible chemicals. Certain hazardous combinations can occur even between chemicals of the same classifications. For chemical compatibilities refer to the Recommended Storage Groups for Common Chemicals form.

7.1.2 Chemical Segregation

Read the label carefully before storing a chemical. More detailed storage information is usually provided by the SDS. Ensure that incompatible chemicals are not stored in close proximity to each other.

7.2 General Chemical Handling and Storage

- Handling and storage of chemicals shall conform to the manufacturer's recommendations, the SDS and any relevant information provided in this manual.
- Be aware of potential hazards (fire/explosion, health, chemical reactivity) associated with the chemicals you work with. This information can be found on the SDS.
- Store hazardous chemicals in an area that is accessible only to authorized laboratory workers.
- Keep up to date inventory records of all chemicals.

- Conduct periodic chemical inventory inspections; properly disposing of damaged and or deteriorated containers.
- Store chemicals based on compatibility and not in alphabetical order. Refer to forms Recommended Storage Groups for Common Chemicals form and to relevant sections of this manual. Once chemicals are segregated into approved storage groups then they can be arranged in alphabetical order, if desired.
- Incompatible materials shall be separated to prevent accidental contact.
- Designate specific storage areas for each class of chemical, and return reagents to those locations after each use.
- If a chemical presents more than one hazard, segregate according to the primary hazard.
- Wear the appropriate proper PPE for the hazards associated with the work being performed.
- Practice good housekeeping and equipment maintenance. Keep area clear of flammable materials.
- Keep containers closed when not in use.
- To the extent possible, minimize quantities of chemicals stored in the lab.
- Do not store chemicals in aisles, under sinks or on floors, desks or bench tops.
- Store chemicals away from sources of heat (e.g., ovens or steam pipes) and direct sunlight.
- Never stack bottles on top of each other.
- Do not store chemicals above eye level/shoulder height.
- Store larger containers on lower shelves.
- Store chemicals inside closable cabinets or on sturdy shelving that has 12.7 mm-19 mm (½ - ¾ inch) edge guards to prevent containers from falling.
- Ensure that chemicals cannot fall off the rear of shelves.
- Store liquids inside chemically-resistant secondary containment (such as trays or tubs) with the ability to hold the contents of the primary container if breakage occured.
- Store volatile toxic and odorous chemicals in a way that prevents release of vapours (e.g., inside closed secondary containers or, ventilated cabinets, or sealing with paraffin wax).
- Storage of chemicals in fumehoods is prohibited.
- Dispose of unwanted chemicals promptly through the Hazardous Waste Management Program.
- Use approved equipment, including labelled safety containers, for flammable and combustible liquids.

7.3 Flammable Liquid Handling and Storage

- Flammable chemicals should be stored inside National Fire Protection Association (NFPA) approved flammable storage cabinets. Keep cabinet doors closed and latched when not in use.
- Do not store incompatible materials (i.e. oxidizers) in flammable storage cabinets.
- Use the smallest amount of flammable liquid necessary in the work area. Only those flammables in use for the day should be outside the storage cabinet. Within the open laboratory a maximum of 50 liters of flammable liquid is allowed. Containers must be tightly capped when not in use.
- Class 1 flammable liquids having volumes greater than 4 liters shall be stored in approved safety containers having a capacity not greater than 25 liters.
- A container used to carry, transfer, or store a flammable liquid shall meet CSA Standards.
- Store flammables requiring refrigeration in an explosion-safe or lab-safe refrigerators.
- Unless necessary for your work, eliminate ignition sources (sparks, smoking, flames, hot surfaces, etc.) when working with flammable and combustible liquids.
- Store, handle, and use flammable and combustible liquids in well-ventilated areas.
- Flammable liquids shall not be stored in or adjacent to exits, elevators or principal routes that provide access to exits.
- Containers of flammable liquids, including those used for waste collection, shall be kept tightly capped. Place open reservoirs, or collection vessels for organic procedures, like HPLC, inside vented chambers.
- Waste material contaminated with a solvent, oil, grease, paint or other flammable substance shall be placed in a covered metal containers before disposal and shall not be stored in work areas.
- Clean up spills of flammable liquids promptly.

7.4 Dispensing of Class 1 Flammable Liquids

When dispensing a class 1 flammable liquid from a container having a capacity of 20 L or more, consideration must be given to the hazard of static electricity. Static charges are produced by the flow of liquid from one container to another. The risk is higher when handling liquids of high electrical resistance - mostly those liquids immiscible in water and having low flash points. During transfer, both an ignitable vapour/air mixture and static sparks can develop. Sparks can be prevented through implementation of the following measures:

- Dispensing should be done using a pump in a well-ventilated area, preferably in a chemical fumehood or in an area equipped with local exhaust ventilation.

- When dispensing through a gravity fed container, it must be equipped with a self-closing valve.
- Electrically ground and/or bond conductive containers.
  - Grounding – Provides a path for static charge to drain off to the earth. Grounding straps or wires must be connected to known grounds such as metal water pipes and/or grounded metal building framework.
  - Bonding - connects the metal containers using a flexible bonding conductor i.e. bonding strap or wire.
  - Only bond those containers that conduct electricity, such as those made from metal or special, conductive plastics.
  - If a container is made from a material that does not conduct electricity, such as polyethylene plastic or glass, bonding or grounding is not necessary.
  - Check bonding and grounding connections to ensure that they are in good condition.
  - Allow flammable liquids to flow slowly to minimize the generation of static electricity.
  - Do not splash-fill containers since the turbulance of the liquid can generate static charge.
  - Pour the liquid through a funnel having a long delivery stem immersed deeply in the receiving container to avoid splashing and turbulence.

7.5 Flammable Storage Cabinet Venting

Flammable liquid storage cabinets are designed to protect the internal contents from a fire outside the cabinet. The cabinet is not required to be vented for fire protection purposes:

- If not vented, the storage cabinet vent openings shall be sealed with the bungs supplied with the cabinet or with bungs specified by the manufacturer.
- If vented the storage cabinet vent openings shall be ducted directly to outdoors in such a manner that will not compromise the specific performance of the cabinet and in a manner that is outlined in the National Fire Code

Venting could compromise the ability of the cabinet to protect its contents from a fire.

7.6 Toxic Chemicals

When working in a laboratory environment it is quite common to use substances that, with exposure, will directly and adversely affect health, both long term and short term. Whenever possible, it is always best to avoid using a toxic material either by eliminating its use by changing the method or process required or by substituting the toxic material with a less hazardous one. Unfortunately, it is not always possible.

When working with toxic substances, it is extremely important to control occupational exposures by any means necessary. Reference the SDS for information on hazard identification, exposure limits and additional PPE required. Universal precautions must be used for all chemicals that will adversely and seriously affect the health of a person upon exposure.

SWP's are required when using any high hazard chemicals (e.g. reproductive toxins, sensitizers, NFPA Health 4, etc.). Please contact EHS if assistance is required.

7.6.1 Carcinogens, Mutagens, Teratogens and Reproductive Toxins

Carcinogens, mutagens, teratogens and reproductive toxins are regarded as especially hazardous toxins because they can cause very serious health problems (e.g. cancer, birth defects, sterility and genetic mutations) in workers and/or their children, and because there may be no early warning signs of the harmful, and possibly irreversible, effects that may occur long after exposure

Carcinogens are substances, mixtures or exposures that increase the occurrence of cancer by altering the genetic structure of the affected cells causing them to multiply erratically and continuously without need. While it is often difficult to prove a link between exposure to certain chemicals and subsequent cancer, there is evidence that a number of compounds are cancer causing and others are under strong suspicion.

Reference the toxicological information sections of the SDS to determine classification of known carcinogens. For list of carcinogens and reproductive toxins refer to Carcinogens Listing.

A ***reproductive toxin*** is a substance which affects the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses. They have the potential to cause adverse reproductive effects on female and male reproductive organs, tissues, or cells, causing sterility, reduced fertility, or other adverse reproductive effects. Examples of reproductive toxins that can cause reproductive effects on men and women of child bearing age are ethylene oxide, lead, and some glycol ethers (e.g.2-ethoxyethanol).

There are also types of reproductive toxins that will have a direct effect on a developing embryo or fetus, and may result in developmental abnormalities, tumor, and adverse effects on the new born; these chemicals are classified as teratogens and mutagens.

- Teratogens and embryotoxins can cause birth defects, abnormalities, developmental delays, or death in animal offspring in the absence of significant harmful effect on the mother. These materials are usually identified using test animals and may cause similar effects in humans;

Examples: carbon monoxide, lead and xylene

- Mutagens can cause changes (mutations) in the genetic material (DNA) of cells from people or test animals, which may result in disease or abnormalities in future generations.

7.6.2 Hydrofluoric Acid

WARNING: The use of hydrofluoric acid without the proper knowledge of risks and training is extremely hazardous. A task specific safe work procedure must be developed, communicated, and followed by any individual working with hydroflouric acid.

Hydrofluoric Acid, HF(aq) is an extremely toxic and corrosive liquid . Solutions of hydrofluoric acid are clear and colourless. The acid is also volatile and gives off vapour that has an irritating, pungent odour.

Hydrofluoric acid differs from other acids because the fluoride ion readily penetrates the skin, causing destruction of deep tissue layers. Exposure to hydrofluoric acid may not be initially painful, and symptoms may not occur until several hours later, when the acid begins to react with calcium in the bones. Under most circumstances without treatment, hydrofluoric acid exposure results in severe or even lethal damage to the heart, liver, kidneys, and nerves. In all cases, hydrofluoric acid exposure requires immediate first aid with professional medical attention.

Hydrofluoric acid is known to react with glass and must never be placed within a glass container or be left open in a chemical fume hood as it will damage the sash.

Prevention of exposure or injury must be the primary goal when working with hydrofluoric acid. Nonetheless, any user must have in close proximity the calcium gluconate antidote and be familiar with its use and the appropriate first aid in case of an HF exposure.

7.6.3 Formaldehyde

A gas at room temperature and pressure, formaldehyde, H2CO(g), is colorless and has a characteristic pungent, irritating odor. It is most commonly used in an aqueous solution known as formalin, and is often spiked with methanol, which acts as a stabilizer. Formalin is commonly used in tissue fixing and preservation, disinfection and as an organic chemical reagent.

IARC has classified formaldehyde as a human carcinogen since June 2004. Even at low concentrations, short-term exposure will cause severe irritation to the eyes, skin and respiratory tract. In case of occupational exposure which might occur over a period of time (years), formaldehyde has been strongly linked to cancer of the nasopharynx.

Given its volatility and toxicity it is recommended that the use of concentrated formaldehyde be eliminated, if possible. This can be achieved by ordering formalin in the required concentration thereby eliminating unnecessary occupational exposure to highly concentrated sofutions. Regardless of concentration, formaldehyde and formalin should only be used in a fume hood or under local exhaust ventilation that provides worker protection. Appropriate PPE must be used at all times.

7.6.4 Mercury

Mercury is a very toxic heavy metal that is a silvery-white in appearance and is a liquid at room temperature. Mercury is an extreme hazard based it on its low vapour pressure at room temperature. Mercury vapor is odourless and colourless. Common routes of exposure for mercury include inhalation of vapours and absorption through the skin. Depending on the dose and number of exposures, symptoms may appear relatively quickly (acute disease) or take a number of years for symptoms to appear (chronic disease).

Mercury and its compounds exist in three general forms:

Elemental (or metallic) mercury

Is a very volatile substance and can be inhaled and/or absorbed through the skin. The use and storage of elemental mercury is not recommended if it is not required for a specific process or procedure, or for use in equipment. If storage and use is deemed necessary the lab must be equipped with a mercury spill kit. Refer to the Chemical Spill Response procedure.

Inorganic Mercury

Mercury when combined with other elements, mainly chlorine, sulfur, and oxygen will form inorganic mercury compounds. Most of these are toxic and corrosive. They accumulate mainly in the kidney causing renal damage.

Organic Mercury

Mercury when combined with carbon or carbon-containing substances can form organic mercury compounds. These organic compounds are further divided between alkyl (carbon-chain; highly toxic) and aryl (aromatic ring; moderately toxic) groups. Dimethyl mercury, is an example of an extremely toxic alkyl mercury containing compound. It has a flash point of -4°C, making it a severe fire hazard and will also rapidly penetrate the skin resulting in severe exposure from small quantities, which can be fatal.

7.6.5 Cyanide

Chemical compounds containing the cyanide ion (cyanides) are poisonous whether compound is a solid, liquid, or in solution. In addition, nearly all will release a poisonous gas, hydrogen cyanide, when they are exposed to, or mixed with, solid, liquid or gaseous acid; any form of moisture may cause decomposition and slow release of poisonous hydrogen cyanide gas. Cyanides have poor warning properties, a faint almond-like odour, and are acutely toxic to humans. Toxicity can occur so quickly that first aid is often ineffective.

Cyanide is acutely toxic to humans and can enter the body through inhalation, ingestion, or absorption through the skin and eyes. Cyanides in solution are also corrosive chemicals and, with exposure, will cause damage to tissues and membranes.

7.6.6 Hydrogen Sulfide

Hydrogen sulfide (H2S(g)) is a colourless gas which at lower concentrations has a pungent rotten-egg odour. The most common route of exposure for this gas is by inhalation. It is slightly heavier than air and is therefore especially dangerous in low-lying areas and confined or enclosed workspaces. At high temperatures (260 oC, 500 oF) hydrogen sulfide reacts explosively.

Hydrogen sulfide can be detected by smell at very low concentrations ranging from 0.01 – 0.3 parts per million. Detection by odour is not reliable because at high concentrations (e.g. 100 ppm), hydrogen sulfide deadens a person's sense of smell thus make it non-detectable.

Hydrogen sulfide can be produced anywhere where elemental sulfur comes in contact with organic materials, especially at high temperatures. Special caution should be taken when working with crude petroleum products as they may contain sulphur which has the potential, under certain conditions to form hydrogen sulfide gas.

7.6.7 Reactive and Time Sensitive Chemicals

Reactive chemicals are substances that can react violently and cause the spontaneous liberation of heat and/or gases that is too rapid to be safely dissipated by the surroundings. Thus, the reaction becomes out of control and either the reaction vessel bursts, an explosion occurs, toxic vapours are uncontrollably liberated, flammable gas is evolved or spontaneous ignition occurs.

Reactive Chemicals may be grouped into five broad categories:

- Explosives (generally shock sensitive and/or heat sensitive materials)
- Water Reactives
- Air Reactives
- Oxidizers and Reducers
- Peroxide Forming Chemicals

Time sensitive chemicals during prolonged storage can developin them hazardous substances that were not present in the original chemical. This can occur due to exposure to elements such as air, heat and/or light. Essentially, the chemical degrades to form hazardous products that are toxic or reactive. Some examples of time sensitive chemials are chloroform, ethers, perchloric acid.

Time sensitive chemicals that develop hazardous substances i.e. crystals can not be disposed of through regular chemical waste streams. PI is responsible for ensuring the proper protcols are implemented and chemicals are disposed of before they become shock sensitive.

7.6.7.1 Explosive Chemicals

Many chemicals are susceptible to rapid decomposition or explosion when subjected to forces such as being struck, vibrated, agitated or heated. Some sunstances become increasingly shock sensitive with age i.e. picric acid becomes shock sensitive and explosive if it dries out.

- Avoid acquiring chemicals that are explosive.
- Refer to the chemical's label and the SDS to determine if a chemical is explosive.
- Wear appropriate PPE and perform experiments inside a fume hood and/or behind a blast shield. If the use of a blast shield is not feasible, use a face shield.
- When working with explosive chemicals in a fume hood, remove any unnecessary chemicals and equipment from the hood. Also, post a sign on the fume hood as notification that there is an experiment in progress utilizing or producing explosive chemicals. These precautions should be used for the entire duration of the experiment including set up, work up, and clean up.
- Do not work alone while using explosive chemicals.
- Write the dates received and opened on all containers of explosive or shock-sensitive chemicals
- Inspect all such containers every month
- Keep picric acid solutions wet i.e., 30% or more water
- Discard opened containers after six months, and closed containers after one year, unless the material contains stabilizers.
- Work with small quantities.
- Explosive chemicals require special disposal procedures

The following are atomic groupings that are associated with the possibility of explosion:

Acetylide, amine oxide, azide, chlorate, diazo, diazonium, fulminate, N-haloamine, hypohalite, hydroperoxide, nitrate, nitrite, nitroso, nitro, ozonide, perchlorate, peroxide and picrate.

7.6.7.2 Water Reactives

Water reactive substances will have dangerous reactions when they come in contact with water. The reaction may release a gas that is either flammable or presents a toxic health hazard. In addition, the heat generated when water contacts such materials is often enough for the item to spontaneously combust or explode.

Examples: alkali metals (sodium, potassium, etc.), organometallic compounds, halides, hydrides, peroxides, carbides, oxides, phosphides, anhydrides, etc…

- Do not store these substances under a sink. Store in a cool, waterproof area
- Isolate water reactive chemicals from other reactive materials

- Clearly label the area where water reactives are stored
- Ensure work area is equipped with a class “D” fire extinguisher

7.6.7.3 Air Reactives

Examples: metallic dusts (eg. nickel, titanium, zinc), alkali metals (potassium), hydrides, etc.

- Metallic dusts, such as nickel and titanium, should normally be stored in containers with some moisture. Other air reactive solids should be stored under an inert gas or liquid.
- Isolate these substances from oxidizing agents.
- Clearly label the area where air reactives are stored.
- Minimize exposure of these substances to air.
- When working with air reactives, always have on hand a class "D" fire extinguisher.
- Dispose of air reactive substances as per general disposal guidelines for reactive chemical waste (refer to Laboratory Safety website).

7.6.7.4 Oxidizers and Reducers

Oxidizing materials are liquids or solids that readily give off oxygen or other oxidizing substances (such as bromine, chlorine, or fluorine). They also include materials that react chemically to oxidize combustible (burnable) materials; this means that oxygen combines chemically with the other material in a way that increases the chance of a fire or explosion. This reaction may be spontaneous at either room temperature or may occur under slight heating. Oxidizing liquids and solids can be severe fire and explosion hazards.

- DO NOT store oxidizers and reducers together. Use separate storage cabinets or shelves.
- Isolate oxidizers and reducers from other potentially reactive materials. Especially, do not store oxidizers with flammable liquids.
- Many oxidizers and reducers are also explosive, water reactive or air reactive – take the appropriate precautions.
- Minimize the possibility of large quantities of oxidizers and reducers coming in contact with one another.
- DO not put oxidizers and reducers in the same waste container.

7.6.7.5 Perchloric Acid

Perchloric acid ($HClO4(aq)$) is a strong mineral acid that is a colourless, odorless; oily liquid and is very hygroscopic (readily absorbs water from the air). This acid, when stored and used at concentrations of 70% or less, is fairly stable and safe. When heated to temperatures above 150°

C, perchloric acid becomes a strong oxidizer and unstable. At concentrations of more than 70% this acid is referred to as anhydrous perchloric acid and is a powerful oxidizing agent. It is unstable and dangerously reactive, capable of decomposing explosively while standing or when subjected to shock or even when simply left standing.

7.6.7.6 Specific Requirements for Managing Time Sensitive Chemicals

- Buy ethers and other peroxidizable compounds in the smallest size available to limit amounts exposed to air.
- Whenever possible, use chemicals with added inhibitors.
- Store in an air tight amber glass bottle or metal container, in a dark location and under inert atmosphere, if possible.
- Identify all chemicals present that are classified as Time Sensitive.
    - Store in an air tight amber glass bottle or metal container, in a dark location, and under inert atmosphere, if possible.
    - Label these chemicals with date of receipt and the date opened.
    - Define each chemicals inspection frequency, approved inspection methodologies to determine the relative hazard of the time-sensitive material, .pass/fail criteria for inspection results.
        - Chemicals that pass inspection shall be permitted to be re-dated and retained for an additional defined inspection period.
  - Always checka a shock sensitive chemical for peroxide formation prior to distillation
  - If evaporation or distillation is necessary, do not distil to a dry residue. Always leave at least 10-20% residual bottoms.
  - Crystallization, discoloration, and stratification are indicative of shock sensitivity.
  - If a container shows signs of deterioration (i.e. crystal formation around the cap or deteriorating metal), do not or attempt to move the container or remove the cap.
  - Never handle chemicals beyond their expiry dates.

7.6.7.7 Chloroform

- Chloroform, CHCl3(l), is an example of a time sensitive chemicals that with exposure to air and light will degrade to form a toxic gas called phosgene, which is a colorless gas with a suffocating odor like musty hay.
    - Brief exposures (1 to 2 minutes) to 3 ppm phosgene can cause severe lung injury, and higher concentrations can cause death from pulmonary edema.

- o Initial symptoms of exposure include throat irritation, coughing, chest pain, nausea and difficulty breathing.
- Chloroform should not be purchased or stored without chemical stabilizers. Common stabilizers and their storage requirements include:
    - o Ethanol – Chloroform fixed with ethanol must not be kept past the manufacturer's expiry as the stabilizers are not guaranteed to be effective.
    - o Alkenes (i.e. amylene or pentene) – Chloroform fixed with alkenes must not be stored past one year.
- Chloroform should not be stored past the manufacturers' expiration date, if applicable.

7.6.7.8 Peroxide Forming Chemicals

Peroxide forming chemicals are the most commonly occurring and abundant time sensitive chemical that must be monitored. These chemicals can form peroxides when exposed to air over a period of time. Peroxides can be treacherously and violently explosive in concentrated solution or as solids. These are recommended maximum storage times depending on the group of peroxide forming chemicals. Storage times may be extended if specific storage and monitoring programs have been developed.

Table 1 Common examples of compounds prone to peroxide formation and suggested storage times and testing frequencies. This list is not all-inclusive:

Note: maximum storage time requirements if containers are unopened from the manufacturer is either up to 18 months or the stamped expiration date, whichever comes first.		
Peroxide Formation Grouping	Examples of Chemicals	Recommended Safe Storage Limits once Opened
Group A: Chemicals that form explosive levels of peroxides without concentration. Severe peroxide hazard after prolonged storage, especially after exposure to air.	*Butadiene, *Chloroprene Isopropyl Ether, Divinyl acetylene, Divinyl ether, Potassium Metal, Potassium Amide, Sodium Amide, Tetrafluoroethylene, Vinyldiene chloride (dichloroethylene)	Test for peroxide formation before using Discard 3 months after opening

Group B: Chemicals that form peroxides hazards on concentration.	Acetal, 2-Hexanol, Acetaldehyde, Methylacetylene, Benzyl alcohol, 3-Methyl-1-butanol, 2-Butanol, Methylcyclopentane, Cumene, Methyl isobutyl ketone, Cyclohexanol, 4-Methyl-2-pentanol, 2-Cyclohexen-1-ol 2-Pentanol, Cyclohexene 4-Penten-1-ol, Decahydronaphthalene, 1-Phenylethanol, Diacetylene, 2-Phenylethanol, Dicyclopentadiene 2-Propanol, Diethyl ether , Tetrahydrofuran (THF), Diethylene glycol, dimenthyl ether (diglyme), Tetrahydronaphthalene, Vinyl ethers, Dioxanes, Ethylene glycol, dimethyl ether (glyme), 4-Heptanol, Other secondary alcohols	Test for peroxide formation before distillation or evaporation. Discard 12 months after opening
Group C Chemicals which are hazardous due to peroxide initiation of autopolymerisation. (the peroxide forming potential increases for liquids)*	Acrylic acid, Acrylonitrile, *Butadiene, Chlorobutadiene, *Chloroprene, *Chlorofluoroehtylene, *Methyl methacrylate , *Styrene, *Tetrafluoroethylene, *Vinyldiene chloride, *Vinyl Acetate, *Vinyl acetylene, *Vinyl Chloride, *Vinyl pyridine,* Vinyladiene chloride	Test for peroxide formation upon using Discard 6 months after opening

*These monomers must be stored with suitable polymerization inhibitors. If uninhibited, discard after 24 hours.

7.7 Hazards of Compressed Gases

Compressed gases are hazardous due to the high pressure inside cylinders. Knocking over an unsecured, uncapped cylinder of compressed gas can break the cylinder valve; the resulting rapid escape of high pressure gas can turn a cylinder into an uncontrolled rocket or pinwheel, causing serious injury and damage. Poorly controlled release of compressed gas in the laboratory can burst reaction vessels, cause leaks in equipment and hoses or result in runaway chemical reactions. Compressed gases may also have flammable, oxidizing, dangerously reactive, corrosive or toxic properties. Inert gases such as nitrogen, argon, helium and neon can displace air, reducing oxygen levels in poorly ventilated areas and causing asphyxiation.

Compressed gas cylinders must be stored, transported and used only in accordance with the manufacturer's instructions, applicable CSA and NFPA standards and applicable legislation.

7.7.1 General Safe Handling, Storage and Transport of Compressed Gas Cylinders

- Read labels and safety data sheets (SDS) prior to using compressed gases. Never use an unlabeled cylinder and report missing and or damaged labels to your supervisor.
- Every individual gas cylinder, full or empty, must be stored in an upright position and securely fastened to a wall, bench or fixed support.
    - Straps used for securing cylinders should be insulated or of a non-conductive material. Cylinder stands are an alternative to straps
    - Strap must be positioned above 2/3 the height of the cylinder to prevent tipping.
- Use the smallest size cylinder that is available and practicable.
- Do not store empty or extra cylinders in the lab.
- Keep the number of cylinders in a laboratory to a minimum to reduce fire and toxicity hazards.
- All hazardous gas cylinders must be clearly labeled with:
    - Name of Gas
    - Name of Supplier
    - Date of Purchase
    - Date Last Hydrostatic Testing was completed by supplier (minimum every 5 years)
- Each point of supply and each point of use of cylinders or piping systems for compressed gases shall be provided with labels identifying the gas supplied.
- Verify that the regulator is appropriate for the gas being used and the pressure being delivered. Do not rely upon the pressure gauge to indicate the maximum pressure ratings; check the regulator's specifications.
- Do not use adaptors or Teflon tape to attach regulators to gas cylinders.
- Discontinue using a high-pressure cylinder when the pressure approaches 30 psi, clearly label the container “EMPTY”, and move to disposal location.
- Do not expose cylinders to temperature extremes (52 oC).

- Store incompatible classes of gases separately.
- When cylinders are not in use or are being transported, remove the regulator and attach the protective cap.
- An appropriate cylinder cart should be used for transporting cylinders. Chain or strap the cylinder to the cart.
- Do not drag, roll, or slide a cylinder, never attempt to lift a cylinder

7.7.2 Flammable Gases

- Eliminate ignition sources (sparks, smoking, flames, hot surfaces) when working with flammable gases.
- Flammable gases must always use a flash arrestor in the regulator outlet.
- Bond and ground all cylinders, lines and equipment used with flammable compressed gases.
- Flammables and oxidizing gases must never be interchanged on the same equipment
- Propane cylinders greater than 1 lb when not in use shall not be stored indoors.

7.7.3 Oxidizing Gases

- Never allow oil, greases and other readily combustible substances to come in contact with oxygen cylinders, valves, regulators, and fittings.
- Do not lubricate the high-pressure side of an oxygen regulator.
- Flammables and oxidizing gases must never be interchanged on the same equipment.

7.7.4 Corrosive, Toxic and Reactive Gases

Toxic, corrosive or reactive gases present an extreme health and safety hazard within laboratories and precautions must be taken in order to reduce the risk of exposure to laboratory occupants. Reducing the risk relies on minimizing the quantity of gas and enclosing or isolating the source, distribution system and apparatus in which the gas is used (i.e., using passive hazard controls that require no power or human intervention to work after being installed). Active hazard controls rely on the presence of power or human intervention to be effective. Ventilation and other active hazard control measures are secondary controls after minimization and enclosure. Due to the serious nature of these gases, hazard controls must be redundant if a single point failure could result in a significant accident or exposure above the occupational exposure limits (OELs).

Possible passive controls include:

- Substitution with non-gaseous compounds [e.g., liquid tetra ethyl-o-silicate (TEOS) can be used as a substitute for silane in some applications].
- Dilution in a compatible non-toxic, non-corrosive or non-reactive gas in the cylinder mixed by the vendor (i.e., reduced gas concentration).
- On-site gas generation (e.g., reacting acid and cyanide salt to generate hydrogen cyanide).
- Quantity limits that can be stored at a given location and used within a reasonable time (i.e., reduced gas amount)
- Restrictive flow orifices (RFOs) installed by the gas vendor before the cylinder is shipped. An RFO is a small round opening of known diameter provided by the vendor of a compressed gas cylinder that limits the maximum attainable flow rate from the cylinder (i.e., limited available gas)
- Use of all-welded gas delivery lines (i.e., reduced likelihood of gas leaks).

Some examples of active controls are:

- Leak testing using an inert gas
- Ventilation with airflow monitor/alarm having regular testing and calibration
- Operating at pressures below atmospheric with pressure sensors having regular testing and calibration
- Gas monitors with regular testing and calibration
- Process shut-off devices (e.g. solenoid valve interfaced with an airflow monitor/alarm, gas monitor and/or pressure sensors)

7.7.5 Corrosive Gases

Corrosive gases are hazardous to all parts of the body; certain organs (e.g. the eyes and the respiratory tract) are particularly sensitive. The magnitude of the effect is related to the solubility of the material in the body fluids. Highly soluble gases (e.g. ammonia, hydrogen chloride) cause severe nose and throat irritation, while substances of lower solubility (e.g. nitrogen dioxide, phosgene, sulfur dioxide) can penetrate deep into the lungs.

When corrosive gases are being used ensure that:

- The cylinder valve stem is periodically opened and closed to prevent “freezing.”
- Regulators and valves are closed when the cylinder is not in use and flushed with dry air or nitrogen after use. Such control devices should not be left on a cylinder, except when it is in frequent use.
- When they are discharged into a liquid, a trap, check valve, or vacuum break device should always be employed to prevent dangerous reverse flow.

Proper PPE must be worn at all times to prevent eye and skin contact. A second person shall be present when working with these materials.

7.7.6 Poisonous/Toxic Gases

- Compressed gases with an NFPA health hazard rating of 2 when there are no physiological warning properties to toxicity, or a health hazard rating of 3 or 4 are classified as toxic gases and can be immediately dangerous to life and health (IDLH). The following storage and handling requirements must be met when there is toxic gases being used in a lab:
  - Lecture sized bottles must be stored in a fume hood at all times.
  - Cylinders greater then lecture bottle size must be stored in an approved continuous mechanically ventilated gas cabinet.
  - EHS shall be consulted before any poisonous or toxic gas is brought into a laboratory to assess any special storage and handling requirements including the need for a detection system
    - A detection system may be required when using toxic gases with poor warning properties (i.e carbon monoxide). The alarm level must be set at or lower than the permissible exposure limit of the substance.
- Never work alone with poisonous/toxic gases.

7.7.7 Pyrophoric Gases

Gases which, under normal conditions, spontaneously ignite in air at or below 54 oC i.e. silane. Pyrophoric gases must be handled in a way that prevents contact with air.

- Pyrophoric gas cylinder must be stored as follows:
  - Lecture size bottles must be stored in a fume hood at all times
  - Cylinders greater then lecture bottle size must be stored in an approved continuously mechanically ventilated gas cabinet complete with sprinklers.

7.7.8 Cryogenic Fluids

Cryogenics are very low temperature materials such as dry ice (solid CO_2) and liquefied air or gases like nitrogen, oxygen, helium, argon and neon. The following hazards are associated with the use of cryogenics:

- Asphyxiation due to displacement of oxygen (does not apply to liquid air and oxygen).
- Embrittlement of materials from extreme cold.
- Frostbite.

- Explosion due to pressure build up.
- Condensation of oxygen and fuel (e.g. hydrogen and hydrocarbons) resulting in explosive mixtures.

Cryogenic vapours are undetectable to the human sensory system; never enter a suspected oxygen-deficient area without an external source of breathing air or a monitor for the atmosphere to ensure that oxygen levels are safe.

7.7.8.1 Cryogenic Handling Precautions

The following are precautions for handling cryogenics:

- Control ice build up
- Use only low-pressure containers equipped with pressure-relief devices.
- Protect skin and eyes from contact; wear eye protection and insulated gloves.
- Use and store in well-ventilated areas.
- Keep away from sparks or flames.
- Use materials resistant to embrittlement (e.g. latex rubber tubing).
- Watches, rings, bracelets or other jewellery that could trap fluids against flesh should not be worn when handling cryogenic liquids.
- To prevent thermal expansion of contents and rupture of the vessel, do not fill containers to more than 80% of capacity.
- If cryogens must be transported by elevator, take adequate precautions to prevent possible injury. Send cryogenic liquid tanks in elevators without any passengers and ensure that nobody gets on the elevator while the cryogen is being transported.

8 Laboratory Ventilation

There are two kinds of ventilation that are used in labs to control chemical exposures

- general ventilation, and
- local exhaust ventilation.

8.1 General Ventilation

General ventilation, also called dilution ventilation, involves the dilution of contaminated air with uncontaminated air taken from other parts of the building and outside. Dilution ventilation controls pollutants generated at a worksite by ventilating the entire workplace. The use of general ventilation distributes pollutants, to some degree, throughout the entire worksite and could therefore affect persons who are far from the source of contamination. General ventilation is used to:

- Maintain comfortable temperature, humidity and air movement for room occupants.
- Dilute indoor air contaminants.
- Replace air as it is exhausted to the outside via local ventilation devices such as fume hoods.
- Provide a controlled environment for specialized areas such as surgery or computer rooms.

Mechanically driven general ventilation systems are comprised of an air supply and an air exhaust. Dilution ventilation can be made more effective if the exhaust fan is located close to exposed workers and the makeup air is located behind the worker so that contaminated air is drawn away from the worker's breathing zone. The air may be supplied via a central Heating, Ventilation and Air Conditioning (HVAC) system or, especially in older buildings, via open windows. Laboratory air may be exhausted through either local exhaust devices or air returns connected to the HVAC system.

When used to control chemical pollutants, dilution must be limited to only situations where:

- the amounts of pollutants generated are not very high,
- their toxicity is relatively moderate, and
- workers do not carry out their tasks in the immediate vicinity of the source of contamination.

8.2 Local Exhaust Ventilation

In contrast to dilution ventilation, local exhaust ventilation (LEV) systems are designed to capture air contaminants at or near the source and remove them from the workers breathing zone. Local exhaust is generally a far more effective way of controlling highly toxic contaminants before they reach the workers' breathing zones. This type of system is usually the preferred control method if:

- Air contaminants pose serious health risk.
- Large amounts of dusts or fumes are generated.
- Increased heating costs from ventilation in cold weather are a concern.
- Emission sources are few in number.
- Emission sources are near the workers' breathing zones.

Some LEV systems discharge the contaminated air directly outside the building while other systems recirculate the air back into the room in which it’s located. It’s important that workers understand which type of laboratory hood they are working in and the appropriate use of that hood and its limitations.

All local ventilation systems must be certified at the time of installation, annually and if they are relocated or altered in any way.

Examples of local exhaust ventilation devices found in laboratories at the university include:

- Chemical fume hoods
- Canopy hoods
- Biological Safety Cabinets
- Clean benches
- Glove boxes
- Toxic gas cabinets
- Downdraft hoods
- Elephant trunks
- Portable (or ductless) fume hoods

8.2.1 Chemical Fume Hoods

One of the primary safety devices in a laboratory is a chemical fume hood. A well-designed hood, when properly installed and maintained, can offer a substantial degree of protection to the user, provided that it is used appropriately and its limitations are understood.

Chemical fume hoods are enclosed units from which gases, vapours and fumes are removed and discharged directly to the outside atmosphere. A fume hood is used to control the exposure of workers and lab occupants to hazardous chemicals and to prevent their release into the laboratory air. They also help limit the effects of a chemical spill by partially enclosing the work area and by creating a negatively pressurized space as compared to the laboratory air which minimizes the movement of material out of the hood and into the lab. These units have a sliding sash for opening or closing the hood. They are able to capture and exhaust even heavy vapours, and are preferred for all laboratory procedures that require manual handling of hazardous chemical material.

When using any type of local ventilation device, minimize air turbulence both outside the cabinet (eg. pedestrian movement nearby) and inside (eg. use of flames). Chemical Fume hoods do not offer protection to product or environment, as there is no filtration of intake or exhaust air.

Material applications for chemical fume hoods include:

- Chemicals
- Some radioisotopes

Materials NOT to be used in chemical fume hoods include:

- Known or expected infectious agents (biohazards)
- Perchloric Acid, HClO4

8.2.1.1 Safe Use of Chemical Fume Hoods

Fume hoods when properly used and maintained will render substantial protection, provided the user is aware of its capabilities and limitations. The performance standard for fume hoods is the delivery of a minimum face velocity of 90-110 linear feet per minute at a sash height of 18 inches. To ensure your fume hood provides the highest degree of protection observe the following guidelines:

- Only materials being used in an ongoing experiment should be kept in the fume hood. Cluttering the hood will create air flow disturbances.
- When it is necessary to keep a large apparatus inside a hood, it should be placed upon blocks or legs to allow air to flow underneath.
- Operate the hood with the sash as low as practical. Reducing the open face will increase the face velocity.
- Work as far into the hood as possible. At least six inches is recommended.
- Do not lean into the hood. This disturbs the air flow, and also places your head into the contaminated air inside the hood.
- Do not make quick motions into or out of the hood, or create cross drafts by walking rapidly past the hood; this can sometimes cause strong air currents which will disturb the air flow into the hood.
- When working within the fume hood the laboratory doors and windows should remain closed, as room ventilation including the parameters for local exhaust functions optimally when airflow is not disrupted.
- Heating devices should be placed at the rear of the hood.
- Do not use a hood for any function it was not specifically designed, such as perchloric acid, some radioisotopes, etc.
- Keep hood door closed when not attended.
- All local ventilation systems must be certified at the time of installation, annually and if they are relocated.

8.2.2 Canopy Hoods

Canopy hoods are designed to capture heat from processes or equipment, such as atomic absorption spectrophotometers or autoclaves and are must only to be used for the exhaust of non-hazardous substances. A canopy or bonnet is suspended over a process and connected to an exhaust vent. The following limitations make canopy hoods poor substitutes for chemical fume hoods, because they:

- draw contaminated air through the user's breathing zone,
- do not capture heavy vapours,
- provide less containment than chemical fume hoods, and are more affected by air turbulence, and
- do not provide adequate suction more than a few inches away from the hood opening.

Prior to purchasing/installing a canopy hood, approval must be given by EHS.

8.2.3 Biological Safety Cabinets

Biological safety cabinets are for use with biological material; depending on the cabinet class, they provide protection of the environment, user and/or product. They are not recommended for use with hazardous chemicals because most models recirculate air into the laboratory, and because the high efficiency particulate air (HEPA) filter that is integral to the protective function can be damaged by some chemicals.

- Do not block the front intake or rear exhaust grill.
- Keep equipment at least 10 cm inside the cabinet window.
- Perform transfers of viable materials as deeply into the cabinet as possible.
- Disinfect interior surfaces of work area regularly with an appropriate disinfectant and disinfect equipment before removal.
- After activating cabinet's fan, wait 2-3 minutes before beginning work to allow sufficient time to purge airborne contaminants. Allow it to run an additional 2-3 minutes after completion of work.
- Do not work in cabinet when germicidal lamp is on.

8.2.4 Laminar Flow and Clean Benches

Laminar Flow Hoods (LFH) or Clean Benches employ the use of HEPA filters to remove potentially harmful particulates from intake airflow before it is passed over the work area (product) towards the user. This horizontal laminar airflow is an example of positive pressure or pressure in a space causing an outflow of air. Clean Benches can also use vertical laminar airflow downward to provide marginal personal protection. However, clean benches DO NOT offer adequate protection from infectious agents or hazardous chemical vapors. These units:

- Provide product protection only.
- Product protection is provided by HEPA filtered, unidirectional airflow.

- Discharged air is exhausted directly at operator and into work area.

Material Applications for LFH:

- Any application where the product is not hazardous but must be kept contaminant free.
- Preparation of non-hazardous intravenous mixtures and media.
- Particulate free assembly of sterile equipment and electronic devices.

Materials NOT to be used within LFH:

- Any product that presents a biological or chemical hazard.
- If you have questions regarding the hazard level of your product or other materials you will be using in the clean bench, contact EHS (Industrial Hygienist) at (3659) for assistance.

8.2.5 Glove Box

There are two general types of glove boxes, one operating under negative pressure, the other operating under positive pressure. Glove boxes consist of a small chamber with sealed openings fitted with arm-length gloves. The materials are placed inside the chamber and manipulated using the gloves.

- A glove box operating under negative pressure is used for highly toxic gases, when a fume hood might not offer adequate protection. A rule of thumb is that a fume hood will offer protection for up to 10,000 times the immediately hazardous concentration of a chemical. The airflow through the box is relatively low, and the exhaust usually must be filtered or scrubbed before release into the exhaust system.
- A glove box operating under positive pressure may be used for experiments that require protection from moisture or oxygen. If this type of glove box is to be used with hazardous chemicals, the glove box must be tested for leaks before each use. A pressure gauge should be installed to be able to check the integrity of the system.

8.2.6 Toxic Gas Cabinets

Highly toxic or odorous gases should be used and stored in gas cabinets. In the event of a leak or rupture, a gas cabinet will prevent the gas from contaminating the laboratory. Gas cabinets should be connected to laboratory exhaust ventilation using hard duct, rather than elephant tubing, since such tubing is more likely to develop leaks.

8.2.7 Down Draft Hoods

Downdraft hoods or necropsy tables are specially designed work areas with ventilation slots on the sides of the work area. This type of system is useful for animal perfusions and other uses of chemicals with vapor densities heavier than air.

8.2.8 Elephant Trunks

An elephant trunk is a flexible duct or hose connected to an exhaust system. It can only capture contaminants that are very close to the inlet of the hose, typically less than a distance equal to one half of the diameter of the duct.

Elephant trunks can be effective for capturing discharges from gas chromatographs, pipe nipples or the end of tubing. However, the effectiveness of the elephant trunk should be carefully evaluated before they are used to control releases of hazardous substances.

8.2.9 Portable Fume Hoods

Portable, non-ducted fume hoods are not permitted at Memorial except for limited uses as approved by EHS.

Non-ducted fume hoods utilize filters which may become overwhelmed in the event of a spill. Also, the filters are typically not changed out as needed. Breakthrough can also occur as the contaminant is dislodged with the sudden change in air flow velocity associated with turning the blower on and off. In addition, an adequate level of protection cannot be assured for different classes of chemicals.

Applications where ductless chemical fume hoods might be appropriate include the control of particulate and nuisance odors. Ductless hoods should not be used to protect laboratory workers from toxicologically significant concentrations of hazardous chemicals. Where ductless hoods are installed their use must be monitored to ensure that flow rates and capture effectiveness do not change over time and include procedures using hazardous chemicals as outlined above. The scope of work as well as preventative maintenance schedule shall be approved by EHS prior to use.

9 Waste Management

9.1 Hazard Waste Management

The university manages the disposal of hazardous wastes through EHS. Adherence to the hazardous waste disposal procedures are mandatory. It is a serious offence to pour hazardous substances into the drainage system.

9.1.1 Waste Minimization

In order to minimize the amount of hazardous waste presented for disposal, it is important to follow these guidelines:

- Avoid overstocking: one of the main sources of laboratory waste is surplus stock - the result of over buying. Recent pricing arrangements with suppliers have greatly reduced the benefits of purchasing chemicals in large volumes. Also, there is little need to store large quantities of chemicals, as orders are generally shipped the day after an order is received.
- Do not accept donations of materials that you don't plan to use. Many companies have traditionally unloaded unwanted reagents by donating them to laboratories, which eventually transfers the cost of disposal to the University.
- Substitute hazardous experimental materials for non-hazardous ones. For example, use aqueous-based, biodegradable scintillation fluids whenever possible.

9.1.2 Hazardous Waste Disposal Procedures

University campuses generating hazardous products, radioactive, biological or sharp wastes shall comply with MUN's Hazardous Waste Disposal Procedures to be used in conjunction with this manual. The objective of the procedure is to provide information to handle safely, and in an environmentally-responsible manner, the hazardous wastes produced by the University.

Waste generators are responsible for completing a hazardous waste disposal form.

9.1.2.1 Glassware, Sharps and Pointed Waste Disposal

Most laboratories generate glassware, sharps and pointed waste through the course of their laboratory work. It is imperative that proper disposal procedures are employed to protect any person who may come in contact with the waste.

Sharps are defined as needles, blades, scalpels and razor blades.

Glassware and pointed waste other than needles blades are also generated during the course of laboratory work.

Examples: broken glass, pipettes and micro pipetting tips, broken plastic and capillary tubes.

Depending on whether the waste material is pointed, sharp or glass and if it is contaminated with chemical, biological or radiological material different storage containers and disposal methods are required.

Never place glass (even unbroken) in regular garbage bins. It must be disposed of in designated glass garbage containers.

10 Movement and Transportation of Chemicals

"Movement" is defined as the action of moving chemicals within a laboratory or between laboratories within the same building (or adjacent buildings as long as public roads are not used) while "transport" is defined as the action of moving chemicals between buildings or locations along public roadways or through airplane/ship transport (domestic or internationally). Transportation of chemicals requires adequate training as outlined in the Transportation of Dangerous Goods (TDG) Regulations. TDG certificates for trained individuals must be in place prior to transport and must be maintained with in-lab records.

10.1 Movement

Anyone moving chemicals through public spaces within Memorial, such as corridors or elevators must follow these procedures to avoid spills and ensure the health and safety of others (please note that there are additional requirements for movement/transport for radioactive and biohazardous materials and Memorial's RSO/BSO should be contacted prior to movement/transport).

- Individuals must be familiar with the material's hazards, know what to do in the event of a release or spill and have an adequate spill kit available during the move to contain spilled material. Safety Data Sheets (SDS's) are a good source for this information.
- Materials that are unstable, explosive, or extremely or acutely hazardous shall not be moved without first contacting EHS.
- Hazardous chemicals must be attended to at all times while being transported. Never leave chemicals unattended in public spaces.
- Wear appropriate PPE as outlined in Section 4.
    - Do not wear disposable laboratory gloves during transport. Have gloves ready in a pocket or spill kit for if needed.
- Chemicals must be transported in break-resistant or approved secondary containers that are capable of containing all materials in the event of breakage or spill.
    - Approved secondary containers are defined as commercially available bottle carriers made of rubber, metal, or plastic, with carrying handle(s).
    - A cart with leak resistant lips on all four sides is required when the number or size of containers exceeds what can safely be carried with one hand. If using a cart without leak resistant lips, the chemicals should be placed in plastic bins or shipping boxes with padded packing material.
    - Contact EHS, if you have questions about what type of secondary containment is appropriate for your chemicals.

The route must utilize service corridors/elevators (if available). Alternatively, areas less frequented by members of the general public are to be used (see list of restricted areas for movement and transport at the end of this section). Stairs should be used only if elevators are not available.

  - Movement of chemicals that must go through publicly accessible areas may only occur when there is a minimum of public present (i.e. no transport during class change times or in a full elevator).
- Chemical inventories should be updated to reflect the addition/removal/relocation of chemicals.

The movement of hazardous materials is prohibited in the following areas:

- Food and beverage consumption areas
- Washrooms
- Carpeted areas
- Libraries
- Recreational facilities
- Meeting rooms
- Personal and administrative offices
- Common areas accessible or used as a gathering location by the public
- Patient waiting and treatment areas
- Stores (except where hazardous materials are purchased)
- Mailrooms

10.2 Transport

The packaging, offering for transport and transport of hazardous products (i.e. chemicals) shall comply with the Transportation of Dangerous Goods (TDG) Regulations. TDG – road training is available through the EHS>Health and safety Training website.

11 Chemical Spill Response

11.1 Development of Spill Response Plans

All university personnel or students who work with or in proximity to chemicals or other harmful substances must be prepared to respond when an accidental release or spills occurs. Four components required, within the laboratory, for effective response to a spill: Written safe work procedures, clean-up material (i.e. spill kit), PPE and knowledgeable, well-trained staff. Spill clean-up procedures are available to aid PI's and Lab Owners in the development of lab specific procedures and kits. For further information, contact EHS.

11.1.1 General Guidelines

The following factors are to be considered when developing spill response procedures:

- Inventory of chemicals
- Categories of chemicals (e.g. oxidizers, flammable solvents) and their chemical, physical and toxicological properties.
- The quantities that may be released.
- Possible locations of release (e.g. laboratory, corridor).
- PPE needed.
- Types and quantities of neutralizing or absorbing material needed.

11.2 Hazardous chemical spills

In the event of a spill of a hazardous (volatile, toxic, corrosive, reactive or flammable) chemical, the following guideline should be followed:

- Determine appropriate clean up method by referring to the Safety Data Sheet (SDS). If you are unsure how to proceed, or if you do not have the necessary protective equipment, do not attempt to clean up the spill.
- If the spill is of unknown composition, or potentially dangerous (explosive, toxic vapours), alert everyone present and evacuate the room.
- If the spill cannot be safely handled using the equipment and personnel present, call for emergency assistance. If the spill is minor and of known limited danger, clean up immediately.
- If there is fire, pull the nearest alarm. If you are unable to control or extinguish a fire, follow the fire evacuation procedures.
- If the spill is in a laboratory, shop or chemical storeroom:
    - Evacuate all personnel from the room.
    - Be sure the hood/local exhaust is turned on.
    - If flammable liquids are spilled, disconnect the electricity to sources of ignition, if possible.
    - Call the campus emergency telephone number to request additional assistance if you cannot manage the clean-up yourself.
- If the spill is in a corridor or other public passageway:
    - Evacuate all people from the area and close off the area to keep others out.
    - Call the emergency telephone number, to have the air system in the area shut down (to prevent contamination of other areas) and to request additional assistance.

12 Working Alone Guideline

The university's recognizes the importance of providing a safe and secure work environment for the university community. The university will adhere to provincial Occupational Health and Safety Regulations as well as Working Alone Procedure SOP- 014 in an effort to promote worker awareness and facilitate worker health and safety when they are working alone. The MUN Safe app has a tool that will assist workers, students and supervisors develop an effective working alone protocol in conjuction with the Working Alone Procedure SOP-014.

No employee shall work alone in a laboratory or chemical storage area when performing a task that is considered to have a high risk of accident or injury by the laboratory supervisor or PI.

The Working Alone procedure applies when both of the following conditions exist:

- A worker is working by themselves in an office, vehicle, laboratory, workshop, field site, or any area owned or operated by the university.
- Assistance, in the event of an injury, illness or emergency, is not readily available to the worker.

As previously mentioned in Section 1.3.2, each Principal Investigator / Supervisor is responsible for developing a Laboratory Safety Plan specific to their lab. Working alone is included in this plan and at a minimum the following requirements must be addressed prior to start of working alone assignment:

- Conduct a risk assessment of all areas where a worker is assigned to work alone or in isolation. Risk assessment must identify potential hazards and mitigative measures required to eliminate or minimize the hazards.
    - Determine if there are any hazardous experiments involved?

Examples:

- High temperature
- High vacuum
- Extremely flammable materials (low flash point)
- Poisonous materials
- Scaling up i.e. higher quantities

Inspect required equipment and apparatus and ensure it is good working condition.

- Develop and implement a written procedure, in consultation with worker assigned to working alone and building Occupational Health and Safety committee, for checking on the well being of workers:
    - Specify time intervals between check-ins.
    - Establish procedure in case worker cannot be contacted including provisions for emergency response.

- Designate a person to establish contact with employee at predetermined intervals and record results.
- Use of the MUNSafe "work alone" feature is recommended to accomplish these criteria

Identify effective means of communication and ensure availability in the event of an emergency.

- Develop and communicate emergency evacuation procedures.
- Ensure workers have access to a first aid kit.
- Ensure workers have access to appropriate spill kits, as required.
- Provide workers with written operating procedures for the task
- Ensure workers been adequately trained to carry out the specific task

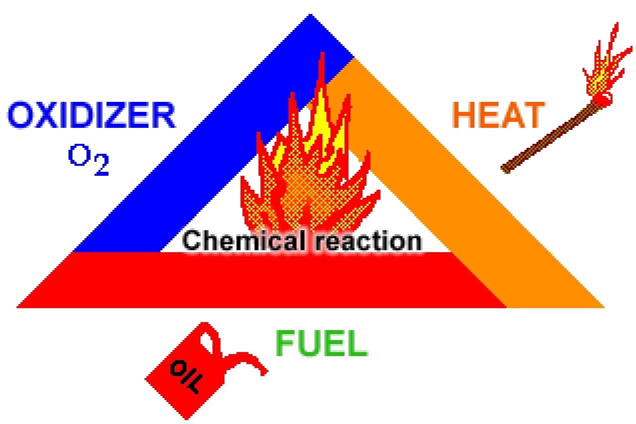
13 Fire Safety

Flammable substances are among the most common hazardous materials found in laboratories. The main objective in working safely with flammable liquids is to avoid accumulation of vapors and to control sources of ignition.

Laboratory fires can be caused by the accumulation of flammable and/or combustible vapours, runaway chemical reactions, electrical heating units, failure of unattended or defective equipment, or overloaded electrical circuits. Familiarize yourself with the operation of the fire extinguishers and the location of pull stations, emergency exits and evacuation routes where you work. In the event that the general alarm is sounded use the evacuation routes established for your area. Once outside of the building, move away from the doors to enable others to exit.

13.1 The Fire Triangle

Fire cannot occur without an ignition source, fuel and an oxidizing atmosphere (usually air), the three elements that comprise what is called the "fire triangle":



Fire will not be initiated if any one of these elements is absent, and will not be sustained if one of these elements is removed. This concept is useful in understanding prevention and control of fires. For example, the coexistence of flammable vapours and ignition sources should be avoided, but when flammable vapours cannot be controlled elimination of ignition sources is essential.

13.1.1 Classes of Fire

The National Fire Protection Association (NFPA) has defined four classes of fire, according to the type of fuel involved. These are:

- Class A fires involve combustibles such as paper, wood, cloth, rubber and many plastics.
- Class B fires entail burning of liquid fuels like oil-based paints, greases, solvents, oil and gasoline.
- Class C fires are of electrical origin (fuse boxes, electric motors, wiring).
- Class D fires encompass combustible metals such as magnesium, sodium, potassium and phosphorus.

13.2 Fire Extinguishers

Fire extinguishers are rated as A, B, C or D (or combinations of A, B, C and D) for use against the different classes of fires. Familiarize yourself with the fire class ratings of the extinguishers in your work area so that you will know what types of fire you can attempt to extinguish with them.

Learn how to use the extinguisher in your lab, as there will be no time to read instructions during an emergency. Attempt to fight small fires only, and only if there is an escape route behind you. Remember to have the extinguisher recharged after every use; this is coordinating through Facilities Management. If you do fight a fire, remember the acronym "PASS" when using the extinguisher:

- P: Pull and twist the locking pin to break the seal.
- A: Aim low, and point the nozzle at the base of the fire.
- S: Squeeze the handle to release the extinguishing agent.
- S: Sweep from side to side until the fire is out.

Be prepared to repeat the process if the fire breaks out again

13.3 Preventing Fires

There are a number of precautionary measures that must be followed when working with or using flammable chemicals in a laboratory; these measures are outlined in section 6.4 “Flammable Liquid Handling and Storage”.

14 Physical Hazards

14.1 Electrical Safety

The typical laboratory requires a large quantity of electrical power. This increases the likelihood of electrically-related problems and hazards. One must address both the electrical shock hazard to the facility occupants and the fire hazard potential. The following recommendations are basic to a sound electrical safety program in the laboratory.

- Purchase and use only CSA-approved or equivalent electrical equipment.
- Equipment, appliance and extension cords shall be in good condition.
- All electrical equipment shall be properly grounded; never remove the ground pin of a three-pronged plug.
- Extension cords shall not be used as a substitute for permanent wiring.
- Remove cords by grasping the plug, not the cord.
- Multi-outlet plugs shall not be used unless they have a built-in circuit breaker. This causes overloading on electrical wiring, which will cause damage and possible overheating.
- Electrical cords or other lines shall not be suspended unsupported across rooms or passageways.
    - Do not route cords over metal objects such as emergency showers, overhead pipes or frames, metal racks, etc.
    - Do not run cords through holes in walls or ceilings or through doorways or windows.
    - Do not place under carpet, rugs, or heavy objects.
    - Do not place cords on pathways or other areas where repeated abuse can cause deterioration of insulation unless they are protected by a cord cover that prevents against wear and tripping hazards.
- Be familiar with the location of any emergency shut-off switches on equipment within laboratories.
- Passageways and working space around electrical equipment:
- Shall be kept clear of obstructions and arranged to give authorized persons ready access to all parts requiring attention; and shall not be used for storage.
- Electrical equipment with frayed wires should be repaired before being put into operation.
- Tag and disconnect defective equipment.
- Minimize the use of extension cords and avoid placing them across areas of pedestrian traffic.

- Use only CO2 or dry chemical fire extinguishers for electrical fires.
- Flammable material shall not be stored or placed close to electrical equipment.
- Ensure that all wires are dry before plugging into circuits and that all cord connections are protected from potential contact with water.
- All building electrical repairs and wiring shall be performed by the Facilities Management department.
- Use ground fault circuit interrupters for all electrical equipment used for administering electrical current to human subjects or measuring electrical signals from human subjects.

14.2 High Pressure and Vacuum Work

Pressure differences between equipment and the atmosphere result in many lab accidents. Glass vessels under vacuum or pressure can implode or explode, resulting in cuts from projectiles and splashes to the skin and eyes. Glass can rupture even under small pressure differences. Rapid temperature changes, such as those that occur when removing containers from liquid cryogenics, can lead to pressure differences, as can carrying out chemical reactions inside sealed containers.

The hazards associated with pressure work can be reduced by:

- Checking for flaws such as cracks, scratches and etching marks before using vacuum apparatus.
- Using vessels specifically designed for vacuum work. Thin-walled or round-bottomed flasks larger than 1 L should never be evacuated.
- Assembling vacuum apparatus so as to avoid strain. Heavy apparatus should be supported from below as well as by the neck.
- Taping glass vacuum apparatus to minimize projectiles due to implosion.
- Using adequate shielding when conducting pressure and vacuum operations.
- Allowing pressure to return to atmospheric before opening vacuum desiccators or after removal of a sample container from cryogenics.
- Wearing eye and face protection when handling vacuum or pressure apparatus.

14.3 Glassware Safety

Glass breakage is a common cause of injuries in laboratories. Only glass in good condition should be used.

When handling glass rods or tubes:

- fire polish the ends,
- lubricate with water or glycerine when inserting through stopper,

- ensure stopper holes are properly sized, and not too small,
- insert carefully, with a slight twisting motion, keeping hands close together,
- protect hands with leather gloves when inserting glass tubing, and
- Hold elbows close to the body to limit movement when handling tubing.

14.4 Needles and Sharps Safety

Needlestick injuries and cuts are frequent occurrences in laboratories. For needles contaminated with a toxic chemical or pathogenic organism, the consequences can be serious. You can reduce the likelihood of injuries by limiting the use of syringes and needles. Consider finding alternative procedures or use of a blunt needle. Other safety precautions include:

- where possible avoid recapping needles,
- if recapping is necessary, develop a Safe Work Procedure for task,
  - procedure must be included in the Laboratory Safety Plan.
- do not remove needles from syringes unless you have the appropriate equipment.
- do not bend, break, or otherwise manipulate needles.
- discard in puncture resistant containers.

Razor blades are common in laboratories, and are another potential source of injury. Keep razor blades sheathed when not in use. If your lab uses blades that do not have sheaths, use a styrofoam block, adhesive tack, or other material to prevent exposure to blades between uses. Do not store blades unprotected on countertops, or in drawers where personnel could reach in and cut their hands. Disposal of sharps must follow the guidelines outlined in Section 9.1.2.1.

14.5 Equipment Safety

Whenever lab equipment is purchased, preference should be given to equipment that:

- Limits contact between the operator and hazardous material, and mechanical and electrical energy.
- Is corrosion-resistant, easy to decontaminate and impermeable to liquids.
- Has no sharp edges or burrs.

Every effort should be made to prevent equipment from becoming contaminated. To reduce the likelihood of equipment malfunction that could result in leakage, spill or unnecessary generation of aerosolized pathogens:

- Review the manufacturer's documentation. Keep for future reference.
- Use and service equipment according to the manufacturer's instructions.

- Ensure that anyone who uses a specific instrument or piece of equipment is properly trained in setup, use and cleaning of the item.
- Ensure that equipment leaving the laboratory for servicing or disposal is appropriately decontaminated.

15 Emergency Procedures

All incidents occurring on University property or while conducting work on behalf of the university must be reported as per Memorial's Incident Management element. All emergencies occurring after normal working hours which may require immediate response should be reported to Campus Enforcement and Patrol (864-4100).

15.1 First Aid

Know how to handle emergency situations before they occur:

- Become familiar with the first aid responders in your area.
- Become familiar with the properties of the hazardous products used in your area.
- Familiarize yourself with the contents of the first aid kit and learn how to use them. Keep instructions readily available and easy to understand.
- Locate and know how to test and operate emergency equipment, such as showers and eyewashes, in your area.

To obtain information on the First Aid responders for a particular area contact your unit's general office or consult the building Occupational Health and Safety bulletin board.

15.2 Burns

In a laboratory, thermal burns may be caused by intense heat, flames, molten metal, steam, etc. Corrosive liquids or solids such as bases and acids can cause **chemical burns**; first aid treatment for chemical burns is described below. In electrical burns, electrical current passing through the body generates heat.

15.2.1 Burns to Skin

First aid treatment of skin burns encompasses the following:

- If the burn is electrical in origin, ascertain that the victim is not in contact with the power supply before touching him/her. If the victim remains in contact with a power source, unplug the device or shut off the main power switch at the electrical distribution panel.

- Dial 911 if the burn is serious. Seek immediate medical treatment for all electrical burns, even if they don't appear to be serious.
- Remove jewellery, including watches, from the burned area.
- Expose the burnt area, but avoid removing clothes that are stuck to the skin.
- If possible, immerse burnt surfaces in cold water for at least 10 minutes, or apply cold wet packs.
- Avoid applying lotions, ointments or disinfectants to a burn. First and second degree burns can be washed with soap and water after the cool down period.
- Cover first and second degree burns with a moist bandage; apply dry compresses to third degree burns and to entry and exit wounds of electrical burns.
- Do not burst blisters, as they form a natural barrier against infection.

15.2.2 Burns to Eyes

Burns to the eyes may be caused by chemical substances, heat (hot liquids, steam, open flames, molten metal, etc.), or radiation from welding procedures, laboratory lamps and lasers. Burns caused by ultraviolet, visible or near-infrared radiation may not produce symptoms until 6-8 hours after exposure. First aid procedures are described below. General first aid procedures for thermal and radiation burns to the eyes are as follows:

- Prevent the victim from rubbing or touching the eyes.
- For heat burns, flush the eyes with cool water until the pain subsides.
- Cover the eyes with dry sterile gauze pads; apply a wet compress to the eyes if it is too painful to close them.
- Send the victim for medical care. If the burn is the result of exposure to a laser beam, advise emergency medical personnel of the characteristics of the laser and the distance between the victim and the laser.

15.2.3 Cuts

First aid treatment for minor scrapes, scratches, cuts, lacerations or puncture wounds include the following:

- Wash the wound and surrounding area with mild soap and running water.
- Remove any dirt around the wound.
- Cover with an adhesive dressing or gauze square taped on all sides with adhesive tape.
- Wounds caused by dirty, soiled or grimy objects should be examined by a physician, who will determine whether a tetanus immunization is needed.

- If the wound was caused by an object that has contacted human blood or body fluids, the victim must be seen by a physician immediately, as immunization or post-exposure prophylaxis may be required.
- If a wound is bleeding profusely, the first aider should attempt to stop the bleeding as quickly as possible:
  - Elevate the injured area above the level of the heart, if possible, in order to reduce the blood pressure to the area of the wound.
  - Apply direct pressure to the wound unless an object is protruding from it (in this situation, apply pressure around the injury). Direct pressure can be applied with the fingers of the hand, the palm of the hand or with a pressure dressing.
  - If bleeding cannot be controlled with direct pressure, apply pressure to the arteries supplying the injured area. This involves compressing the artery between the wound and the heart, against a bone.
  - Do not remove a dressing that has become soaked with blood, as this may interrupt the clotting process; apply an additional dressing on top of the first.
  - Avoid over-tightening of the dressing; i.e., do not cut off the blood circulation to limbs.
  - As a tourniquet completely stops the flow of blood to beyond the point of application, it should be applied only as a last resort, as in the case of a severed limb.

15.2.4 Animal Bites

Seek medical attention for all animal bites regardless of severity and advise medical staff if animal was contaminated with a virus.

- Allow the wound to bleed uninhibited for a few seconds to purge the wound.
- Apply pressure to the wound with a sterile pressure dressing.
- Wash wound if bleeding stops.

15.2.5 Needle Stick Injuries

- Notify your immediate supervisor and consult a physician immediately, as post-exposure prophylaxis or immunization may be required. EHS must be notified of any needle stick injuries.

15.2.6 Chemical Splashes to the Skin

- If the splash affects a large area of skin, go to the nearest shower and rinse thoroughly for at least 20 minutes; remove contaminated clothing while in the shower
- For splashes involving a small skin area, proceed to the nearest drench hose, remove contaminated clothing and jewellery and rinse for 15 minutes.
- Refer to the First Aid section of the SDS

15.2.7 For Splashes to Eyes

- Go to the nearest eyewash and rinse for at least 20 minutes.
- Hold your eyelids open with your fingers.
- Roll your eyeballs, so that water can flow over the entire surface of the eye.
- Lift your eyelids frequently to ensure complete flushing.
- Cover the injured eye with dry sterile gauze pads while waiting for medical attention.

The flushing or rinsing time can be modified if the identity and properties of the chemical are known. For example:

- A minimum 5-minute flushing time is recommended for mildly irritating chemicals,
- At least 20 minutes for moderate-to-severe irritants,
- 20 minutes for non-penetrating corrosives, and
- At least 60 minutes for penetrating corrosives.

15.2.8 Poisoning

Toxic substances can enter and poison the body by inhalation, absorption through the skin, ingestion or injection. When assisting a victim of poisoning:

- Call for an ambulance (dial 9-911) for serious poisoning
- Ensure that the area is safe to enter before attempting to aid the victim
- Move the victim away from the contaminated area and provide first aid as required
- Do not induce vomiting unless advised to do so by a medical professional.
- Provide emergency medical personnel with the SDS for the poisonous product. If the victim was overcome by an unknown poison and has vomited, provide the ambulance technicians with a sample of the vomitus.
- Always ensure that the victim receives medical attention, even if the exposure seems minor.

15.3 Fires

The immediate response depends on the size of the fire. Laboratory personnel should attempt to extinguish a fire only if it is clearly safe to do so.

15.3.1 Suspected Fires

All members of the University should familiarize themselves with the locations of the fire alarms and evacuation routes in the areas that they occupy. Anyone discovering smoke, strong smell of burning or smell of an unusual nature, should immediately:

- Inform Campus Enforcement and Patrol
- Alert the Building Emergency Warden

15.3.2 Known Fires

- **Shout "FIRE!" repeatedly to give the alert.**
- Pull the fire alarm.
- Telephone Campus Enforcement and Patrol (CEP) by dialling 4100.
- For buildings not serviced by CEP call 9-911 to initiate emergency response.
- Evacuate the premises in a swift, orderly fashion using the stairways and/or fire escapes, but NOT the elevators, and following the instructions of Evacuation Monitors.
- Inform the Building Emergency Warden of the location, magnitude and nature (e.g. electrical) of the fire, the open evacuation routes, individuals requiring assistance, and other pertinent details.
- Once outside the building, move away from the doors to enable others to exit.

15.3.3 Clothing Fires

If your clothing should catch fire, it is important not to run, as this would provide additional air to support the flames. Remember the "Stop, Drop and Roll" rule:

- stop where you are
- drop to the floor, and
- roll to smother the flames.

As soon as the flames are extinguished, go to the nearest emergency shower to cool burned areas with copious amounts of water. If someone else is on fire:

- Immediately immobilize the victim and force him/her to roll on the ground to extinguish the flames.

- Assist in smothering the flames, using whatever is immediately available, such as a fireproof blanket or clothing.

Give appropriate first aid, refer to Section 15.1.

15.4 Chemical Spills

If a hazardous product spill occurs, the risk associated with the spill must be assessed to determine course of action required. Depending on the chemical, amount spilled and the person responding it may or may not require outside resources. MUN's Chemical Spill poster outlines response actions required.

15.5 Evacuations

In the event that the general alarm is sounded, follow the evacuation routes established for your area; do not use the elevators. Follow the instructions of the building emergency wardens. Once outside the building, move away from the doors to allow others to exit and proceed to the designated muster station.

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