



LABORATORY SAFETY MANUAL

Carleton University



TABLE OF CONTENTS

1.0 Key Contacts.....	1
2.0 Introduction	2
3.0 Responsibilities	3
4.0 Laboratory Work Practices	5
5.0 Workplace Hazardous Materials Information System.....	7
6.0 Laboratory Equipment	9
7.0 Personal Protective Equipment	14
8.0 Hazardous Materials (Handling, Storage and Disposal)	16
9.0 Hazardous Waste Disposal.....	26
10.0 Emergency Response	27
11.0 Appendices.....	31

1.0 KEY CONTACTS

As Carleton endeavors to become a leader in research excellence, the expansion of laboratory safety programs is critical to ensure protection of faculty, staff and students. By meeting the increased demands, the EHS office supports the community in conducting safe and compliant research

Environmental Health and Safety.....613-520-2600 x 3000
carleton.ca/ehs

Science Stores, 118 Steacie Building.....613-520-2600 x 3854

Facilities Management and Planning613-520-2600 x 3668

Supervisor....._____

FOR EMERGENCY POLICE/FIRE/AMBULANCE RESPONSE CALL

Campus Safety Services.....613-520-4444

Use any of the following means to contact emergency services:

- **Red Phones**

Red phones have no dial pad. These phones automatically dial Campus Safety Services when the handset is lifted.

- **Office Telephones**

Dial **4444** to reach Emergency Campus Safety Services.

- **Blue Light - Exterior Emergency Telephones and Emergency Phones**

Located outside on the campus grounds, parking garages and the tunnel system. These phones are directly linked to Campus Safety Services and are equipped with a camera that starts recording once the phone is activated.

2.0 INTRODUCTION

Under the provisions of the Occupational Health and Safety Act, Carleton University, as an employer, is responsible for ensuring compliance, and for taking every precaution reasonable for the protection of the worker. We have broadened this definition to include the safety of our students.

Carleton University is committed to the protection of the health, safety, and wellbeing of all members of the University community. The University strives to promote a strong and sustainable culture of a safe and healthy workplace and study environment that will facilitate the awareness of risk, the prevention of injury and illness, in an environment free from violence and harassment.

This manual provides general guidelines, procedures, and requirements and is considered the minimum for the safe operation of a laboratory at Carleton University. ***Supervisors must identify and supplement this manual with safe procedures and training specific to the needs of their laboratory.***

All laboratories can be inherently hazardous places, and the attitudes and actions of those who work in the laboratory determine their own safety and that of their colleagues.

Acknowledgements

This manual's general form and content were shaped from other Ontario University laboratory safety manuals.

Objectives

1. Provide the minimum general guidelines for the safe operation of a laboratory at Carleton University.
2. To ensure that laboratory workers are aware of the general health and safety requirements for teaching and research laboratories at Carleton University.
3. Highlight legislative requirements and standards which pertain to the operation of a laboratory.

Application

For this manual, a laboratory is a space equipped and used for conducting scientific experiments, measurements and research. This focuses on spaces with various hazards including, but not limited to, mechanical, chemical, radiological, biological.

3.0 RESPONSIBILITIES

Supervisor

A supervisor is a person who has charge of a workplace or authority over a worker. For laboratory safety at Carleton University this includes all principal investigators, faculty and staff who administer a laboratory including Deans, Directors, Department Chairs and Lab Coordinators. The supervisor of a laboratory is responsible for the overall safety of any individual in the laboratory (including staff, students, visitors and volunteers).

Prior to any work being performed by a new or experienced laboratory worker, the supervisor is responsible to ensure training is given and a record of this training is kept.

Supervisors shall ensure workers receive:

- Training in the location and use of emergency equipment and emergency response.
- WHMIS education and training.
- Laboratory Safety training
- An appropriate safety orientation when a worker is first assigned to a laboratory space including safe practices, the location of hazards and specific emergency equipment.
- Additional workplace specific training (ex. radiation, biosafety, laser safety or specific chemical handling) when necessary.
- Refresher (every three years) or additional training when workplace conditions change.

Supervisors are also responsible to:

- Report any incidents, injuries or illness through CU Worksafe.
- Ensure that emergency equipment is in proper working order and is readily available.
- Ensure workers know that safety procedures are developed specifically for the lab.
- Ensure a worker uses or wears the Personal Protective Equipment (PPE) required.
- Ensure workers are following safety rules and procedures.
- Conduct regular safety inspections of the laboratory with a record kept on file.
- Appoint an appropriate alternate if they will be absent.

Worker

A worker is an individual who performs procedures in a laboratory. Workers include, but are not limited to, undergraduate students, teaching assistants, graduate students, research assistants, post-doctoral fellows, technicians.

Every laboratory worker is responsible to:

- **Attend all required health and safety training** as indicated by their supervisors, prior to beginning work within the laboratory.
- Know the location and proper use of emergency equipment (e.g. emergency showers, eyewash stations, fire extinguishers, equipment on/off switches, circuit breakers, spill kits and first aid kits).

- Follow all applicable safety rules, guidelines and safe work practices outlined in this manual and as directed by their supervisor.
- Determine the potential hazards, appropriate safety precautions and proper waste disposal procedures before beginning any new operation or experiment.
- Use and wear the appropriate PPE for the work being done.
- Report any hazards or accidents/incidents to their laboratory supervisor.
- Not operate or use any equipment or hazardous material in such a manner as to endanger him/herself or someone else.

Workplace Safety Inspections

Inspections prevent injuries and illnesses by identifying and eliminating actual and potential hazards. The employer and supervisor have a legal responsibility to provide a safe workplace.

Workers shall always perform informal inspections when in the lab. Any hazards noticed must be reported to someone who can take action to correct it. Everyone in a workplace has a legal obligation to report hazards.

Appropriate parties shall conduct formal health and safety inspections. These parties include, but are not limited to the supervisor, the Joint Health and Safety Committee (JHSC), the Fire Prevention Officer, the Manager of Laboratory Safety and the Radiation Safety and Biosafety Officers.

Supervisors shall:

- Perform inspections on a frequency that is appropriate for the hazards.
- Complete a Workplace Inspection checklist and report.
- Distribute all corrective actions within two days following an inspection to the area supervisor or designated contact.
- Take immediate action to eliminate or lessen the hazard if possible.
- Recommend action to the next level of supervision if no immediate action is possible.

Additional information is available on the Office of Environmental Health and Safety's website (carleton.ca/ehs)

Incident Reporting and Investigation

Supervisors are responsible for reporting and investigating all incidents in the laboratory. Examples of incidents include injuries requiring first aid, spills, fires, explosions, and good catches. Reports are submitted online through CU Worksafe.

Additional information is available on the Office of Environmental Health and Safety's website (carleton.ca/ehs)

4.0 LABORATORY WORK PRACTICES

General Laboratory Safety Guidelines

Before beginning work every worker shall:

- Have current WHMIS training (must be renewed every 3 years)
- Have current Laboratory Safety training (must be renewed every 3 years)
- Be familiar with the locations and operation of safety and emergency equipment such as fire extinguishers, first aid kits, spill kits, fire alarm pull stations, telephones, emergency exits, eye wash stations, emergency showers and electrical panels.
- Ensure the safety equipment mentioned above is accessible and operational.
- Read the Safety Data Sheets (SDS) of any chemicals to be used.
- Read and follow written safe work procedures found in this manual.
- Check all equipment for proper operation.

While working, every worker shall:

- Wear clothing and PPE appropriate for the level of hazard. Lab coats (knee-length), safety eyewear and closed toed shoes are required at all times while in the lab.
- Restrain long hair.
- Food and drink are prohibited in the lab.
- Label decanted reagents and samples as per WHMIS legislation.

When finished working every worker and supervisor shall?:

- Wash their hands and arms with soap and water (unless SDS states otherwise) before leaving the work area.
- Clean their work area, especially spills and properly dispose of waste.
- Perform a safety check at the end of each experiment.
- Make sure that gas, water, electricity, vacuum lines, air and heaters have been turned off.
- Store chemicals according to chemical compatibilities and in appropriate locations (e.g. flammable storage and acid storage cabinets). See Appendix 2.
- Leave behind PPE (including lab coats) when leaving the work area, except when going directly from one laboratory to another.

Unattended Procedures

No worker or supervisor should ever leave an experiment unattended if it represents a potentially hazardous situation.

Unattended procedures should be avoided as much as possible, however if a procedure must be left unattended, workers shall:

- Post warning signs, include contact information, potential hazards, date and time the procedure was started and when it is expected to be completed.
- Visit the procedure regularly.

Working Alone/ After Hours

Working alone refers to activities where a worker is not directly supervised and that in the event of injury, illness or emergency, immediate assistance is not readily available. Weekdays before 8:30am and after 4:30pm, weekends, and holidays are considered “after hours” and periods where emergency help may be delayed.

While not ideal, there are circumstances which may require work to be scheduled after-hours, particularly in research and teaching activities. Security measures are in place after-hours:

- External doors to buildings are secured in accordance with University Standards
- Campus Safety Services offers the Working Alone Program, a check-in service for those working late at night.

A person could also;

- Use the buddy system.
- Have someone contact you periodically.

Permission to access the laboratory after hours must be granted by supervisor. A Working Alone Safety Plan must be completed and kept on file. The Working Alone Guidelines provide a mechanism whereby the supervisor and person discuss the hazards and safety measures (i.e. risk assessment) to then determine a proper risk level.

Additional information is available on the Office of Environmental Health and Safety’s website (carleton.ca/ehs)

Lab Housekeeping

All workers are responsible to keep the workplace neat and organized.

Laboratory workers shall:

- Keep aisles and exits clear.
- Ensure emergency equipment and signage are not obstructed from view.
- Ensure access to emergency equipment and exits are never blocked or obstructed.
- Keep work area clear of clutter and unnecessary belongings and equipment. This is especially important in the fumehood.
- Decontaminate surfaces as required.
- Deal with chemical spills immediately (if safe). The spill should be cleaned by the person responsible for the spill, and they must be reported to the supervisor.
- Not use a vacuum cleaner for picking up; it will pick up solids and liquids, but it will also spray vapors of these spilled chemicals around the room.
- Return all chemicals to storage when not in use.

5.0 WORKPLACE HAZARDOUS MATERIAL INFORMATION SYSTEM

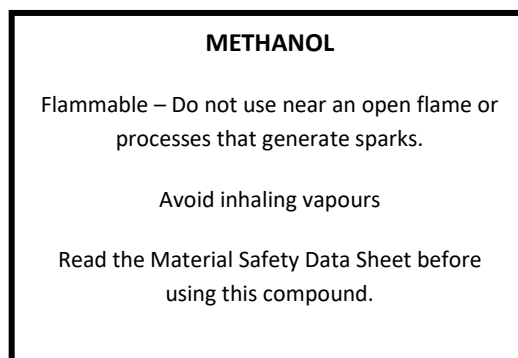
WHMIS is implemented by provincial and federal legislation and is designed to provide employers and employees with information regarding hazardous materials in the workplace. As of 2015, Canada has aligned WHMIS with the worldwide communication system known as GHS – the Globally Harmonized System of Classification and Labelling of Chemicals. The main components of WHMIS are hazard identification and product classification, labelling, safety data sheets, and worker education and training.

Labels

Suppliers of hazardous materials or controlled products are required to label their products according to a specified format. Supplier labels must be in both English and French and must include a product identifier, initial supplier identifier, pictogram(s), signal word, hazard statement(s), precautionary statement(s) and supplemental label information.

Employers are responsible for making sure that hazardous products that come into the workplace are labelled and must apply workplace label when appropriate. A workplace label is required when

- A hazardous product is produced (made) at the workplace and used in that workplace,
- A hazardous product is decanted (e.g., transferred or poured) into another container, or
- A supplier label becomes lost or illegible



A workplace label must include the following information:

- Product name
- Safe handling precautions, may include pictograms or other supplier label information
- Reference to the SDS

An example of a workplace label is shown to the right.

Note: If a material is decanted or created and will be used up by the person who decanted it and the product will be used during one shift, a full workplace label may not be required. However, the contained must still be identified with the product identifier.

Safety Data Sheets (SDS)

Safety Data Sheets (SDSs) are summary documents that provide information about the hazards of a product and advice about safety precautions. SDSs are usually written by the manufacturer or supplier of the product. The SDSs provide more detailed hazard information about the product than the label. They tell the users what the hazards of the product are, how to use the product safely,

what to expect if the recommendations are not followed, how to recognize symptoms of exposure, and what to do if emergencies occur.

Employers are responsible to make sure that workers have access to information related to hazards in their workplace. The SDSs must be readily available to the workers. At Carleton, SDSs may be accessed online via Chemwatch. Workers shall always be familiar with the hazards of a product before they begin using it.

Training

WHMIS requires training to be provided to those who work with or are potentially exposed to controlled products. **All lab workers are required to complete WHMIS Training.** Carleton University offers Generic Training online, but this must be supplemented with specific workplace training by the workplace supervisor. Both the Generic and Workplace Specific training should be renewed **annually**.

Generic Training includes:

- An explanation of the legal requirements.
- Instructions on the content required on supplier, workplace labels and material safety data sheets.
- Instructions on the safe handling, storage and disposal of Hazard Classes of controlled products.

Workplace Specific Training includes:

- Procedures for the safe use, storage, handling and disposal of controlled products used in the workplace.
- Emergency response procedures for incidents involving controlled products.

Laboratory safety training is mandatory for all Carleton staff and students working in a laboratory environment

The session provides general information regarding the health and safety practices and considerations required for working in a laboratory environment. Topics covered include worker and supervisor responsibilities, control measures to avoid exposures to chemical and physical hazards, procedures and personal protective equipment.

Additional information is available on the Office of Environmental Health and Safety's website (carleton.ca/ehs)

6.0 LABORATORY EQUIPMENT

Laboratory equipment must be inspected and maintained. If equipment is broken and/or no longer used, it must be decommissioned and removed from the lab.

All mechanical equipment must be adequately guarded to prevent access to electrical connections or moving parts.

Before a worker uses any equipment for the first time they must consult the lab supervisor and become familiar with the operating procedures.

Chemical Fume hoods

Laboratory fume hoods are designed for the protection of personnel by preventing contaminants such as vapors, dusts, mists, and fumes from being released into the laboratory. Functioning fans on the building rooftop draw vapours that are then exhausted through stacks.

A properly functioning unit will help reduce or eliminate the potential of occupational exposure to hazardous chemicals if it is used properly by laboratory personnel. The face velocity reading on the fumehood monitor must read 80-150 cfm. If the reading is outside of these parameters, the monitor will alarm. Stop using the hood, close all containers, lower the sash and contact FMP Service Centre for repair.

When working with chemical fume hoods, the worker shall:

- Perform activities and equipment at least 15 cm (6 in.) inside the hood.
- Work with the sash at the indicated operating level.
- Close the sash when not using the fume hood.
- Minimize storage of chemicals or equipment in a fume hood. Stored material interfere with air flow, and contribute to an incident in the event of an accident or fire.
- Do not obstruct back slots.
- Avoid cross drafts such as windows or people walking past as these will interfere with air flow. Large apparatus should be placed upon blocks to allow air to flow underneath.

Fume hoods are tested annually (or following any adjustment to the ventilation system) to confirm the fume hood is operating as intended. Testing includes the following;

- Visual inspection of the fume hood that includes general condition and sash and baffle function
- Fume hood performance testing through face velocity measurements and airflow visualization using a smoke test
- Fume hood monitor performance
- Fume hood testing certification stickers

If a fume hood fails the test, the unit is tagged out with a Notice of Failure sign. EHS notifies the owner of the space and coordinates the repair with Facilities Management and Planning.

Contact EHS if the fume hood in your lab has not been tested within the last year, or if you feel that the fume hood is not operating properly due to one of the following reasons:

Biological Safety Cabinets

Biological Safety Cabinets are for use with biological material only. A Biological Safety Cabinet will not protect against chemical vapours.

When using biological safety cabinets, workers shall:

- Confirm the cabinet was certified at installation, annually, and after relocation.
- NOT block the front intake or rear exhaust grille.
- Keep equipment that generate aerosols toward the back of the cabinet.
- Disinfect interior surfaces of work area before, during and after work.
- Disinfect material before removal from the Biological Safety Cabinet.
- Wait 5-10 min after turning the fan on before beginning work to allow sufficient time to purge any airborne contaminants. Allow it to run an 2-3 min after completion of work.
- Minimize air turbulence both inside and outside the cabinet.

Centrifuges

Improper use or maintenance of centrifuges can present significant hazards to users. Failed mechanical parts can release flying objects, hazardous chemicals and biohazardous aerosols.

Below are some general guidelines on centrifuge operation, refer to Carleton University's *Centrifuge Safety Manual* for additional requirements for safe centrifuge operation.

Centrifuges must be interlocked so they cannot be opened while still spinning.

When working with centrifuges, workers shall:

- Receive training on its correct use, care and maintenance before operating a centrifuge.
- Carefully read the *Centrifuge Safety Manual* and the specific instructions for the centrifuge model in use prior to instrument use.
- Check centrifuge tubes for stress lines, hairline cracks and chips before use.
- Check centrifuge rotor for cleanliness or damage before use.
- Inspect O-rings regularly and replace if cracked or dry.
- Use sealed centrifuge buckets that can be loaded/unloaded in a biological safety cabinet when spinning biohazardous material.
- Decontaminate the outside of the cups or buckets before and after centrifugation.
- Ensure that the centrifuge is properly balanced.
- Log all usage.
- Ensure the centrifuge has been inspected annually by the Department.
- Not leave the centrifuge until full operating speed is attained, and the instrument appears to be running normally without vibration (If vibration occurs, stop the run immediately; wait until the rotor stops, and check the load balances.)
- Immediately disconnect the centrifuge from the power source and a clearly mark DO NOT USE until serviced if problems occur or maintenance is required. This notice will include the

name of the person, the date, the reason and the signature of the lab supervisor or employee designate.

•

Heating Baths

When using heating baths, workers shall:

- Use a thermometer in the bath at all times to provide the actual temperature of the bath.
- Wear thermal gloves or use tongs when moving heated vessels; bath temperatures can be high enough to cause severe burns.
- Avoid dripping water or oil by carefully wiping the bottom of the vessel when removing a vessel from the bath.
- Not place the bath near either flammable or combustible materials.
- Move the bath only if emptied or when the liquid is cool.
- Set the thermostat well below the flash point of the heating liquid in use.

Ovens

Ovens are used in laboratories for baking or curing materials, off-gassing, drying samples, drying glassware, or in some cases providing a controlled, elevated temperature for an experiment.

When using ovens, workers shall:

- Ensure solvent residues have evaporated prior to placing containers in the oven.
- Not tighten lids on containers placed in the oven.
- Not use a unit with only a single thermostat for a long, unattended process.
- Not use ovens to heat any material from which a hazardous vapour will be produced unless vapours are exhausted outdoors.

Autoclaves

Pressurized sterilizing chambers or autoclaves are used to sterilize glassware, instruments, gloves, liquids in bottles, biological waste, and other materials by steam under pressure.

While using autoclaves, workers shall:

- Obtain training on the safe use of autoclaves. This includes online safety training and hands on practical training.
- Wear PPE including lab coats, heat resistant gloves and face shield.
- Check periodically to ensure that the seals to the closures are in good condition.
- NOT seal containers in the autoclave.
- Only use containers intended for autoclave use.
- Allow steam to vent out after a cycle by opening the door slightly. Wait 10 min before opening the door further.

Additional information is available on the Office of Environmental Health and Safety's website (carleton.ca/ehs)

Refrigerators and Freezers

Appropriate refrigerators and freezers are used for chemical/specimen storage.

When using refrigerators or freezers, workers shall:

- **Never** store food or beverage in a laboratory refrigerator or freezer.
- Ensure the refrigerator or freezer type is appropriate for the work being done.
- Ensure all containers in the refrigerator are properly labelled with the identification of contents, owner, date of preparation, and any health and safety hazard.
- Seal containers to prevent escape of any vapours.
- Keep an updated inventory and regularly dispose of surplus material.
- Not store flammable liquids in a lab refrigerator unless it is designed to store flammable material and is explosion proof.
- Post a label indicating the type of materials and possible hazards being stored within the refrigerator or freezer.
- Post a sign indication “NOT FOR STORAGE OF FOOD”.

Compressed Gas Cylinders

Compressed gases may have flammable, oxidizing, reactive, corrosive or toxic properties. Gases can also displace air causing asphyxiation. In addition, the cylinders are hazardous due to the high pressure. If a cylinder is knocked over, the valve can break and the rapid escape of high pressure gas can turn a cylinder into an uncontrolled rocket or pinwheel.

When working with cylinders, workers shall:

- Always wear PPE appropriate for the gas being used.
- Use only in well ventilated areas.
- Dispense toxic, flammable and corrosive gases in a functioning exhaust system.
- Never tamper with safety devices in valves or cylinders.
- NEVER subject a cylinder to high temperatures or flames as it could explode.
- NEVER direct high pressure gas at a person.
- NEVER use an oxygen regulator on a flammable gas cylinder or vice versa.
- Secure all gas cylinders, full or empty in the upright position for storage.
- Ensure cylinders are regularly inspected. Any cylinder that is corroded or has a damaged valve should be returned to the supplier.
- Move cylinders only with an approved cylinder cart.
- Replace the cap when the tank is not in use.

Electrical Equipment

Laboratories may contain electrically powered equipment, such as hot plates, stirrers, vacuum pumps, and refrigerators. These devices can be hazardous, particularly when mishandled or improperly maintained.

When handling electrical equipment, workers shall:

- Ensure that all wires are dry before plugging into circuits.
- Report defects/faults or frayed wires and discontinue use of this equipment.
- Minimize the use of electrical equipment in areas near liquids or with heavy condensation.
- GFI Circuits must be considered where appropriate.
- Use extension cords temporarily only. Request an additional outlet if required.
- Ensure all electrical equipment is CSA approved or inspected by an electrical authority.
- Always be conscious of the potential for generating sparks.
- Allow ONLY qualified and trained people to repair or modify electrical equipment.
- Electrical equipment must be properly grounded.

Lasers

Lasers can pose significant hazards including eye injury, burns, fire and exposure to hazardous fumes and therefore control measures must be in place in order to mitigate these associated risks.

The Carleton Laser Safety Program has been implemented in order to;

- prevent personal injury resulting from the exposure to laser radiation through the implementation of safe work practices, proper signage and training;
- conform to the requirements of the Ontario Ministry of Labour, the American National Standard for Safe Use of Lasers (ANSI Z136.1), the American National Standard for Safe Use of Lasers in Research, Development, or Testing (ANSI Z136.8 – 2012), and related regulations and standards.

The Laser Safety Program applies to all employees and students of Carleton University. The program outlines registration, training and commissioning requirements.

Additional information is available on the Office of Environmental Health and Safety's website (carleton.ca/ehs)

Glassware

When working with glassware, workers shall:

- NOT point test tubes at any person (including their self) when heating substances.
- Carry glass tubing vertically rather than horizontally.
- Wear leather gloves when inserting a glass tube into a stopper.
- Protect their hands with a towel when removing tubing from stopper.
- NOT use Erlenmeyer or other thin-walled flat bottom flasks under vacuum.
- Inspect containers and pipettes for any cracks, stress fractures or chips before using it.
- Completely empty and rinse all containers prior to disposal.
- Wear eye protection when working with glass under high pressure, vacuum and heat.
- Wrap glassware under vacuum with tape.

7.0 PERSONAL PROTECTIVE EQUIPMENT

The worker is responsible for wearing and maintaining their personal protective equipment in good condition and the supervisor is responsible for ensuring access to and the proper use of the required personal protective equipment; including ensuring the worker is properly trained in its use. PPE must not be worn in non-laboratory areas.

Body Protection

Workers shall:

- Wear lab coats at all times when working in a lab.
- Wear lab coats made of non-flammable fabric with snap closures.
- Remove and hang up the lab coat prior to leaving the lab.
- Launder lab coats separately from regular clothing (can be done through Science Stores).

Foot Protection

Workers shall:

- Use footwear to protect feet against chemical exposure, impact, compression and puncture.
- Wear closed toed and closed heel shoes at all times in the lab.
- Wear additional foot protection depending on the hazards present (e.g. steel toed shoes or slip-proof shoes).

Eye Protection

Workers shall:

- Wear safety glasses, goggles, face shields, welding helmets and full hoods as required (consult the SDS).
- Eye protection must meet the ANSI Z87 standard for impact resistance.
- Goggles must be worn when handling liquids.
- Wear safety eyewear at all times in the laboratory

Head Protection

Workers shall:

- Use head protection when working where there is risk of injury from moving, falling, or flying objects or when working near high-voltage equipment.
- Wear hard hats to protect from the impact and penetration caused by objects hitting the head or from limited electrical shock or burns.

Respiratory Protection

Workers shall:

- Use respiratory protective devices to protect against airborne contaminants or an oxygen-deficient environment only when a fume hood cannot be used.
- Select proper respiratory protective device in accordance with the supervisor and SDS.
- Contact EHS for fit testing prior to using the respirator.
- NOT use a respirator if they have a beard or other facial hair that passes between the sealing flange of the respirator face piece and the wearer's face. Facial hair may cause leakage or

interfere with the proper operation of the respirator exhalation valve; thereby exposing the worker to the hazardous contaminants.

Hand Protection (Gloves)

Hand protection can be provided with barrier creams, finger guards, hand pads and gloves. In the laboratory, gloves are used for protection from chemical products, biohazardous material and hazards such as abrasion, tearing, puncture and exposure to temperature extremes.

Workers shall:

- Be aware that no single glove material is resistant to all chemicals, nor will most gloves remain resistant to a specific chemical for longer than a few hours.
- Determine which gloves will provide appropriate protection against your agent by consulting a chemical resistance chart for common glove material.
- Inspect gloves for leakage before using; test rubber and synthetic gloves by inflating them.
- Ensure that there is no exposed skin between the glove and the sleeve of the lab coat.
- Discard worn or torn gloves.
- Discard disposable gloves that are, or may have become, contaminated.
- NOT reuse disposable gloves.
- Follow the manufacturer's instructions for cleaning and maintenance of reusable gloves.
- Remove gloves and wash hands before carrying out tasks such as using the telephone and leaving the lab.
- Always wash hands after removing gloves.
- Avoid contaminated oneself when removing soiled gloves by applying the proper technique.
- Keep gloves away from face, eyes, and body and working supplies (i.e. pens).

8.0 HAZARDOUS MATERIALS (HANDLING, STORAGE AND DISPOSAL)

General Hazardous Materials

When working with any potentially hazardous material, workers shall:

Ordering:

- Ensure all protective equipment required for a product is on hand (spill kits, PPE etc.).
- Request a current SDS from the supplier.
- Ensure at pickup that controlled product containers are barcoded and entered into the chemical inventory system

Handling

- Wear the appropriate PPE (as per the SDS and supervisor instruction).
- Use any chemicals that can create vapours inside a fume hood.
- Monitor containers for signs of instability (change in colour, crystal formation, drying out)
- Stick to the procedures and do not substitute without thorough review from the supervisor.
- Use carts and secondary containment when transporting chemicals within buildings or between adjacent buildings.

Storage

- Ensure all containers are in good condition and properly labeled.
- Label storage vessels and areas.
- NOT store liquid chemicals higher than eye level.
- Store materials in an area away from offices and emergency exits.
- Keep quantities to a minimum.
- NOT store incompatible chemicals in close proximity to one another.
- Store chemicals according to chemical characteristics and compatibilities .

Chemical Inventory

Carleton University uses a web-based enterprise application to track chemicals within the university working environment. All hazardous chemicals are tagged with a unique barcode label that cross-references to:

- Storage location
- Principal Investigator (PI) responsible for the item
- Chemical properties and information
- SDS-related information

All newly purchased chemicals are barcoded and entered into Carleton's Chemical Inventory. Unless exceptions were made, laboratories must have hazardous products delivered to Science Stores to be barcoded, regardless of the faculty. Laboratories have unique credentials to access the system and their specific inventories.

When a chemical bottle is empty and is to be discarded it is removed from the inventory by removing the barcode from the empty/waste container and affix it to the Barcode Disposal Sheet. Submit the

Barcode Disposal Sheet once a month, or whenever it is filled, to have the chemicals removed from your inventory. Discard of waste as per established procedures

Cryogenics

Cryogenic materials are primarily characterized by extremely low temperatures; cryogenic liquids typically have boiling points between -100°C and -270°C . Examples include liquid nitrogen, argon and dry ice.

The following hazards are associated with cryogenics:

- Asphyxiation due to displacement of oxygen
- Cracking of materials from cold.
- Frost bite.
- Explosion due to pressure build-up (i.e., in a cold trap).
- Condensation of oxygen and fuel (e.g., hydrocarbons) resulting in explosive mixtures.

Workers shall:

Handling

- Wear safety glasses, face shield, apron and cryogloves.
- Use cryogenics only in well ventilated areas.
- NOT wear metallic objects such as watches, rings, bracelets or other jewelry.
- Perform tasks slowly to minimize splashing.
- Use tongs to withdraw objects immersed in a cryogenic liquid.

Storage

- Use only containers designed for cryogenics (dewars).
- Fill containers to the indicated maximum level.
- When filling dewars:
 - ✓ Open the lid, place the nozzle of the tank into the dewar and open the valve.
 - ✓ Not over fill causing spillage onto the floor. The cryogen will immediately start to bubble when filling. Never leave the tank unattended when filling.
 - ✓ Close the valve, remove the nozzle and cap dewar.

Disposal

- Allow most cryogenic materials to evaporate in a safe, ventilated area.

In the event of a full dewar tipping over, workers shall immediately evacuate the area due to the potential hazard of asphyxiation.

Corrosives

Corrosive materials cause destruction of tissue through chemical action at the point of contact. Since corrosive chemicals can be liquids, solids, or gases, corrosive effects can affect the skin, eyes, and respiratory tract. Chemicals with low pH (acids) and high pH (bases) are corrosive. Strong acids are also oxidizers and must be stored properly as they can corrode incompatible materials.

Workers shall:

Handling

- Wear safety goggles, a splash shield, appropriate gloves and footwear.
- Wear a rubber apron and oversleeves when appropriate.
- Always use a fumehood to prevent exposure to corrosive vapours.
- Be trained in the use of each chemical.
- NOT add water to a highly-concentrated acid since this will result in a violent exothermic reaction that may cause serious injury. Always add acid to water.
- Keep corrosives away from heat sources as much as possible to avoid production of fumes.
- Avoid direct contact with vapours.
- Wipe drips from containers and bench surfaces to prevent residue build up as skin contact with dry residue will still result in burns.

Storage

- Ensure all containers are properly labeled.
- Not store acids and bases together
- NEVER store on shelves above waist level.
- Use vented storage areas if possible.
- Store in acid resistant cabinets or on polyethylene trays if possible.
- Store away from high traffic areas.
- Keep strong acids away from oxidizable substances.

Disposal

- Store corrosive waste in the original bottle or in a clean compatible bottle.
- Ensure the container is properly labeled.
- NEVER combine waste acids and bases together. Use individual waste collection containers.

Hydrofluoric Acid

Most fluorides will produce hydrogen fluoride (HF) upon contact with moisture. HF is a strong corrosive acid and both its liquid and vapour forms can cause severe burns which may or may not be immediately painful or visible. HF may produce acute life threatening systemic toxicity with minimal external tissue damage.

Workers shall:

Handling

- Receive training in the use of HF prior to using HF for the first time.
- Read the Safety Data Sheet (SDS)
- Complete the *Hydrofluoric Acid – Lab-Specific Standard Operating Procedure* template available on the EHS website
- Wear appropriate gloves.
- Ensure HF Antidote Gel (calcium gluconate) is available in the laboratory and not expired.

Disposal

- Collect waste HF in Teflon or polyethylene containers as it reacts with glass.

Hydrofluoric Acid requires unique first aid, workers shall:

- Read the instructions for use of HF Antidote Gel (calcium gluconate).
- Know that the appearance of symptoms can be delayed for up to 24 hours.
- BE aware that first aid must be started immediately following any exposure to HF.
- Call emergency 4444
- Seek medical attention in all cases, regardless of the amount or concentration involved.

Skin Exposure:

- Immediately move to safety shower or other water source and begin rinsing affected area(s). Remove contaminated clothing (if applicable) while flushing.
- Call Campus Safety Services Emergency Number – 4444
- Inform emergency responders that the exposure involved HF and that the exposed person must go to the hospital immediately.
- Flush affected area(s) under safety shower for 5 minutes. Then use 2.5% calcium gluconate gel. Don chemically-resistant gloves and continuously rub the ointment onto the affected area(s). Pay particular attention to areas under the fingernails (if applicable). If gels are not available, continue flushing the affected area(s) with water.
- Keep applying ointment every 10-15 minutes or rinsing affected area(s) until emergency personnel arrives.
- Report incident to PI/Supervisor and EHS.

Eye Contact:

- Immediately move to the eyewash station, hold eyelids open and flush with water. Remove contact lenses while flushing (if applicable).
- Call Campus Safety Services Emergency Number – 4444

- Inform emergency responders that the exposure involved HF and that the exposed person must go to the hospital immediately.
- Continue flushing the eyes until emergency personnel arrives.
- Report incident to PI/Supervisor and EHS.

Ingestion:

- Immediately rinse the mouth with cold water. Do NOT induce vomiting. Do NOT give emetics or baking soda.
- Call Campus Safety Services Emergency Number – 4444
- Inform emergency responders that the exposure involved HF and that the exposed person must go to the hospital immediately.
- If the victim is conscious, give six calcium gluconate or calcium carbonate tablets dissolved in water. If tablets are not available, drink water until emergency personnel arrive.
- Report incident to PI/Supervisor and EHS.

Flammable, Combustible and Ignitable Materials

Category	Flammable Liquids	Combustible Liquids
Flash Point	Below 37.8°C	37.8 to 93.3°C

When working with flammable materials, workers shall:

Handling

- Wear safety glasses and appropriate gloves.
- Refer to the Safety Data Sheets (SDS) prior to using product.
- Use only in fume hood.
- Keep away from sources of ignition.
- Add boiling chips to boiling liquids and minimize volumes.
- **Ground** both containers when transferring between metal containers.
- Clean the work area frequently to prevent the accumulation of ignitable dusts.

Storage

- Store flammable and combustible liquids in 4L containers or less, or in metal or plastic containers of 20L or less.
 - Store these liquids in approved flammable storage cabinets.
 - Always keep cabinet doors closed when not in use.
 - Store flammable liquids that must be maintained cold in explosion-proof refrigerators.
- Store ignitable solids in airtight containers or bottles to prevent dispersal of dust.
 - Store under an inert material if necessary.
 - Store ignitable solids in approved flammable storage cabinets.
- Do not store oxidizers with flammables.
- Ensure all containers are labeled.

Disposal

- Make sure waste bottles are properly sealed and labeled.
- Dispose of flammable and combustible liquids in 20 L polypropylene drum or 4L (or smaller) glass bottles.
- Dispose of ignitable solid in airtight containers or bottles and stored under an inert material (i.e. argon) if necessary.

Explosives (Shock Sensitive / Heat Sensitive Materials)

Explosives are chemicals sensitive to friction, shock, or sudden heating, or which can become shock sensitive when dry (e.g. picric acid).

When working with explosives, workers shall:

Handling

- Ensure proper safety equipment is available.
- Check containers regularly for crystallization of liquids, discoloration or drying out.
- Use explosives with added inhibitors when possible.
- Work with small quantities.

Storage

- Protect from shock, elevated temperature, light, ignition sources and other reactive chemicals.
- Store in areas isolated from high-traffic and AWAY from combustible materials.
- Store in a flammable storage cabinet. Clearly label the area where explosives are stored.
- DATE all chemicals when first received.

Water Reactive Chemicals

Water Reactive chemicals are those that spontaneously react with water. Some examples are Alkali metals (sodium), organometallic compounds, halides, hydrides, peroxides, anhydrides, etc.

When working with water reactive materials, workers shall:

- Protect from exposure to moisture or accidental contact with **water**.
- Store in a cool, water-proof area. They should be properly desiccated whenever possible.
- **NOT** store water reactive materials under the sink.
- Isolate from other reactive materials.
- NOT combine with other wastes when disposing.

Air Reactive Chemicals

Air reactive chemicals spontaneously react with air. Metallic dusts (e.g. nickel, titanium, zinc), alkali metals (potassium), hydrides, are examples of air reactive materials.

When working with air reactive materials, workers shall:

- Minimize exposure to air.
- Store under an inert gas or liquid.

- Isolate from oxidizing agents.

Oxidizers

Oxidizers can readily stimulate the combustion of organic matter and unprotected contact with oxidizers causes chemical burns.

Workers shall:

Handling

- Use shields or other methods of isolating the material or process.
- Wear the appropriate PPE such as goggles, face shield, apron, or other equipment in accordance to the safety recommendations for the chemical in use.

Storage and Disposal

- NOT store oxidizers and reducers together. Use separate storage cabinets or shelves.
- Isolate oxidizers and reducers from other potentially reactive materials.
- NOT store oxidizers with flammable liquids.
- Store in a cool, dry place.
- NOT dispose of oxidizers and reducers in the same waste container.

Perchloric Acid

Perchloric acid (73%) is a strong acid at room temperature, but when at temperatures above 160°C it becomes a strong oxidizing agent as well as a strong dehydrating reagent (anhydrous).

Workers shall:

Handling

- Wear safety glasses, thick gauntlets and rubber apron.
- Use a face shield and fume hood.
- Clearly identify fume hoods used for perchloric acid work as the vapours tend to condense forming perchlorate crystals which are shock-sensitive explosives.
- Only use freshly prepared acid. Make only as much anhydrous perchloric acid as is required for a single day's work.

Storage and Disposal

- Never store anhydrous perchloric acid for more than 30 days.
- Store on larger glass or ceramic trays in case the container breaks.
- Store in flammable storage cabinet.
- Check containers regularly for the formation of crystals or discoloration. Any discoloration of the anhydrous acid requires its immediate disposal. If discoloration or crystal formation is noted, do not move bottle or attempt to remove the cap. Contact EHS.
- Dispose of *Anhydrous perchloric acid (>85%)* by first dilution and neutralization then through hazardous waste disposal procedures.

Unstable Chemicals - Peroxide Formers

Many chemicals may form explosive decomposition products. Some common examples include isopropyl ether, diethyl ether, tetrahydrofuran and dioxane. Since products are usually packaged in an air atmosphere, peroxides can form even in unopened containers.

When working with unstable chemicals, workers shall:

- Store in air-tight, amber glass bottles and under inert atmosphere if possible.
- Store in cool, dark, dry, well ventilated areas.
- Always date chemicals when received and upon opening.
- Dispose unopened containers of ethers after one year, unless inhibitors have been added.
- Keep opened ethers for a maximum of 6 months.
- Buy only necessary quantities.
- Keep away from sources of heat and shock. Avoid friction and impact.
- Ensure ethers are free of peroxides before distilling.
- TEST all ethers and peroxidizable compounds for peroxide concentration at regular intervals. If the peroxide concentrations are not acceptable, or if crystals have formed in the bottle or around the cap, do not move the bottle or attempt to remove the cap. Contact EHS.

Toxic materials

Toxic materials are substances that may cause harm to an individual if it enters the body. Toxic materials may enter the body in different ways (inhalation, dermal, ingestion). The effects can be immediate or through upon repeated exposures (e.g. sensitizers, mutagens)

Workers shall:

Handling

- Wear appropriate PPE.
- Refer to Safety Data Sheets (SDS) prior to using product and/or their supervisor for appropriate precautionary measures.
- Use only in a fume hood.
- Cover surfaces, which may become contaminated, with a suitable disposable covering.
- Practice good personal hygiene. Wash hands immediately with soap and water, after working with these materials.
- Be aware of emergency procedures.
- Clean all work surfaces.

Storage and Disposal

- Secure highly toxic, carcinogenic or mutagenic materials in a storage cabinet or cupboard.
- Put highly toxic wastes in separate, appropriately sized waste containers. Make sure waste bottles are sealed.
- Label waste containers with "TOXIC", the names of all chemicals contained, and their concentrations and quantities.

Designated Substances

The following substances, if present in any amount in your laboratory, cause a legally required written assessment to determine the risk of exposure. The use, handling, storage and exposure to these chemicals are strictly regulated by the Ontario Ministry of Labour.

Prior to working with any of these substances the appropriate regulation must be consulted.

- ACRYLONITRILE
- ETHYLENE OXIDE
- ARSENIC
- LEAD
- ASBESTOS
- ISOCYANATES
- MERCURY
- BENZENE
- SILICA (crystalline, but not amorphous)
- COKE OVEN EMISSIONS
- VINYL CHLORIDE

Additional information is available on the Office of Environmental Health and Safety's website (carleton.ca/ehs)

Biohazards

A biohazard is any potentially infectious agent or hazardous biological material that could present a health risk to humans, animals or the environment. Biohazards include bacteria, viruses, fungi, parasites, blood, bodily fluids and tissues, allergens or other infectious agents.

The biohazards committee must approve all work involving biohazardous material at Carleton.

Workers shall:

Handling

- Wear appropriate PPE.
- Use a biological safety cabinet when aerosols are generated. Procedures such as blending, sonicating or vigorous mixing may generate aerosols.
- Wash hands frequently.
- Wash their hands immediately after removing gloves.
- NOT bend or recap needles.
- Perform procedures to minimize the creation of aerosols.
- Decontaminate work surfaces after use and after a spill. Use an appropriate disinfectant (e.g. 1 in 10 dilution of household bleach, 70% ethanol or alternative germicide).
- Get relevant recommended vaccinations.

Disposal

- Dispose of sharps in a puncture resistant container.
- Treatment and disposal of biohazardous material is conducted as outlined in the Carleton autoclave safety guidelines.
- When appropriate and compatible, liquid waste can be mixed with bleach (1:10 dilution) and after an appropriate contact time, poured down the drain (in accordance with City Sewer Use by-law).

Additional information is available on the Office of Environmental Health and Safety's website (carleton.ca/ehs)

Radiation

For all work involving Radioisotopes and X-Rays, including spills and disposal, please refer to the *Carleton University Radiation Safety Manual* for safe practices and regulations.

Additional information is available on the Office of Environmental Health and Safety's website (carleton.ca/ehs)

9.0 HAZARDOUS WASTE DISPOSAL

Below are general guidelines that apply to all laboratories.

Workers shall NOT:

- Store waste in public access areas.
- Reduce liquid waste by evaporation in fume hoods or other areas.
- Dilute waste to then dispose down the drain.
- Allow waste to be handled by custodial staff.
- Allow filled hazardous waste containers to accumulate in the laboratory. They must be brought to departmental storage areas.
- Dispose of any hazardous materials down the drain. Refer to the Sewer Use Guidelines on the EHS Website

When preparing waste for disposal, workers shall:

- Use the original container the chemical was packaged in if possible.
- Use a container that is empty, clean and in good condition.
- Ensure the container material is compatible with the waste material.
- Collect different waste in individual waste containers to avoid reactions due to incompatibility.
- Remove/deface the original labels.
- Label containers using the Carleton Hazardous Waste sticker. Include all contained materials and their concentration on the label for mixed waste.
- Store broken/waste glass in glass waste disposal boxes or in sturdy cardboard boxes clearly marked "glass for disposal". This ensures housekeeping staff remain safe.
- Sharps are disposed of in puncture resistant sharps containers.

NOTE: Do not put incompatible chemicals together in one waste container.

Hazardous waste disposal procedures (e.g. collection areas, contact individuals) are specific to the department. Additional information is available on the Office of Environmental Health and Safety's website (carleton.ca/ehs)

Decommissioning

Decommissioning is essential in order to validate the safety of research equipment originating from laboratory spaces that is being either transferred, disposed of or sent for repair, maintenance or calibration.

This same requirement for ensuring hazards are addressed applies to university spaces. When a university laboratory is being closed, vacated, relocated, renovated or demolished it must be decommissioned. The intent is to ensure the area, furniture and related equipment are free from all physical, chemical, biological or radioactive hazards such that the laboratory is left in a condition which is safe for the next occupant, or for construction/renovation workers.

Detailed decommissioning procedures are available on the EHS website (carleton.ca/ehs)

10.0 EMERGENCY RESPONSE

Workers shall be familiar with the location and operation of emergency equipment that is nearest to their work station. Workers shall also ensure that emergency equipment is readily accessible and clear of obstructions.

Eyewash Stations

Workers shall:

- Flush eyes for a minimum of 15 minutes when using the station.
- Seek medical attention and follow up.

Supervisors shall:

- Ensure any incident requiring the use of the eyewash stations be reported through CU Worksafe.
- Ensure that eyewash stations are activated at least once weekly for at minimum of 2 min by the supervisor and record of this is kept. The eyewash is verified for spray pattern, flow and temperature.

Emergency Showers

Workers shall:

- Flush body/affected area for a minimum of 15 minutes when using the station.
- Remove contaminated clothing to allow the shower to work effectively.
- Seek medical attention and follow up.

Supervisors shall:

- Ensure any incident requiring the use of the emergency shower be reported through CU Worksafe.
- Ensure that showers are tested ANNUALLY by Facilities Management and Planning and that record of this is kept on the inspection tags attached to the shower.

Fire Extinguishers

All laboratories with flammable solvents must be equipped with an appropriate fire extinguisher.

Fire Extinguisher types:

CLASS A (H₂O): Ordinary combustible materials such as cloth, paper, rubber and many plastics.

CLASS B (CO₂): Flammable liquids, gases, oils, greases, tars, oil-based paints and some plastics.

CLASS C (Dry chemicals): Class A/B materials in the presence of live electrical equipment.

CLASS D (Metalex): Combustible metals such as magnesium, titanium, sodium, potassium, zirconium, lithium and any other finely-divided metals which are oxidizable.

Supervisors shall:

- Ensure fire extinguishers are checked monthly by the fire warden and record of this is kept.

First Aid

In an emergency, contact Campus Safety Services at 4444. If you require simple first Aid treatment, contact the designated first aid provider in your area. A list of designated first aid providers in the area is posted on the building Health and Safety Board.

First Aid Kits should contain the following:

- A current edition of a standard St. John Ambulance First Aid Manual
- 1 card of safety pins
- 24 adhesive dressings individually wrapped
- 12 sterile gauze pads, 3 inches' square
- 4 rolls of 2-inch gauze bandage
- 4 rolls of 4-inch gauze bandage
- 4 sterile surgical pads suitable for pressure dressings, individually wrapped
- 6 triangular bandages
- 2 rolls of splint padding
- 1 roll-up splint
- 2 pairs of nitrile gloves
- 1 roll of waterproof non-latex tape
- 1 disposable one way valve CPR mask
- 1 pair of dressing scissors
- A WSIB poster known as Form 82 applied to the front cover
- An inspection record card (kept inside)

Supervisors shall:

- Ensure that First Aid Kits are inspected every 4 months (minimum).
- Ensure supplies are restocked as required.

Chemical Spill Kits

Departments are responsible for obtaining their own spill kits that suit their needs.

Most generic kits contain the following items:

Personal Protective Equipment:

- Safety goggles and face shield
- Nitrile and neoprene gloves
- Lab coat/overalls/chemical resistant apron
- Rubber boots
- Chemical cartridge respirator

Cleanup Equipment:

- A bucket, mop and floor sponge
- Spill Control Pillows
- Plastic dust pan
- Heavy plastic garbage bag
- Neutralizers
- Absorbent material

Chemical Spill Cleanup

The worker responsible for the hazardous material spill is responsible for cleaning it up. Spill kits should be available in all labs.

In the event of a spill, if a worker determines the area to be unsafe the worker shall:

- Contact Campus Safety Services at x4444 if the spill is beyond the resources or worker's abilities to cleanup (if in doubt call Campus Safety Services).
- Evacuate the area using the fire pull station if there is any doubt about the safety of an area or the nature of the spilled material. If the pull station is used, meet emergency personnel at the entrance to the building to explain the situation.

If the area is safe to continue with the spill cleanup, the worker shall:

1. **Evacuate personnel from the area.** Prevent others from entering area by closing doors, posting warnings, etc.
2. Remove clothing or shoes that are contaminated.
3. Gather required information such as SDS's. Consult your supervisor and/or EHS.
4. Immediately block any drains the material enters if safe to do so and contact Emergency x4444.
5. Carefully evaluate the situation and form an action plan.
6. Wear all required personal protective equipment.
7. Quickly block or contain size and spread of spill by using appropriate absorbing material (sand, vermiculite, inert absorbent, spill pillows, etc.).
8. Using appropriate cleanup agents, cleanup spill.
9. Once spill has been absorbed, place cleanup material in a sealable container. Seal container
10. Ensure the supervisor reports the incident through CU Worksafe.

Mercury Spills

In the event of a mercury spill, workers shall:

- Determine if it is safe to contain and cleanup the spill.
- Contact EHS for assistance.

If it is safe to continue, the worker shall:

1. Use an aspirator bulb, medicine dropper or mercury sponge to pick up droplets if a small amount of mercury is spilled (e.g. a broken thermometer). If available, use a mercury spill kit. **When cleaning the spill, appropriate respirator and protective clothing must be worn.**
2. Place the mercury in a container and seal.
3. Label the container for disposal as hazardous waste.
4. Sprinkle with zinc powder or other commercial products after collecting most of the mercury or if some residue has remained in cracks or other hard to clean areas.
5. Using the sponge, work the zinc powder into a paste consistency.
6. Sweep and place the dried paste into a plastic container for disposal.
7. Place rags, shoe covers, sponges, and anything used for the cleanup in the trash bag to be disposed of as contaminated material.
8. Ensure the supervisor reports the incident through CU Worksafe.

Fire Prevention

All workers shall be familiar with the location and operation of the fire extinguishers, emergency telephones, emergency exits, two evacuation routes, fire alarm pull stations and safe destination sites for their laboratory.

In Case of Fire

A worker shall NOT attempt to extinguish a fire unless they are confident in using an extinguisher.

In the event of a fire, workers shall:

- Pull, or send someone to pull the nearest fire alarm before attempting to extinguish a fire.
- CALL 4444 for Campus Emergency.
- Give the exact location and details of the fire.
- Encourage others to evacuate the area without endangering themselves.
- Use a fire extinguisher to assist in getting out of the building safely if necessary.
- Close, but NOT lock the door.
- Follow the Departmental Emergency Evacuation Plan and go to the “safe destination site”.
- NOT use elevators.
- Meet the Campus Safety Services Staff at the entrance of the building and explain the nature of the fire and possible associated hazards such as toxic fumes, explosive potential, fire extinguishing media etc.
- Remain available in case further information is required.
- NOT re-enter the building before the “ALL CLEAR SIGNAL” (45-60 seconds continuous tone on the evacuation system), or an announcement is made by Ottawa Fire Services, Campus Safety Services, the Building Authority, or the Chief Fire Safety Warden.

NOTE: if a worker requires assistance to evacuate or is mobility restricted, ensure this information is included in the Emergency Evacuation Plan, and the Building Fire Safety Plan. Contact the Fire Safety Officer for additional information on the “Stay in Place” program.

Additional information is available on the Office of Environmental Health and Safety’s website (carleton.ca/ehs)

11.0 APPENDICES

APPENDIX I: CHEMICAL INCOMPATIBILITIES

The term "incompatible chemicals" refers to chemicals that can react with each other:

- violently
- with evolution of substantial heat
- to produce flammable products,
- to produce toxic products

The following table contains general classes of incompatible chemicals. These examples are illustrative of common laboratory chemicals. **They are not intended to be exhaustive.**

General Classes of Incompatible Chemicals

(Chemicals from Column A must not be combined with chemicals from Column B)

ACIDS Oxidizing Agents	METALS, BASES Reducing Agents
Chlorates Chromates Chromium Trioxide Dichromates Halogens Halogenating Agents Hydrogen Peroxide Nitric Acid Nitrates Perchlorates Peroxides Permanganates Persulfates, Metals	Ammonia Carbon Metals Metal Hydrides Nitrites Organic Compounds Phosphorus Silicon Sulphur

The following table provides a more complete list of specific compounds that can pose reactivity hazards. **The chemicals in the left-hand column should be transported, stored, used and disposed of in such manner that they DO NOT accidentally come into contact with the corresponding chemicals in the right-hand column.**

Incompatible families



This chemical:	Is INCOMPATIBLE with:
Acetic Acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetone	Concentrated nitric and sulfuric acid mixtures, chlorinated solvent/alkali mixtures
Acetylene and monosubstituted acetylenes	Chlorine, bromine, copper, fluorine, silver, mercury
Alkali, alkaline earth metals such as powdered aluminium,	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens

magnesium, calcium, lithium, sodium and potassium	
Aluminium and its alloys (particularly powders)	Acid or alkaline solutions, ammonium persulphate and water, chlorinated compounds, nitrates, and organic compounds in nitrate/nitrite salt baths.
Ammonia (anhydrous)	Mercury (in manometers, for example), chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid (anhydrous)
Ammonium nitrate	Acids, powdered metals, flammable liquids, chlorates, nitrites, sulphur, finely divided organic or combustible materials
Aniline	Nitric acid, hydrogen peroxide
Arsenical materials	Any reducing agent
Azides	Acids
Barium peroxide	Combustible organics, oxidizable materials, and water
Barium rhodanide	Sodium nitrate
Bismuth and its alloys	Perchloric acid
Bromine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, benzene, finely divided metals, turpentine
Calcium or sodium Carbide	Moisture (in air) or water
Calcium oxide	Water
Carbon (activated)	Calcium hypochlorite, all oxidizing agents
Carbon tetrachloride	Sodium
Chlorates or perchlorates	Ammonium salts, acids, powdered metals, sulfur, finely divided organic or combustible materials
Chlorine	Acetone, acetylene, ammonia, benzene, sodium butadiene butane and other petroleum gases, hydrogen, metal powders, carbide, and turpentine
Chlorine dioxide	Ammonia, hydrogen sulphide, methane, and phosphine
Chloroform	Strong bases, ketones and strong base, alkaline metals, aluminium, strong oxidizers
Chromic acid and chromium trioxide	Acetic acid, naphthalene, camphor, glycerol, alcohol, flammable liquids in general
Copper	Acetylene, hydrogen peroxide
Cumene hydroperoxide	Acids (organic or inorganic)
Cyanides	Acids or alkalies
Flammable Liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, Halogens
Fluorine	Most materials
Hydrazine	Hydrogen peroxide, nitric acid, or any other oxidant
Hydrocarbons such as benzene, butane, gasoline, propane, etc.	Fluorine, chlorine, bromine, chromic acid, sodium peroxide

Hydrocyanic acid	Nitric acid, alkali
Hydrofluoric acid or anhydrous hydrogen fluoride	Ammonia (aqueous or anhydrous)
Hydrogen peroxide 3%	Chromium, copper, iron, most metals or their salts
Hydrogen peroxide 30% to 90%	Chromium, copper, iron, most metals or their salts, aniline, any flammable liquid, combustible materials, nitromethane, and all other organic matter.
Hydrogen sulphide	Fuming nitric acid, oxidizing gases
Hypochlorites	Acids, activated carbon
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Lithium	Acids, moisture in air, and water
Lithium aluminium hydride	Air, chlorinated hydrocarbons, carbon dioxide, ethyl acetate, and water
Mercuric Oxide	Sulphur
Mercury	Acetylene, alkali metals, ammonia, nitric acid with ethanol, fulminic acid, and oxalic acid
Nitrates	Sulphuric acid
Nitric acid (concentrated)	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulphide, flammable liquids, flammable gases, copper, brass, any heavy metals
Nitrites	Acids, potassium or sodium cyanide
Nitroparaffins	Inorganic bases, amines
Oxalic acid	Silver, mercury
Oxygen (liquid or enriched air)	Flammable gases, liquids, or solids such as acetone, acetylene, grease, hydrogen, oils, and phosphorus
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease, oils, and reducing agents
Peroxides (organic)	Acids (organic or mineral), avoid friction, store cold
Phosphorus (white)	Chlorates and perchlorates, nitrates and nitric acid
Phosphorous pentoxide	Organic compounds or water
Phosphorous (red)	Oxidizing materials
Phosphorous (white)	Air (oxygen) or other oxidizing material
Picric acid	Ammonia heated with oxides, or salts of heavy metals and friction with oxidizing agents, or friction associated with picric acid crystals
Potassium	Air (moisture and/or oxygen), carbon tetrachloride, carbon dioxide, water
Potassium chlorate or perchlorate	Acids and their vapours, combustible materials, especially organic solvents, phosphorus, and sulphur
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, glycerine, and sulphuric acid
Selenides	Reducing agents
Silver	Acetylene, oxalic acid, tartaric acid, ammonium compounds, fulminic acid, nitric acid with ethanol
Sodium	As for potassium

Sodium amide	Air (moisture and oxygen) or water
Sodium chlorate	Acids, ammonium salts, oxidizable materials and sulphur
Sodium hydrosulfite	Air (moisture) or combustible materials
Sodium nitrite	Ammonia compounds, ammonium nitrate, or other ammonium salts
Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulphides	Acids
Sulphur	Any oxidizing materials
Sulphuric acid	Chlorates, perchlorates, permanganates (compounds of light metals, such as sodium, lithium, and potassium)
Tellurides	Reducing agents
Water	Acetyl chloride, alkaline and alkaline earth metals, their hydrides and oxides, barium peroxide, carbides, chromic acid, phosphorous pentoxide, phosphorous oxychloride, phosphorous pentachloride, sulphuric acid and sulphur trioxide
Zinc Chlorate	Acids or organic materials
Zinc (particularly powder)	Acids or water
Zirconium (particularly powder form)	Carbon tetrachloride and other halogenated hydrocarbons, in peroxides, sodium bicarbonate, and water

APPENDIX II: WHMIS 2015 SYMBOLS

HAZARD PICTOGRAM	DESCRIPTION	CLASSIFICATION	SAFE HANDLING PROCEDURES
	Gas Cylinder	<ul style="list-style-type: none"> • Gases under pressure 	<p>ENSURE CYLINDER IS ALWAYS SECURED</p> <ul style="list-style-type: none"> • Store in appropriate designated areas • Avoid extreme temperatures
	Flame	<ul style="list-style-type: none"> • Flammable • Pyrophoric & Self-Heating • Emits flammable gases in contact with water • Self-Reactive • Organic Peroxide 	<p>STORE IN DESIGNATED AREAS</p> <ul style="list-style-type: none"> • Keep away from heat and ignition sources • Store in well-ventilated, cool place
	Flame over Circle	<ul style="list-style-type: none"> • Oxidizer 	<p>STORE IN AREAS AWAY FROM COMBUSTIBLES IN WELL-VENTILATED, COOL PLACE</p> <ul style="list-style-type: none"> • Store in proper containers which will not rust nor oxidize • Keep away from heat, sparks and open flames
	Exclamation Mark	<ul style="list-style-type: none"> • Skin/eye irritant • Skin Sensitizer • Acute Toxicity (harmful) • Narcotic Effects • Hazardous to Ozone Layer 	<p>AVOID BREATHING DUST OR VAPOURS</p> <p>AVOID CONTACT WITH SKIN AND EYES</p> <ul style="list-style-type: none"> • Wear appropriate personal protective equipment (PPE) • Work in well-ventilated areas • Wash potentially exposed areas thoroughly after handling (e.g. hands, forearms)
	Health Hazard	<ul style="list-style-type: none"> • Carcinogenicity • Specific Target Organ • Reproductive Toxicity • Aspiration Hazard 	<p>WORK IN WELL-VENTILATED AREA</p> <ul style="list-style-type: none"> • Store in appropriate designated area • Avoid direct contact • Wear appropriate personal protective equipment (PPE) • Obtain and learn special instructions/controls before using • Avoid repeated and/or prolonged exposures
	Biohazardous Infectious	<ul style="list-style-type: none"> • Biohazardous infectious materials 	<p>FOLLOW SAFE LABORATORY PRACTICES AND PROCEDURES</p> <ul style="list-style-type: none"> • Avoid forming aerosols • Store only in special designated areas with limited access and appropriate engineering controls • Follow universal precautions
	Corrosion	<ul style="list-style-type: none"> • Corrosive to metal • Serious eye damage • Severe skin burns 	<p>USE APPROPRIATE STORAGE CONTAINERS AND ENSURE PROPER NON-VENTING CLOSURES</p> <ul style="list-style-type: none"> • Wear appropriate PPE (including respiratory protection) • Store below waist level
	Exploding Bomb	<ul style="list-style-type: none"> • Self-Reactive (Severe) • Organic Peroxides (severe) • Explosives 	<p>HANDLE WITH CARE AVOIDING VIBRATION, SHOCKS, AND SUDDEN TEMPERATURE CHANGES</p> <ul style="list-style-type: none"> • Store in appropriate containers • Ensure storage containers are sealed • Store and work in designated areas
	Skull and Crossbones	<ul style="list-style-type: none"> • Acute toxicity (Fatal or toxic) 	<p>AVOID SKIN CONTACT AND BREATHING VAPOURS</p> <ul style="list-style-type: none"> • Wear appropriate PPE • Work in well-ventilated areas
	Environment	<ul style="list-style-type: none"> (not mandatory) • Aquatic toxicity 	<p>AVOID RELEASE TO ENVIRONMENT</p> <ul style="list-style-type: none"> • Dispose in accordance with regulatory requirements

APPENDIX III: LABORATORY INSPECTION CHECKLIST

Laboratory Inspection Checklist

Date	
Principal Investigator/ Laboratory Supervisor	
Telephone number	
Email address	
Lab room numbers	
Department	
Lab Safety Contact person	
Date of last inspection	

Hazard Identification			
<input type="radio"/>	Radiation	<input type="radio"/>	Biohazards
<input type="radio"/>	Lasers	<input type="radio"/>	Animal Use
<input type="radio"/>	Highly Toxic Materials	<input type="radio"/>	Pyrophoric Materials
<input type="radio"/>	Water Reactives	<input type="radio"/>	Peroxide Formers
<input type="radio"/>	Flammables	<input type="radio"/>	Corrosives
<input type="radio"/>	High Pressure Systems	<input type="radio"/>	Equipment Hazards
<input type="radio"/>	Other:		

Internal Responsibility System		
Issue	Yes/No/NA	Comments/ Follow-up Actions
Are Employees/students aware of their responsibilities under the Act?		
Do Employees/students know what to do (and who to contact) in an emergency?		
Are Employees/students trained in general H&S (WHMIS, violence in the workplace, emergencies, accident reporting)?		
Are employees/students familiar with the evacuation protocols including the safe evacuation sites?		
Are Employees/students trained in Laboratory Safety?		
Are Employees/students familiar with the JHSC and their role in Safety?		
Do Employees/students know where to find the H&S Bulletin Board?		
Is H&S discussed regularly during lab meetings?		
Is the lab area inspected regularly by the supervisor and occupants?		
Do Employees/students have any H&S concerns?		
Notes?		
General Safety		
Issue	Yes/No/NA	Comments/ Follow-up Actions
Is there a safe (unobstructed) egress path?		

Is there sufficient space between benches?		
Are the lab benches free of clutter?		
Is the general cleanliness adequate?		
Are heavy items stored on lower shelves as opposed to overhead spaces?		
Is the floor area free of tripping hazards (including dry and slip resistant)?		
Is the lab well ventilated (no odors)?		
Is the lighting adequate?		
Does the lab have appropriate signage (hazards, contact info, other)		
Is there evidence of food or drink in the lab?		
Is a sink available for handwashing?		
Notes?		
Fire Safety		
Issue	Yes/No/NA	Comments/ Follow-up Actions
Fire extinguisher mounted and accessible? Checked monthly?		
Sufficient vertical clearance from ceiling (18" with sprinklers)?		
Flammable materials stored appropriately?		
Is there excessive accumulation of combustible materials (paper and other)?		
Is the emergency gas shut off marked and accessible?		
Notes?		

Mechanical and Electrical Safety		
Issue	Yes/No/NA	Comments/ Follow-up Actions
Moveable parts guarded on equipment as appropriate?		
Training has been provided on equipment? Documented?		
Electrical outlets in good condition (no missing cover plates, no burn marks)?		
Electrical cords and plugs in good condition?		
Are there overloaded outlets or power bars connected in series?		
Extension cords only present for temporary use?		
Are there any power cords found under doors, carpets or through ceilings?		
All equipment CSA (or other) certified?		
Are faulty or broken equipment locked/ tagged out?		
Notes?		

Hazardous Materials Safety		
Issue	Yes/No/NA	Comments/ Follow-up Actions
WHMIS labels on containers?		

All containers identified (including squirt bottles, beakers)?		
All containers closed except when actively adding or removing materials?		
Chemical inventory available and up to date?		
MSDS for chemicals available?		
Incompatible materials segregated?		
Flammable materials stored in flammable storage cabinets? If requiring refrigeration, is proper unit in use?		
Corrosive materials stored in corrosive cabinets?		
Corrosive chemicals stored below eye level?		
Strong acids and bases stored in secondary containers?		
Ethers and other peroxide formers dated?		
Water reactive chemicals segregated, contained and labeled?		
Pyrophoric chemicals segregated, contained and labeled?		
Highly toxic materials segregated, labeled and stored in designated areas?		
Chemical containers in good condition?		
Chemical storage cabinets clearly labeled?		
Refrigerators containing chemicals clearly labeled?		
General chemical storage appears appropriate?		
Notes?		

Compressed Gas Cylinder Safety		
Issue	Yes/No/NA	Comments/ Follow-up Actions
Cylinders stored away from main egress point?		
Cylinders secured in an upright position in a rigid structure?		
Cylinder valves closed and valve caps in place when cylinders not in use?		
Cylinders transported using suitable carts?		
If flammable, corrosive or toxic gases are in use, are monitoring devices (sensors) in use?		
Are SOPS in place for cylinder changeout, verification?		
Notes?		
Health and Safety Equipment and Personal Protective Equipment (PPE)		
Issue	Yes/No/NA	Comments/ Follow-up Actions
Are fume hoods certified and the proper sash height indicated?		
Is storage within the fume hoods minimized?		
Is the front sash of the fume hood lowered to the appropriate level?		
Are sash stoppers functional where present?		
Is the hood illumination functional?		
Is the fume hood alarmed (to provide audible warning of low flow)?		
Is the biological safety cabinet certified?		

Is an emergency eyewash/shower unit available within 10 seconds (travel distance no greater than 100 feet)?		
Is the emergency eyewash unit verified weekly?		
Is there sufficient clearance (16 inches) around the emergency shower/eyewash?		
Is there a first aid kit available or is there a designated first aider nearby?		
Is there a spill kit available and are spill procedures known to staff/students?		
Are closed-toe shoes and long pants worn by staff/students?		
Are lab coats worn?		
Are safety glasses available? In use?		
Is additional safety eyewear available (goggles, laser goggles, face shield) if required?		
Are safety gloves (general use, and chemical resistant, cryogloves, heat resistant) available?		
Notes?		
Hazardous Waste		
Issue	Yes/No/NA	Comments/ Follow-up Actions
All chemical waste properly contained and labeled?		
All biological waste properly contained and labeled?		

All radiological waste properly contained and labeled?		
All waste containers kept closed except when adding waste (ie: no funnels in place, biowaste covered)?		
Hazardous waste stored directly on the floor?		
Accumulation/ long term storage of waste?		
Hazardous waste found in regular garbage?		
Sturdy cart available for transport of hazardous waste as needed?		
Secondary containment available for transport of hazardous waste?		
Notes?		
Other Issues		