Earth Sciences
UNIVERSITY OF TORONTO

Safety Procedures Manual

2024 – 2025

IMPORTANT INFORMATION

Earth Sciences Health and Safety Committee Members for 2024-2025

Name	Office	Tel#	email
Colin Bray (co-chair, worker)	310	978-6516	cjbray@es.utoronto.ca
Mike Hamilton (co-chair, management)	1016/B175	946-7424	mahamilton@es.utoronto.ca
Sarah Ariano (management)	4101	946-7454	sarah.ariano@utoronto.ca
Jorg Bollman (management)	4110	978-2061	jorg.bollmann@utoronto.ca
Yanan Liu (worker)	3114	978-5420	liu@es.utoronto.ca
Duane Smythe (worker)	3108		duane.smythe@utoronto.ca
Heidi Tomes (worker)	2127	946-7148	heidi.tomes@utoronto.ca
Julia Hathaway (graduate/CUPE rep)	4118		julia.hathaway@mail.utoronto.ca

First Aid trained personnel in the Department of Earth Sciences

Name	Office	Tel#	Station	Expiry
Wil Munro	2105		3rd Floor, Rm 3119	Jan. 2027
Heidi Tomes	2127	946-7148	3rd Floor, Rm 3119 1st Floor, Rm 1066	Nov. 2025
Karyn Gorra	2123	978-2060	1st Floor, Rm 1066	Mar. 2026
Duane Smythe	3108		Basement, Rm B160	In progress
Mike Hamilton	1061	946-7424	Basement, Rm B160	In progress

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INTRODUCTION

The purpose of this manual is to outline the responsibility of both supervisors and workers under the Occupational Health and Safety Act and to list department and university policies developed in response to the Act.

Under the Occupational Health and Safety Act, all university employees are considered workers. This includes faculty members, research, administrative and other support staff and students where they have been paid to perform work or supply services. According to the Act, a supervisor is anyone in charge of a workplace or anyone with authority over a worker. Thus, faculty members or principal investigators over seeing research projects are considered to be supervisors.

Regulations under the Act include, but are not limited to, procedures governing the disposal of wastes, the handling of designated substances, the handling and disposal of radioactive or biohazardous materials and the transport and handling of dangerous goods.

Although volunteers, undergraduate and graduate students involved in laboratory activities through course work or their research, are not officially covered by the Act, the University and the Department requires that everyone be given appropriate training. However, whenever graduate students are working as a TA (Teaching Assistant) they <u>are</u> covered by the act. The Department has also formulated procedures to cover the safety of students in the field.

The manual also lists procedures for ensuring personal safety and security.

RESPONSIBILITIES

Much of the Occupational Health and Safety Act as it applies to the Department of Earth Sciences is covered by WHMIS (Workplace Hazardous Materials Information System). This is a comprehensive system for safe management of hazardous materials. The WHMIS legislation requires cautionary labels on containers of controlled products, the provision of Safety Data Sheets (SDS) for each controlled product, the maintenance of inventories for hazardous materials, and worker education (training).

Effective implementation requires not only training but the recognition and acceptance of certain responsibilities.

(a) Supervisor Responsibilities

Under the Occupational Health and Safety Act, supervisors have a legal duty to take every reasonable precaution to ensure that their workplace is safe. The following specific duties also apply:

- Supervisors must be familiar with the provisions of the Occupational Health and Safety Act,
- and with the University and Departmental policies as they apply to the workplace under their supervision.
- Supervisors must be knowledgeable about health and safety hazards (actual or potential) in their

workplace, and must advise workers about these hazards.

- Supervisors must provide appropriate safety and protective equipment to workers, and ensure that this equipment is properly maintained.
- Supervisors must ensure that workers under their supervision properly use safety equipment, and that workers follow safe working procedures, as governed by the Act or by University or Departmental policies.
- Supervisors must maintain an up-to-date inventory of all hazardous materials in their workplace.
- Supervisors must ensure that all hazardous materials are properly identified and labeled, and that material safety data sheets are readily available for all hazardous materials.
- Supervisors must ensure that workers under their supervision receive and participate in safety training sessions.
- Supervisors must ensure that hazardous materials are disposed of in accordance with Federal, Provincial, Municipal, University, and Departmental regulations.

(b) Worker Responsibilities

As previously outlined, workers must comply with the Occupational Health and Safety Act and related regulations and policies. Specific duties include:

- Workers must use protective equipment as directed by the employer.
- Workers must immediately report unsafe working conditions and violations of safety regulations to their supervisor, or to the Chair of the Department or the Co-Chairs of the Departmental Health and Safety Committee.
- Workers must not remove or tamper with protective devices required by the Act or by the employer.
- Workers must not work in a manner that may endanger themselves or any other worker.
- Workers must not engage in horseplay, pranks, or other potentially dangerous conduct.

(c) Health and Safety Committee

The Act requires the establishment of a Health and Safety Committee. This body has the responsibility for overseeing the implementation of health and safety measures throughout the building, and for monitoring and evaluating them. A list of current committee members is included as the first page of this manual along with useful telephone numbers and other resources for safety information.

(d) Earth Sciences Department Safety Day

Once a year, at the beginning of term (in late September or early October) there is a departmental safety day. **ATTENDANCE AT SAFETY DAY IS REQUIRED FOR ALL NEW STUDENTS, STAFF AND FACULTY.** It is also recommended that all students, staff and faculty attend a safety day at least once every four years.

Safety issues such as Safety Data Sheets (SDS) and Workplace Hazardous Materials Information System (WHMIS) training are presented during safety day as well as sessions on personal safety, fire safety, hazardous waste disposal, and gas cylinder use.

(e) Earth Sciences Department Safety Inspections

A safety inspection is performed at least once a year by representatives from the **Earth Sciences** Health and Safety Committee. It is the responsibility of each laboratory supervisor to comply with the recommendations of the safety inspection.

EMERGENCY PROCEDURES

(a) Fire;

- Activate the nearest wall mounted fire alarm.
- Evacuate the fire area immediately, and close any doors behind you.
- Leave the building by the nearest safe exit. Do not use elevators.
- Report the fire to Campus Safety at 416-978-2222 and give exact location of the fire.
- Do not re-enter building until authorized to do so.

Note: Do not attempt to extinguish fire unless you can do so safely. Propping or wedging open fire doors is prohibited by the fire code.

(b) Chemical Spills:

Chemical Spill Procedures - Environmental Health & Safety (utoronto.ca)

Chemical spill kits are to be used only for very small spills. They should be clearly identified in each lab that uses chemicals.

If the spill is major, evacuate immediate area, get out of the laboratory, and close the door. Call Environmental Protection Services (416-978-7000 or 416-978-2222 after hours). Identify, if possible, the chemical(s) involved, approximate amount and location. It may be necessary to evacuate the building.

(c) In case of injury or incident:

1. **Get medical attention**.
2. **First aid:** Locate the nearest first aid station or call Campus Safety (416.978-2222).
3. **Medical treatment:** Call 911* and Campus Safety (416.978-2222).

Individuals are asked to contact Campus Safety after contacting 911 as Special Constables will at most time, be the first responders on scene and provide additional assistance. Campus Safety can also escort and provide access to emergency responders as buildings may be locked after business hours.

Please note, 911 does not always notify Campus Safety for service.

4. **Report** the injury or incident to a U of T contact.

5. **Submit** an Accident / Incident eForm within 24 hours. (Form will be completed by a supervisor or U of T contact). https://ehs.utoronto.ca/report-an-incident/

There are first aid boxes located in the basement, first-floor, and third floor of the Earth Sciences wing of the Earth Sciences Centre. In addition, there are first-aid trained personnel on each floor of the building. A current list of first-aid trained personnel in the Earth Sciences department is given as the first page of this safety manual.

LABORATORY PROCEDURES

(a) Personal Safety and Security

If you have immediate concerns for your own safety or the safety of others, call 9-1-1 or Campus Safety at 416-978-2222

Call 9-1-1 for life-threatening events, and Campus Safety for any other incidents.

When working alone, on weekends, evenings, nights, keep your room/lab door locked. Do not leave laboratories or offices unlocked while unattended. Make sure that valuables are not left in open unattended areas. **NEVER COMPROMISE BUILDING SECURITY BY PROPPING OPEN DOORS OR WINDOWS.**

Make sure that someone knows if you intend to work alone and/or late and that the lights are on in areas where you are working. A 'buddy' system in which voice contact is maintained every half hour is advised. You can let the Campus Safety (416-978-2323) know the room that you plan to work in.

When you leave the building, you can make use of the TravelSafer Program operated by the University (416-978-SAFE (7233)). https://www.campussafety.utoronto.ca/travel-safer

Faculty, staff or students working alone at night may avail themselves of the "Work Alone Program." The program is available via the U of T Campus Safety App or by calling Campus Safety at 416-978-2323 to register their location and contact number. Campus Safety will check-in with them on a regular schedule to make sure they are okay. For more information, refer to this website: Work Alone | Campus Safety (utoronto.ca)

• You can also refer to Environmental Health and Safety's guideline for working alone: https://ehs.utoronto.ca/wp-content/uploads/2021/01/Working-alone-guidelines.pdf

In an emergency, phone Campus Security at 416-978-2222, if you can safely access a telephone.

UTAlert : The University alert system is a service that allows the University quickly to send important messages via Email, SMS Text and Mobile App push notifications. Go to this link to ensure you are signed up: https://www.utoronto.ca/alerts

(b) Training

It is required that all involved in laboratory activities (supervisors, workers, and students) are appropriately informed and trained.

Undergraduate Students, Graduate Students, Research Assistants and Volunteers

All workers (including volunteers) are required to attend the Departmental Safety Day. They are also expected to familiarize themselves with the health and safety requirements for the department of Earth Sciences and for the specific materials with which they will have contact. If it is not possible for an individual to attend Safety Day, then that individual must attend one of the University WHMIS training sessions. Check with WHMIS coordinator for times and locations of sessions.

Undergraduate students who need to work in laboratories to satisfy a course requirement are required to read the WHMIS information booklet, this manual and the appropriate SDS's for the materials that they will be using. It is the responsibility of the instructor and/or lab supervisor to provide information on specific lab procedures. Undergraduate students working in labs during the summer are required to complete WHMIS training through one of the 'generic' training sessions provided across the university. Check with WHMIS coordinator for times and locations of sessions.

(c) Personal Safety Equipment

1. Wear a lab coat or coveralls. Long pants protect legs from chemical spills. Wear shoes not sandals.

II Use Neoprene gloves when handling corrosive chemicals and those poisons which can be absorbed through the skin. Use insulated gloves when handling very hot or cold items. A full-length rubber apron should be worn when handling corrosive chemicals.

III Protect your eyes. Use safety glasses, goggles and a face shield.

IV Masks may be required in some situations. Dust masks protect from particulate matter. Cartridge-type masks with activated charcoal filters protect from chemical fumes (these are likely to be needed only in emergencies).

V Handle hazardous chemicals in fume hoods when this is possible. Make sure that these are working. Leave them on. Minimize clutter. This will maximize the efficiency of extraction and helps to avoid mishaps. Do not store chemicals in the fume hood.

VI Make sure that you are familiar with the everyday procedures and the locations of the emergency protection equipment (eye wash, spill kits, fire extinguishers, etc.), telephones and exits. **ENSURE THAT YOU HAVE READ THE LABELS AND THE SDS'S OF THE CHEMICALS THAT YOU ARE USING.**

Note: **STORAGE AND/OR CONSUMPTION OF FOOD AND DRINK IN LABORATORIES IS PROHIBITED.**

(d) Fume Hoods and Exhaust Vents

All reactions involving potentially toxic fumes, vigorous reactions and dangerous chemicals should be performed in a fume hood. The user should ensure that the work area is clear and that labware can be manipulated without interference. A properly maintained fume hood should be free of clutter and should not be used as a chemical storage area.

When not in use the fume hood should be lowered to minimize energy use and wear on the moving parts (fans and belts). The proper position during use is to have the sash as low as possible but still to be able to accurately manipulate the lab ware as required. Ideally, only enough room should be open for the users' hands and forearms and the face and torso should be protected behind the sash.

If the fume hood alarm or an exhaust vent alarm should sound, then immediately call facilities and services (Phone: 416-978-3000) and report it. The operator will ask for the problem (fume hood alarm) ask your name, the building (Earth Science Centre, Earth Sciences Dept.) and the room number. Within less than an hour a building engineer should arrive to fix the problem. Please remain available at the fume hood to answer any questions that the service person might have.

(e) Fire Extinguishers

Familiarize yourself with the fire extinguishers available in the areas where you work. Fire extinguishers are inspected every month and are inspected every year by university Fire Prevention personnel. If you notice any problems with an extinguisher, such as low charge, please inform Colin Bray (416-978-6516 cjbray@es.utoronto.ca)

FIRE EXTINGUISHERS MUST NOT BE OBSTRUCTED! Make sure that the area around fire extinguishers in your working environment are clear of obstructions.

(f) Chemical Storage and Transport

Researchers are required to transport and store all chemicals safely, including gas cylinders. Approved bottle carriers must be used when transporting chemicals. Avoid transporting chemicals between floors. In laboratories chemicals must be segregated according to their chemical classes. Avoid storing incompatible chemicals in proximity. Store flammable solvents in the special fire-resistant cabinets.

A list of chemical compatibility for storage and segregation is included as Appendix 1 to this safety manual.

(g) Waste Disposal

(i) Liquid chemical waste must not be flushed down the drains. Solid or liquid chemical must

not be mixed with general garbage.

Chemical waste must be stored in flammable storage area in the Forestry wing of the Earth Science Centre – Rm. 1011. Hazardous waste services periodically empty the waste from this storage facility. Containers may be provided by the Hazardous Materials Disposal Service (contact them for your specific chemical material), but wastes may also be stored in any properly labeled glass/plastic bottle. All containers must be properly sealed and undamaged. Liquid waste containers should only be filled to 70 - 80% of capacity. Incompatible combinations of chemicals should not be mixed. Oxidizing agents should not be mixed with reducing agent and/or organic materials. Acid-reactive compounds should not be mixed with acids, organic acids should be segregated from inorganic acids. If in doubt, check with the supervisor or WHMIS coordinator.

Chemical Waste labels to be placed on the containers can be obtained from Colin Bray – cjbray@es.utoronto.ca and / or contact Environmental Protection Services (EPS) (416-946-3473).

The Hazardous Materials Disposal Service will pick up chemical waste from the Hazardous Waste Storage and Disposal room at ES1011 as long as the waste is properly labeled. A description of the waste disposal area is given below. For specific waste removal issues, such as on-site removal, please contact Hazardous waste services directly.

For questions regarding hazardous waste disposal contact hazardous waste services (see important information on the first page of this manual). Alternatively, consult a member of the departmental health and safety committee.

(ii) Solid wastes (uncontaminated soil, sediment, etc.) and rock waste should be kept until a waste bin is available in the loading dock. This is organized once or twice a year when there is enough material to make it cost effective. Contact Colin Bray or Mike Hamilton.

(iii) Equipment waste has to be removed by Campus Movers and a service order is needed and paid for. It is more cost effective to have Campus Movers collect several pieces of equipment at one time as there is an hourly minimum rate. Inform Ampy Tolentino in the main office if you have some old equipment or furniture to be collected and she will advise on collection.

(iv) Toxic solid waste should be deposited in properly labeled containers and taken to the waste storage area in Forestry.

(v) Large waste bins are available on every floor except the 1st floor for laboratory clear glass, amber glass and plastic containers. This is separate from the regular recycling bins.

(vi) Sharps (syringe needles, razor blades, etc.) should be disposed in the special sharp containers and not in general garbage. These containers are not provided and must be purchased from a scientific supply company. Full sharp containers can be placed into an empty white drum, the same as for glass disposal, and the cleaning staff will take them away.

Hazardous Waste Storage and Disposal Area, ES 1011:

The key to the waste disposal/storage area in Forestry can be obtained from the main office in the Earth Sciences Department. The key is labeled 'flammable'. To get to the flammable/waste disposal room take the elevator down to the basement in Earth Sciences. Travel all the way under EEB and Forestry until you get to a set of elevators – you can also access this elevator from the 2nd, 3rd and 4th floors. Take an elevator to the first floor in the Forestry wing. Turn right out of the elevator, turn right through the double doors, follow the corridor around to the left and go through the next set of double doors too. The flammable storage is accessible through the first door on the right which opens onto a loading dock. The storage area is on the left of the loading dock and is labeled Rm. 1011. If you allow the door to the Department to close it will lock behind you, so prop it open. The switch to the fan is on the left as you enter the room. It comes on every hour but can be switched on if you wish.

(h) Gas Cylinders

Handle gas cylinders with care. Keep cylinders away from heat or other ignition sources. Do not damage, strike or puncture cylinders. Cylinders must be secured to a wall, shelf or fixed object. Keep valve protection cap in position when cylinder is not in use, or when moving/transporting cylinders. Never move a cylinder any distance by hand, use a cart.

Gas cylinders are delivered on the loading dock and stored in the gas cylinder storage room. **ALL CYLINDERS IN THIS ROOM HAVE TO BE CHAINED UP TO STOP THEM FALLING OVER, WHICH IS EXTREMELY DANGEROUS**. Empty gas cylinders are placed in this room in the section marked 'EMPTY CYLINDERS' ready for collection and must also be chained up. It is the responsibility of the user to contact the gas supply company to collect them. There is limited room to store new cylinders and especially empty cylinders so do not order more cylinders than you realistically can use in the near future.

Additional gas cylinder safety information is included as Appendix 2 to this manual.

FIELD RESEARCH / OFF-CAMPUS SAFETY

For the U of T field safety manual please refer to: https://ehs.utoronto.ca/field-research-safety/

(a) University of Toronto Field Research Safety Planning Record

There is a form that must be filled out by the research supervisor before each field season. This form is available at: https://ehs.utoronto.ca/wp-content/uploads/2021/07/FieldTripExcursionSafetyPlanning-Record_Final_FillablePDF.pdf
Pursuant to the University of Toronto Guidelines for Safety in Field Research, this form is to be completed by the Academic Supervisor and submitted to the Department Chair (or equivalent) prior to departure on field research. Multiple trips to the same site or group of sites can be covered by one form. The form is good for a single academic year and a new form must be completed annually.

(b) General Guidelines for Field Safety

The University expects all of those involved in field situations to take reasonable precautions to protect their personal health and safety. It is essential that all participants understand the associated risks and the best means for dealing with such risks.

For all off-campus activities, stay connected to your supervisor.
• Report any health and safety concerns to the site and to your supervisor
• Report any work-related accident or injury (https://ehs.utoronto.ca/report-an-incident/)

Reasonable care must be exercised in the following areas:

(a) first-aid supplies and expertise.
(b) appropriate clothing, personal and field equipment.
(c) transportation to, at and from the field location.
(d) information prior to departure on the characteristics of the area, and of distinctive local risks and dangers.
(e) information prior to departure on insurance needs etc.
(f) definition prior to leaving (and continuing on-site) of the tasks and responsibility of participants.
(g) recognition of the right and responsibility of an individual to exercise personal judgement in acting to avoid harm.
(h) availability of procedures for contacting local authorities and the university in emergency situations.

Note: Individual field researchers and students in field situations are required to acknowledge the risks of participation, to understand the Requirements for Reasonable Care, and to confirm these matters in writing.

EARTH SCIENCES MACHINE SHOP

Access to these facilities is strictly limited. Contact Duane Smythe (Rm 3108, Email:duane.smythe@utoronto.ca)

ROCK CRUSHING AND CUTTING

Use of these facilities must be cleared with the facility supervisor. For rock crushing and use of rock saws please consult Yanan Liu (Rm 3118, Phone: 978-5420, Email: liu@es.utoronto.ca). Access to both rooms is by key fob which can be activated by Yanan.

APPENDICES

Appendix 1: Chemical Compatibility for Storage and Segregation

Details of chemical segregation for storage at U of T are given at the following links:
https://ehs.utoronto.ca/wp-content/uploads/2014/06/Chemical-Storage-Flowchart.pdf
and
https://ehs.utoronto.ca/wp-content/uploads/2017/01/Chemical-Storage-Table-Updated.pdf

and the waste disposal procedures are found here: Laboratory Hazardous Waste Management and Disposal Manual - Environmental Health & Safety (utoronto.ca)

The following groups of chemicals must be stored separately from chemicals in other groups and away from general chemical storage. All other chemicals including inorganic salts, and organic liquids and solids may be stored together.

Mineral Acids including HCl, HF, HNO_3, H_2SO_4, H_3PO_4, $HClO_4$*

* Perchloric acid should be stored with other acids however it should be kept on a tray separate from the other acids. If sulphuric acid is spilled on a wooden shelf and then perchloric acid is spilled on the same spot an immediate fire will result. Perchloric acid must be used in a special fume hood if used in quantities greater than 10 mL. The only such fume hood in the department is in the analytical chemistry lab on the fourth floor (4088).

Flammable Solvents Flammable materials have a flash point of less than 37.8°C. Combustible materials have a flash point between 37.8 and 93°C. Special storage cabinets must be used for storage of flammable solvents. The special storage cabinets are yellow coloured and are available in most laboratories. Flammable solvents include acetone, alcohol, diethyl ether, benzene, acetonitrile, toluene and xylene.

Organic acids such as acetic (flash point 39°C), butyric and formic are combustible materials and should be kept in a flammable storage cabinet.

Inorganic Oxidizers these include nitrates, nitrites, chlorates, perchlorates, periodates, permanganates and persulfates.

Bases (Alkaline Materials) these include sodium hydroxide, potassium hydroxide, ammonium hydroxide and organic amines.

Cyanide Containing Materials these include sodium cyanide, cyanogen bromide, potassium ferricyanide, potassium ferrocyanide, sodium thiocyanate.

Materials Requiring Special Storage Considerations
Please consult with safety documentation (MSDS) if any of the following materials are going to be used.

Picric Acid, Peroxide Formers, *Other Shock Sensitive Materials, Organic Peroxides*, *Water Reactives*, *Air Reactives (Pyrophorics)*

Appendix 2: Gas Cylinder Safety

The following material is taken from the University of Guelph Department of Chemistry and Biochemistry safety manual (http://www.chembio.uoguelph.ca/sop/gastanks.htm).

There are multiple hazards associated with compressed gas cylinders, which can roughly be grouped in two categories:

1) **Mechanical Hazards**

- Compressed gas cylinders are sleeping giants - a full standard size cylinder at a pressure of ~ 200 atm (2500 psi) contains the kinetic energy equivalent to a small anti-tank weapon. Cylinders whose valves were accidentally broken off have been known to fly in excess of 500 m and penetrate reinforced concrete walls. Breaking off a valve from a full cylinder is the ultimate accident and all operations should aim at absolutely avoiding this incident.

- Compressed gas cylinders are heavy - especially when full! *In a recent incident at a university in Ontario a student severely injured several fingers when an improperly handled cylinder crushed his hand.*

- Compressed gas cylinders typically come with brass valves, i.e. threaded connections made from a relatively soft metal designed to give gas-tight metal-metal seals that can easily be damaged with potentially disastrous consequences when improperly installed.

2) **Hazards from the Cylinders Content**

Depending on the type of gas contained in the cylinder several hazards or (multiple) combinations thereof can exist. These are in particular:

- Asphyxiation: All gases available in compressed gas cylinders (except breathable air) will lead to death by asphyxiation, if their concentration within any enclosed space, such as laboratory exceeds certain levels. A particular hazard may arise from A simulated air, i.e. cylinders that contain a 80:20 mixture of N_2 and O_2 but no CO_2. As breathing is controlled by the CO_2 concentration in the blood one can thus asphyxiate, even though air is present.

- Ignition and/or explosion hazards from flammable gases: Many gases in particular H_2, but also a variety of organic compounds such as ethylene, propene, or methane are flammable and can turn a cylinder into a flame-thrower if ignited. Even a very small leak on an improperly installed gas-valve or otherwise compromised cylinder can lead to build-up of flammable or worse, explosive gas/air mixtures within enclosed spaces. A particular hazard are cylinders containing F_2 (e.g. sometimes used in LASER labs), as F_2 will spontaneously ignite with any organic matter with which it comes in contact.

- Poisoning of people and/or environment from toxic and/or corrosive gases: A variety of gases available in compressed gas cylinders are highly toxic, for example CO and H2S. Others are toxic as well as corrosive to tissue (in particular in the respiratory tract and the eyes) and equipment. Examples of the latter class are Cl_2, NO_x, or SO_3.

In light of these hazards the safety committee mandates the following Standard Operating Procedures for the handling, use, and storage of compressed gas cylinders in the Department of Earth Sciences at the University of Toronto:

1) Any gas cylinder that is being moved - however short the distance - must have a safety cap screwed over the valve on top of the cylinder. This rule is of the utmost importance and applies irrespective of the content (harmless, toxic, flammable, corrosive) and status (full, empty) of the cylinder. Note: Air Liquide use a better design where the valve is protected with a metal safety cover and does not have a metal cap.

NEVER, EVER MOVE A CYLINDER WITHOUT THE SAFETY CAP ON !

2) If a cylinder is to be moved more than 2 m, this must be done using a cart specifically designed for this purpose and fitted with a securing chain. There should be a cart available in all labs that use compressed gas cylinders.

3) All cylinders must be stored in an upright position and secured to a table, lab bench, or wall using an appropriate strap or chain holder as purchased from a laboratory equipment supplier or custom made by the machine shop.

4) The amount of gas cylinders stored in any laboratory should be kept to the absolute minimum. In addition, the number of cylinders stored on the loading dock should be kept to a minimum. Empty gas cylinders should be returned promptly and <u>not stored</u> in the laboratories. The gas cylinder storage area is located in a locked room adjacent to the loading dock elevator. The key to the gas cylinder storage area is available from the main office.

5) Never use excessive force when fitting a pressure-reducing diaphragm regulator to a cylinder. The correct procedure for installing a valve is as follows:

a) Choose the right regulator with the correct pressure output range for the intended application. Never use adapters for attaching regulators. Each type of cylinder has a different kind of connection, and it is only possible to attach the matching regulator.

b) Make sure the threads on both the regulator and the cylinder valve are clean and in good condition.

c) The use of Teflon tape on the threaded connection is <u>not recommended</u> and unnecessary if the regulator and tank threads are in good condition.

d) Holding the regulator vertically and horizontally at a right angle to the cylinder head connect

it to the cylinder valve by closing the thread finger-tight. The thread should move very easily, if it does not it is either damaged or you are not holding it at right angle, i.e. are damaging it as you try to force it in. Using a wrench tighten the connection with a maximum of one turn. Never use excessive force to tighten the connection.

e) Leak check your connection using either commercially available Snoop or a mixture of water/isopropanol/dish soap (100:100:1).

6) With the exception of N_2, Ar, He, and air all gases originating from a compressed gas cylinder must ultimately be vented into a fume-hood. Due to the small gas volumes involved this stipulation is waived for FID, TCD, etc. detectors on GCs.

7) It is the individual researchers'/supervisors' responsibility that any used or stored gas cylinders as well as feed lines originating from them are kept in good conditions and tested for leakage on a regular basis.

Appendix 3: Liquified Cryogenics

(Reproduced from http://www.utoronto.ca/safety/cryog3.htm)

HAZARDS OF LIQUID CRYOGENS

(a) **Oxygen Deficiency**

The release of cryogenic liquids in the work area can result in the rapid displacement of air and the potential for asphyxiation (suffocation) by reducing the concentration of oxygen in air below levels necessary to support life. Cryogenic liquids have very high volume expansion rates. For example, one litre of liquid nitrogen spilled in an enclosed area will expand to approximately 700 litres of nitrogen gas at standard temperature and pressure. Exposure to oxygen-deficient atmospheres may produce dizziness, nausea, vomiting, loss of consciousness and death. Such symptoms may occur in seconds without warning. Death may result from errors in judgement, confusion or loss of consciousness which prevents self-rescue.

ALWAYS KEEP THE DOOR OPEN WHEN TRANSFERRING LIQUID CRYOGENICS !

(b) **Pressure Build-Up Hazard**

Over-pressurization will develop in inadequately vented pressurized systems due to the expansion of cryogenic liquid vaporizing into large volumes of gas. Sudden release of this pressure can cause personal injury by issuing cold gas or liquid, or by expelling parts, as a result of leaks or bursts. The low temperatures of liquid cryogens also result in their potential to freeze water or other materials rapidly, and subsequent blockage and pressure build-up.

(c) **Cryogenic Burns and Frostbite**

Exposure to liquid cryogens or the cold "boil off" gases can result in extensive tissue damage or severe skin burns. Contact with un-insulated pipes or metal containers which are used to contain or transfer

cryogenic materials can cause the flesh to stick and be torn when attempts to withdraw it are made. Prolonged exposure to cold can also result in hypothermia or frostbite.

(d) **Cold Stress to Materials**

Common materials such as carbon steel, plastics and rubber can become brittle and weak, or fracture under stress at cryogenic temperatures. These can cause spills or leakages as a result of system rupture or failure.

(e) **Condensation of Atmospheric Oxygen**

Oxygen in surrounding air can condense when exposed to the temperatures of cryogens such as liquid nitrogen. Such oxygen enrichment may result in increased flammability and explosion hazards.

Appendix 4: Hydrofluoric Acid

Note: whenever HF is being used, a tube of calcium glutamate gel must always be available.

The following tells you what to do in case of an accident using HF and can be found at:

https://ehs.utoronto.ca/our-services/chemical-and-lab-safety/hydrogen-fluoride-hf-program/

Take the completed HF First Aid Report Form, HF Triage Letter in the HF Triage Envelope to the **Emergency Dept at Mount Sinai Hospital** where they have a doctor who knows how to administer the correct treatment. Please note – this is the only hospital in the area who have knowledge of Hydrofluoric Acid (HF) treatment.

HF - First Aid Treatment

The most important thing is to reduce skin contact with the HF as soon as possible.

Minor Exposure

If the exposure is relatively minor, i.e. a few spots or even a milliliter or two, on exposed skin, just wash it off immediately. There will be no long term effects, but it would be a good idea to apply the calcium gluconate gel.

If you are unsure, follow the instructions for more severe exposure.

Severe Exposure
If the exposure is severe, i.e. larger volume of HF and especially saturation of clothing, follow the instructions below:

Skin Contact

1. Immediately proceed to a safety shower and flood the affected body area thoroughly with large amounts of water.
2. Immediately remove all contaminated clothing, footwear and jewelry while rinsing. Calcium gluconate gel can be massaged into skin while flushing with water. PVC, nitrile or neoprene gloves must be worn while touching the victim.
3. While the victim is being rinsed with water, call 9-911 or 8-2222 (St. George campus) from a University phone. Indicate that a person was exposed to hydrofluoric acid.
4. Apply calcium gluconate gel every 15 minutes and massage continuously.
5. Continue applying calcium gluconate gel while transporting the victim to the emergency room at Mt. Sinai Hospital. Either the first aider, or a co-worker should go with the victim to ensure that the ambulance goes to Mount Sinai Hospital.
6. Inform responders and all others that the exposure involved hydrofluoric acid. Provide the medical personnel with the "HF Medical Treatment Package".

Eye Contact

1. Immediately proceed to an eye wash station and flush eyes with water for at least 15 minutes. Hold the eyelids open and away from the eye during irrigation. If the person is wearing contact lenses, the lenses should be removed, if possible.
2. Do not apply calcium gluconate gel to eyes.
3. Take the victim to the Mount Sinai emergency room. Either the first aider, or a co-worker should go with the victim to ensure that the ambulance goes to Mount Sinai Hospital.
4. Ice water compresses may be applied to the eyes while transporting the victim to the emergency room at the Mt. Sinai Hospital.
5. Inform the medical personnel that the exposure involved hydrofluoric acid. Provide the physician with the "HF Medical Treatment Package".

Inhalation

1. Remove victim from the exposure.
2. If the victim is not breathing, begin artificial respiration immediately. Avoid mouth to mouth contact by using mouth guards or shields.
3. Call 9-911 or 416-978-2222 (St. George campus) from a University phone. Indicate that a person was exposed to hydrofluoric acid.
4. Oxygen should be administered as soon as possible by a trained individual.
5. Arrange transportation of the victim to Mt. Sinai Hospital. Either the first aider, or a co-worker should go with the victim to ensure that the ambulance goes to Mount Sinai Hospital.
6. Inform the medical personnel that the exposure involved hydrofluoric acid. Provide the physician with the "HF Medical Treatment Package".

Ingestion

1. Call 9-911 or 416-978-2222 from a University phone. Indicate that a person has ingested hydrofluoric acid.
2. Have the victim drink large amounts of water as quickly as possible to dilute the acid. Do not induce vomiting.
3. Give victim several glasses of milk or about 100 ml of milk of magnesia, Mylanta, Maalox, etc., or grind up and administer up to 30 Tums, Caltrate or other antacid tablets with water.
4. Arrange transportation of the victim to Mt. Sinai Hospital.
5. Inform the medical personnel that the exposure involved hydrofluoric acid. Provide the physician with the "HF Medical Treatment Package".

Information on HF

It should be emphasized that HF does not behave like other acids and the health effects from improper use can be severe.

(a) **General Properties**

Hydrofluoric acid is a solution of hydrogen fluoride gas in water. Hydrofluoric acid is a colourless, fuming, corrosive liquid with a pungent irritating odour at concentrations above 5 ppm. HF attacks glass, concrete, some metals, natural rubber, leather, silica and silicate minerals. It reacts with siliceous materials to produce silicon tetrafluoride which is itself a hazardous colourless gas.

(b) **Harmful Effects**

HF is immediately irritating to mucous membranes at a concentration over 5 ppm. Breathing 50 ppm for even one minute may be fatal and is certainly fatal in less than one hour at this concentration. Eye contact can cause permanent damage and blindness. Skin contact causes severe burns but these effects are insidious because pain is not always felt at the time of contact, and lower concentrations may not produce symptoms for between 1 to 24 hours depending on the dilution factor. If skin burns are not treated properly (see below) the burned area may expand into a painful sore which will not heal over a period of weeks to even months due to necrosis (death and irreversible breakdown of cells and tissue which may lead ultimately to gangrene) of the sub-cutaneous layers and may work down to and damage bone. HF can pass through finger nails without apparent harm but will attack the nail bed and bone beneath, which may then require amputation of the finger if not treated. Ingesting or inhaling HF can result in respiratory ulcers, pulmonary edema (swelling of the windpipe and lungs), lung inflammation and congestion, throat burns, damage to the esophagus and stomach, shock, and possibly death if not treated promptly. Muscle spasms, convulsions, nausea, vomiting and diarrhea can be indications of serious poisoning. With extended exposure, HF is absorbed through the skin and can move into the joints potentially causing a painful and debilitating type of arthritis.

(c) **Safe Handling of HF in the Laboratory**

1. If you are unwell or feel nervous about using HF then don't use it. The use of HF requires a steady hand, so if you are recovering from the flu or a heavy cold and still have the trembles you must wait until you are fully recovered or ask an experienced HF user for help. Always take your time when transferring HF.

2. **NEVER WORK ALONE**! Always have a lab partner present to provide assistance if necessary.

3. Before handling HF containers wear special personal protection clothing as follows:
   - a lab coat as your first line of defense plus jeans or similar (not shorts or skirts) to protect your lower legs
   - thick acid-resistant gauntlets (PVC or neoprene) pulled up over the cuff of your lab coat (very thin kitchen gloves or disposable surgical gloves are not satisfactory because they can easily tear or can absorb acid through the thin membrane).
   - an acid resistant apron covering your entire frontal area
   - a full face shield (goggles will protect your eyes but not your mouth or nose).

4. **NEVER OPEN A BOTTLE OF HF OUTSIDE OF THE FUME HOOD**

5. Never pour HF into a glass container and never use glass stirring rods because glass products dissolve in HF. Polypropylene laboratory ware is available for use with HF.

6. Always work with HF within the fume hood with the front sash pulled down to a comfortable working level. Keep the reaction vessel well inside the fume hood and away from the front lip. The fume hood counter top is acid resistant.

7. If there is a violent or effervescent reaction, do not panic - you are fully protected. Carefully lower the front sash of the fume hood (make sure that nothing on the fume hood counter is in the way of the sash) and wait for the reaction to subside.

8. Clean up the fume hood countertop with plenty of water after use. Wash thoroughly all containers which have come into contact with HF - inside and out.

9. Finally, when all is done, wash your gloves under running water for at least one minute in the fume hood sink while still wearing them so that you do no inadvertently transfer HF residues on to your skin when ungloving.

Appendix 5: Centrifuge safety

Both bench scale and floor model centrifuges are potentially dangerous. These devices spin at very high speeds and should they become unbalanced it is possible for them to go thru cement walls or floors. Thus, it is always important to ensure that when loading a centrifuge that the samples are balanced. Samples on opposite sides of the rotor must have the same weight.

It is also important to ensure that the inside of the centrifuge is clean and the moving parts should be lubricated. In particular, centrifuges used for acidic solutions should be periodically checked for corrosion of the moving parts. For the temperature controlled models, it is important to never set the temperature so cool that liquids might freeze; (water can freeze at 5EC in a fast moving rotor). The freezing of a liquid, or precipitation of salts during centrifugation could unbalance the machine and so should be avoided. In addition, find out what the maximum rotation, and loading is for each rotor and never exceed it.