College of Biological Science

Health & Safety Handbook

2019 Edition

UNIVERSITY of GUELPH

COLLEGE of BIOLOGICAL SCIENCE
DEPARTMENT OF HUMAN HEALTH AND NUTRITIONAL SCIENCES

COLLEGE of BIOLOGICAL SCIENCE
DEPARTMENT OF INTEGRATIVE BIOLOGY

COLLEGE of BIOLOGICAL SCIENCE
DEPARTMENT OF MOLECULAR AND CELLULAR BIOLOGY

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1. Introduction

This handbook provides an overview of the safety program in the College of Biological Science (CBS). Although it touches on many of the hazards that are commonly encountered in the biological sciences, it is far from comprehensive. The handbook is complemented by safety training (both general and specific) and a variety of other references and resources.

Across the College we contend with different risks and hazards daily. Our researchers and educators work at the leading edge of science - to keep you safe, the College does its best to equip you with the knowledge to anticipate, recognize and avoid undue risks. Make sure you understand the nature of the hazards in your work and what must be done to control them.

2. Responsibility for Safety

Everyone at the University of Guelph has a stake in maintaining a safe environment. At work, at school and at home, each one of us is accountable for our own actions. When we take on positions of authority, we assume some additional responsibility for the safety of those under our supervision as well.

This handbook covers the basics – if you need specific information on any aspect of the legislation, departmental procedures, or the controls necessary for the various physical, chemical, biological or radiological hazards, more detailed resources are available and are discussed in further detail below.

The University of Guelph operates under the Ontario *Occupational Health & Safety Act (RSO 1990 c.O.1)* (OHSA) which is administered by the Ministry of Labour. The central premise of OHSA is the **Internal Responsibility System**, which prescribes certain rights and responsibilities for workers, supervisors and employers.

All employees of the University of Guelph have 3 fundamental rights under the OHSA:

- The right to know.
- The right to participate.
- The right to refuse unsafe work.

In addition, employees have some common responsibilities under the Act:

- Follow safe work practices & wear protective equipment when appropriate.
- Report all hazards or defects that could become hazards.
- Avoid putting your safety or the safety of others in jeopardy.

As well, when you are in a position of authority you are required to:

- Ensure people under you are following safe work practices and using the correct protective equipment.
- Point out potential hazards so people are aware of dangers in the workplace.

- Take every reasonable precaution in the circumstances to protect the health and safety of those under you (i.e., exercise due diligence).

Be aware that the Ministry of Labour is an enforcement agency. Inspectors have right of entry, power to issue orders, to ticket and to lay fines against individuals and the institution. It is also important to note that in 2004 the Criminal Code was amended to allow the crown to pursue criminal charges against corporations and individuals in cases where there is reckless disregard for safety resulting in injury or death.

2.1 Working Alone

In an academic institution, people should avoid working alone but practically this may be impossible. The work or a research project may necessitate people working after hours and on occasion working alone. Working Alone is defined as working by oneself such that assistance is not readily available should some injury, illness or emergency arise. Alone is interpreted as being out of visual or verbal contact, and when contact cannot be expected from another person for more than an hour. It includes working in physical isolation, e.g. as the sole occupant of a laboratory. It can occur during normal working hours as well as in the evening, overnight or during weekends. Depending on the type of work being done, the work area, and the time of day or night, working alone can be harmless or it can be dangerous.

Volunteers under an approved program are considered workers. Volunteers are only allowed to work in the presence of adequately trained personnel during normal business hours. Under no circumstances are volunteers allowed to work alone.

Undergraduate students may not have adequate training or experience to recognize, identify or evaluate hazards or hazardous situations and it is not advisable for these students to work alone or work alone after hours. Biodiversity and HHNS generally do not permit undergraduate students to work alone, however with supervisory approval and adherence to lab specific standards it may be permissible for undergraduate students to work alone for computer work or data analysis after hours. MCB does have a policy document for undergraduate students which includes a checklist of points to which the student and supervisor must agree to safeguard the student before any working alone situation. In IB, undergraduates that have undergone adequate safety training are permitted to work alone. IB is currently revising their documentation procedure for this situation.

Staff, graduate students, and postdocs enrolled in research courses or being paid by the University can work alone after normal business hours and on weekends if they have gone through adequate safety training, are aware of the safety practices and have been instructed to follow protocols and safe work practices.

Depending on the hazards of the work, when you work alone, you should make use of these precautionary plans and communication tools:

- access control – lock doors and do not to leave valuables (i.e., money, electronics, medications) in plain sight. Do not provide access to people that you do not know.

- buddy system – prearrange with someone (e.g. via text message) that you are going to the lab, when you expect to be done, and then text again when you are leaving. The "buddy" should be knowledgeable about the work being performed and capable of rendering assistance if necessary. This includes having access to the locked work area. Follow up with buddy or supervisor when you arrive home safely.
- The WorkAlone feature in SAFEGryphon smartphone app is a way for anyone to virtually check in with a family member, friend, co-worker or anyone they choose if the user is working late at night or is working alone or would feel safer if they were being checked up on during this time. The SAFEGryphon app provides access to a real time security feed, emergency contact and support resources.
- SafeWalk – is a student-run organization dedicated to providing people on campus with a safe and reliable escort after dark, 7:30pm until 2:30am every night.
- notification of Campus Police at Ext. 52245.

Supervisors shall be made aware of work alone situations and as appropriate develop a written plan tailored to the individual work situation, with workers to assess risks, identify potential hazards and establish an effective communication system for working alone or after hours. This will also include consideration of personal safety and outline any activities that cannot be done while working alone.

PROHIBITED WORK-ALONE / AFTER HOURS ACTIVITIES:

- Working with hazardous materials - dispensing highly flammable liquids; dangerously reactive substances (e.g. peroxides, pyrophorics or water reactives); highly corrosive substances (e.g. hydrofluoric acid)
- Handling of acutely toxic materials (to be identified / discussed with PI)
- Any work involving possible exposure to high voltage electricity ('voltages of approximately 2000 V and currents of more than 80 mA in electrophoresis procedures create the potential for a lethal electrical shock if the equipment is not operated properly)
- Changing compressed gas cylinders or working with compressed gases
- Temperature extremes
- Manipulation of pathogenic biological organisms
- Physical hazards (radiation, noise, electricity, slippery or unsafe surfaces)
- Dispensing cryogenics (liquid nitrogen or dry ice from bulk storage e.g. the 50L tanks)
- Any work requiring the use of respirators
- Meeting 1 on 1 with human research participants

Schedule these higher risk tasks to be done during normal business hours, or when another worker capable of helping in an emergency is present.

3. Safety Resources

It is good to have questions. The College wants you to think critically and understand the hazards you face, and the precautions required to protect your health and wellbeing.

The best place to start is with your supervisor. Issues that can't be easily addressed can be raised to the Department Chair, departmental safety committees, the Environmental Health & Safety department, or other resources across campus.

You should also familiarize yourself with the building and know the closest location to emergency exit, emergency call station, fire cabinet (containing a fire hose and extinguisher), pull station and automatic external defibrillator (AED). Each floor of the Summerlee Science Complex has wall mounts of the floor plan indicating the location of these emergency devices.

For up to date information on the College safety program, access the CBS Safety website.

The University's Environmental Health and Safety department (EHS) also has a useful website where you can access all University safety policies, register for safety training sessions, and review resources and guidance on many aspects of the University's environmental, health and safety programs.

For further information on University security and emergency preparedness, check out the websites of Campus Community Police and the Fire Prevention Office.

The Ontario Occupational Health & Safety Act (RSO 1990, c.O.1) and provincial occupational health and safety regulations are available on line at http://www.ontario.ca/laws. The Canadian Centre for Occupational Health & Safety has many great resources for workplace safety.

Hardcopies of required and essential information are posted on the EHS Bulletin Boards across campus, including:

- University of Guelph Environmental Health & Safety Policy
- Referral to Ontario Occupational Health & Safety Act
- Contact information for Central and Local Safety Committees
- Campus First Aid Station locations
- 'Injury at Work' poster from the WSIB (a.k.a., Form 82) that lays out the 4 steps to be taken post-injury
- All relevant Ministry of Labour Notices or Orders

You are always welcome to discuss any safety or environmental issue with the University of Guelph EHS Department.

3.1 Safety Committees

Each department in CBS has a local joint safety committee. These committees help support the safety program on campus by identifying hazards, raising safety issues, and conducting workplace inspections.

In addition to our Departmental Committees (also called Local Committees), the University has a Central Joint Health and Safety Committee. The Central Committee has representatives of all employee groups on campus, as well as representatives from management. The responsibilities laid out in the OHSA are accomplished by both the local and the central committees; the focus of the local committees is to conduct inspections, identify hazards and support local safety programs. Members of the central committee fulfill other requirements such as conducting accident investigations, attending to work refusals, and submitting formal recommendations to the employer.

These committees exist to represent your interests, and the interests of your colleagues. If you have an issue you would like the committee to investigate, feel free to contact the appropriate committee chair – current contact information is posted on the CBS Health & Safety website. The committee is always happy to help.

4. Safety Training

Everyone learns from someone, so don't be afraid to ask for help. Training is a critical component of any safety program – no one can reasonably expect you to do the right thing if you haven't been given proper instruction and expectations are not clear.

The training available to personnel in CBS can be subdivided into two categories: general or specific. General training is provided by the College, EHS, and external 3rd parties, and includes courses like WHMIS, Worker Health & Safety Awareness, Sexual Violence Referral and Support Training, Laboratory Safety, Biosafety, Radiation Safety, and First Aid/CPR. These courses may be offered in class or on-line. As well general training courses and ethics and regulatory compliance courses are offered by the Office of Research with human participants and animal care which you may be required to attend, depending on the nature of your work. These courses also include safety components. Please refer to their websites for more details.

Job-specific training is the responsibility of each lab or work group. This includes on-the-job demonstration of equipment, lab methods and experimental techniques. Some departments offer training on operation of certain pieces of equipment, or certain protocols (e.g., Human Anatomy Safety Training course) through dedicated departmental resources. If you are unsure of how to safely and properly complete a task, ask for assistance. It is the responsibility of the supervisor of each work group to ensure that all individuals under their supervision have completed the necessary training prior to entering and conducting experiments.

In CBS, WHMIS, EHS Worker Health and Safety Awareness, Sexual Violence Referral and Support Training, Laboratory Safety and Biosafety training are mandatory for anyone involved in laboratory and/or other research.

Additional courses may be mandatory due to the nature of the research being performed, or the level of supervision being exercised. All personnel working with radioactive materials or devices are required to complete the Radiation Safety training program provided by the Radiation Safety Officer. Anyone conducting animal experiments is required to complete the training modules set out by the Animal Care Committee.

Supervisory personnel are required to complete the EHS Supervisor Health and Safety Awareness and Due Diligence training.

5. Standard Operating Procedures

CBS has developed a catalogue of Standard Operating Procedures (SOPs). These are documents that lay out specific directions on what to do in certain emergency situations, or instruction on the use of common lab equipment.

Standard Operating Procedures for the College of Biological Science are available on the CBS Health & Safety Website, under 'Procedures'.

Also, be aware of non-posted departmental procedures that apply to your work; for example, the code of conduct requirements applicable to the human anatomy laboratories.

6. Emergency Procedures

Knowing what to do in an emergency could save your life. All emergency response on campus is centrally coordinated through Campus Police (x52000). Campus Police will centrally dispatch any emergency responders to the location of the emergency providing directions and wayfinding. Additionally, Campus Police will escort any emergency vehicle on campus utilizing emergency access locations.

6.1 Evacuation

When you hear the evacuation alarm, **immediately:**

- Extinguish any open flames and close any open gas valves.
- Close the sash on fume hoods and biosafety cabinets (BSCs).
- Exit the lab or office and close the door behind you.
- Move quickly and calmly to the nearest safe exit or stairwell. Do not use the elevator.
- Anyone requiring assisted evacuation must be moved to the landing of the nearest safe stairwell. Ensure a fire warden or colleague notifies the emergency authorities of the person's location.
- Once outside, move well away from the building and meet at an established gathering point
- Pass any relevant information on to fire wardens.
- Reentry to the building may proceed once the alarm bells have stopped ringing unless instructed otherwise by emergency response personnel.

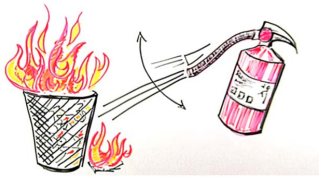
6.2 Fire

In the event of a fire, getting out safely is the top priority. Please follow this evacuation plan:

- Sound the alarm, pull the closest pull station.
- Notify others in the lab and move quickly to the nearest safe exit or stairwell.

- If you need assistance to evacuate, move to the nearest safe stairwell and have a colleague or fire warden notify the emergency authorities of your location.
- DO NOT use any elevators.
- If you are last to leave an area or room, close doors behind you.
- Pass any relevant information on to fire wardens and be available if the emergency authorities need to speak with you.
- If able to, call x52000 from a neighbouring building to relay information to Campus Community Police.
- Once outside, follow instruction of fire wardens and move well away from the building.
- Reentry to the building may proceed once the alarm bells have stopped ringing (for a minimum of 2 minutes) unless instructed otherwise by emergency response personnel.

This video puts forth considerations for assessing a small fire and demonstrates the proper use of a fire extinguisher.



1. Assess the fire – if it is small and controllable, you may use one portable extinguisher to put out the fire.
2. Before attempting to extinguish a fire ensure that the fire department has been notified, others in the vicinity have been alerted and the evacuation has begun.
3. Always have an exit behind you, if the fire does not go out you will be able to safely exit without having to navigate around the fire.
4. Make sure you are familiar with the operation of an extinguisher (now is not the time to figure it out) and that the extinguisher is suitable for the type of fire. Your safety is paramount, if it is unsafe or you are uncomfortable trying to put the fire out, don't.
5. To operate an extinguisher, use the **P-A-S-S** technique:

   P - **Pull** the pin. Hold the extinguisher by the carrying handle and pull/twist the pin out. You do not want to place your hand on the trigger because this will make it impossible to pull the pin out.

   A - **Aim** at the base of the fire. Aim the nozzle at the leading edge of the fire.

   S - **Squeeze** the trigger. Fully depress the trigger with the palm of your hand and expel the entire extinguisher onto the fire.

   S - **Sweep** back and forth. Sweep the extinguisher side to side; ensure that you extend beyond the edges of the fire to completely cover the base of the fire.

In all CBS buildings, we have people who voluntarily serve as Fire Wardens. During an evacuation they are identifiable by their bright orange hats; please follow their instructions and be respectful. Evacuation is mandatory, and the Fire Prevention Officer may take disciplinary action against anyone refusing to leave.

Please refer to the University of Guelph's Fire Safety Plan for more detailed information regarding fire safety. The Fire Safety Plan, extinguisher classifications and other related information can be found on the Fire Prevention website.

6.3 Chemical Spill

Spills can be classed as major (i.e. you need help) or minor (i.e. you can handle it yourself).

A critical factor in chemical spill emergencies is knowing when you need to evacuate and get help. Refer to the EHS Laboratory Safety Manual and CBS SOP for detailed instructions on how to manage a chemical spill. If you are ever in doubt of your ability to handle and clean a chemical spill, evacuate the lab and dial x52000 for assistance.

A major chemical spill requires lab evacuation and to get help if you have a spill that:

- You are not comfortable cleaning yourself.
- Is greater than 4L and is a flammable, combustible or other organic liquid.
- Poses a risk of fire or explosion.
- Creates a respiratory hazard (e.g., corrosive vapours, highly toxic chemicals).
- Involves unknown chemicals.
- Involves >1L of a concentrated strongly oxidizing acid (e.g., nitric, perchloric or chromic acid).

Following a spill, do a 'self-check'. If you have been splashed with a hazardous chemical, flush the area immediately. Remove all contaminated clothing and continue to flush the area; caustic or corrosive chemicals trapped against your skin can cause severe burns.

There are certain chemicals (e.g., hydrofluoric acid, mercury, and formaldehyde) that require specific neutralizers or absorbents not commonly found in lab spill kits. If these materials are used in your lab, make sure the spill kit has the supplemental items recommended in the SOP.

The Chemistry Stockroom has 3 chemical handlers available for purchase to supplement your spill kits; a Base Control, an Acid Handler and a Solvent Handler.

Once a minor spill has been cleaned up it is important to notify your supervisor of the spill and complete an EHS Incident Report

6.4 Biohazard Spill

Review the Biological Spill Response Plan and CBS SOP for further details.

The important principles when managing a biohazard spill are to know the hazards of what you are working with, to avoid aerosol exposure or contact with contaminants, and to use the right disinfectant in the right way.

The first consideration is your safety. If biohazardous material has spilled on you, remove contaminated clothing and thoroughly wash the affected areas. If material gets in your eye, flush at the eyewash for 15 minutes. If it is a spill that that creates a hazard for others in the area (e.g. aerosolized pathogen), notify everyone in the lab and have them evacuate.

You want to avoid inhalation of pathogens. If the spill is in the lab and there is concern of airborne exposure, evacuate the room and allow 30 minutes for aerosols to settle. If the

spill occurs in a biosafety cabinet, lower the sash and ensure the fan is running for at least 10 minutes. If a tube of pathogenic material breaks in a centrifuge, put a sign on the equipment and leave the centrifuge closed for 30 minutes for droplets to settle before you attempt to clean the spill.

Specific directions are provided in the SOP. The basic technique is to cover the spill with absorbent material, soak with a suitable chemical disinfectant, allow enough contact time for the disinfectant to work, then bag all waste and send for autoclaving. It is also important to notify your supervisor of the spill and complete an EHS Incident Report.

6.5 Medical Emergency

Obtain first aid assistance. The names and contact numbers of departmental first aiders are posted in every lab. Additionally, the locations of the University's first aid stations are:

- Student Health Services, JT Powell Building
- Occupational Health and Wellness (OHW), Alexander Hall
- Campus Police/Fire Prevention, mobile service

Students may obtain further medical treatment from Student Health Services. Employees can seek medical treatment or advice through Occupational Health and Wellness. For emergencies, dial x52000 and request emergency assistance.

In an emergency, do not attempt to transport the casualty to the hospital yourself. Dial x52000 and request an ambulance. Severe injuries require immediate notification of EHS. If an injury meets the regulated definition of 'critical', the Ministry of Labour must be notified and the scene preserved. A critical injury is an injury of a serious nature that:

- Is potentially life threatening.
- Causes loss of sight in an eye.
- Burns more than 10% of the body.
- Produces unconsciousness.
- Causes substantial loss of blood.
- Causes fracture or amputation of a limb.

For non-critical injuries, notify your supervisor as soon as possible and ensure an Incident Report is submitted to OHW (Fax: 519-780-1796) within 24 hours.

Specific Incidents:

Cuts – if someone suffers a severe cut, place pressure on the wound, and if possible elevate the wound above the heart.

Punctures – if the object is still lodged in the person's body, do not remove it. Call x52000 immediately and request medical assistance.

Fainting – if someone is about to faint, have them sit or lie down. If they have fainted in a seated position, steady them and put their head between their knees. If they have fallen to the ground, roll them to their back and elevate the legs 20-30 cm. If someone sustained an

injury during the fall, begins convulsing, or does not recover within two minutes, dial x52000 and request emergency medical assistance.

Needle sticks – Rinse the wound for 15 minutes and encourage bleeding. Determine whether it is a 'clean' or potentially 'dirty' needle. If the needle was potentially contaminated with an infectious substance, advise the victim to immediately contact Occupational Health and Wellness (x52647) or Student Health Services (x52131) and seek medical treatment. Outside of regular hours, advise the victim to seek immediate medical treatment (i.e. Emergency Room). Prophylaxis for hepatitis and HIV must be started as soon as possible following exposure.

Seizures – help the person to the floor and clear away nearby objects. Try to prevent the person from striking objects in the area and harming themselves during the seizure. Do not attempt to restrain the victim or force anything into their mouth. Placing any object in the mouth of a seizure victim only increases the likelihood of choking. Dial x52000 immediately and request medical assistance; be sure to inform them if the victim is having trouble breathing or any other relevant details.

Choking – call for help. If the airway is only partially obstructed and there is air exchange, encourage the victim to continue coughing. If the airway is fully obstructed, characterized by the inability to speak, cough, or breathe adequately, administer the Heimlich maneuver by alternating 5 back blows with 5 abdominal thrusts to dislodge an upper airway obstruction.

Cardiac emergency - if someone is showing symptoms of a heart attack (sudden pain in arm, chest, neck, jaw or back; pale skin), call x52000 and request an ambulance be sent to your location. Get the person to a sitting position and remove any constrictive clothing. Monitor their pulse and provide reassurance. If the victim goes into cardiac arrest and you are trained, administer CPR until emergency authorities arrive. Campus Police and Fire Division vehicles are equipped with portable Automated External Defibrillators (AED) and provide mobile first aid services. Additionally, there are two AED locations within the College: one in the Science Complex Atrium, and the other in Animal Science and Nutrition Building just outside of room 382.

6.6 Active Threat

If you become aware of a violent situation, such as an armed person on campus:

- If possible, lock yourself in the nearest safe room and stay out of sight.
- If safe to do so, dial x52000 and request help.
- If you are certain you can get to an exit safely, move quickly and evacuate the building.

6.7 Power Outage

Many of the areas occupied by the College of Biological Science are supplied with back-up power by generator, either from a stand-alone system or via the university's essential service grid. The time required for back-up power to come on-line is typically about 30 seconds, so if the power does go out, stay where you are for a moment to see if it comes

back on. If it doesn't, check to see if the rest of the building is out as well. If it is a problem in only a portion of the building, have one person contact the Physical Resources work order desk at x53854.

Fume hoods and biosafety cabinets must be closed during a power outage to prevent migration of hazardous aerosols or vapours into the lab. Keep away from the hoods to prevent introducing air currents and minimize exposure to any accumulated vapours or aerosols.

If it is a widespread outage and back-up power has not come on-line, before leaving the lab for any length of time, shut off any open gas valves, compressed air/vacuum valves, light switches, fans, and any other equipment. One person from the department should call Physical Resources to notify them of the outage. Also ensure the rest of the department is notified by informing the chair's office.

6.8 Flood

If you discover a flooded area and it is safe to do so, try to cut off the source of the water. If there is an electrocution hazard (e.g., the water has risen to the level of electrical outlets, submerged electrical cords), evacuate everyone from the area and contact Physical Resources at x53854. Outside of regular hours, notify Campus Police at x52000 or x52245.

7. Hazard & Incident Reporting

7.1 Reporting of Hazardous Conditions

Under OHS law, every worker has a duty to report unchecked hazards. With the nature of our work across the College, there are many hazards; but with proper planning and precautions the risk can be controlled to an acceptable level. If you have concern about a hazard in your work area, start by discussing it with your supervisor or advisor. If the scope of the problem is too large or if there is question on what should be done, the issue can be raised to the Department Chair, the local safety committee and/or EHS.

If your concern is not resolved, remember that as workers in Ontario, you have a legal right to refuse work that you legitimately feel would put you in danger. Refer to section 43 of the OHSA for more details.

7.2 Incident Reporting

If you are injured at work, get appropriate first aid and notify your supervisor as soon as possible. An Incident Report Form must be filled out, signed by the supervisor, provided to the department chair and your employee group, and submitted to EHS within 24 hours – but if an injury is serious and potentially life threatening, after getting help for the victim, call EHS (x53282) to report the incident as soon as possible. Allow Campus Police to notify the next of kin to avoid miscommunication and confusion.

Near misses (i.e., accidents that were narrowly avoided) should also be reported using the Incident Report Form.

8. Laboratory Safety

8.1 General Laboratory Safety

The goal of the safety program is not to have you memorize an arbitrary set of rules – it is much better if you try to understand the rationale behind the rules. In a lab, we need to do three fundamental things:

1. protect ourselves from exposure to the hazards present
2. prevent the migration of contaminants out of the lab
3. put systems in place to mitigate the impact of a serious incident (e.g., fire, spill)

Key points:

- Report all potential hazards or safety issues to lab supervisor/advisor.
- Familiarize yourself with the emergency response procedures.
- Know evacuation routes from your lab and the location of emergency equipment such as pull stations, fire extinguishers, spill kits, emergency showers/eyewashes, first aid kits, phones and emergency call boxes.
- Don't let others come in to the building or wing behind you if you don't know them.
- Never leave lab doors propped open.
- Do not bring food, drinks, tobacco products or cosmetics into the lab.
- **Closed-toe, closed-heel shoes are required to be worn in all laboratory areas.** Bare feet, sandals, and open-toed shoes are not permitted while working in any laboratory as there is the potential for exposure to physical hazards and hazardous materials.
- Always wear suitable clothing, a lab coat, closed-toe/heel shoes constructed of a resistant material (preferably leather), and required personal protective equipment (PPE) when working with potentially hazardous materials.
- Dispense hazardous materials inside a fume hood.
- Never allow gloved hands to touch surfaces outside of the lab, or 'clean' surfaces in the lab such as door knobs, phone receivers, or computer keyboards.
- Do not wear lab coats in common areas or stairwells.
- Keep personal items separated from hazardous materials.
- All materials dispensed from their original containers must be labeled.
- Place a sign on any unattended experiments and provide contact information so you can be reached if something goes awry. A template is provided on the CBS Safety Forms page. A printed copy is to be posted on the door of the lab and a copy submitted to the supervisor.
- Avoid use of personal headphones when doing lab work – you need to be able to hear if equipment is functioning properly, be aware of the location of people around you and be able to hear emergency alarms.
- Keep incompatible chemicals separate (no acids with bases, no flammables with oxidizers) – look at the labels and/or SDS if you aren't sure.
- Practice good housekeeping and good hygiene.

Safety rules and regulations in a laboratory environment are unavoidable - it is an environment where fires, explosions, injuries, and exposures to chemical/biological/radiological/physical threats are a very real possibility. We have had serious incidents in CBS in the past that we do not want to repeat, so please take lab safety seriously.

Proper control measures are to be implemented as appropriate to the situation. Before engaging in a new procedure or operation, every effort should be made to determine the potential hazards and appropriate safety precautions required. The schematic below depicts the order in which control strategies should be ranked; the more reliable and effective preventative measures are given preference. In practice, usually a combination of controls is used together to reduce exposure to a hazard.

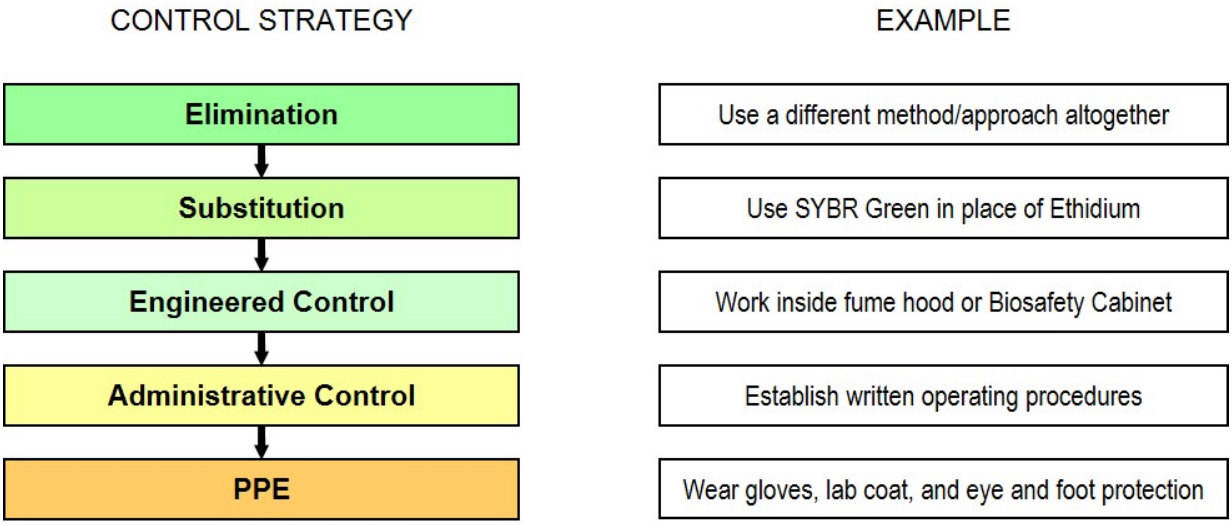


Figure 1 Hazard Control Strategies

Keep these concepts in mind when critically evaluating the work that you do in your lab.

To demonstrate the type of precautions needed to protect oneself, consider the simple task of decanting strong acid into a beaker for dilution. To do this properly one would:

- plan ahead and anticipate hazards
- perform all tasks inside a fume hood, with the sash in a low position (an engineered control that keeps corrosive fumes from entering the breathing zone)
- ensure there is clear space to work in the fume hood (a work practice control that reduces the likelihood of a spill/accidental exposure)
- wear close-toed/heeled shoes, long pants or long skirt to fully cover the legs, a lab coat, acid-resistant gloves, and goggles (personal protective equipment to protect the skin and eyes in the event of small spills and splashes)
- slowly pour the acid into a beaker partially filled with water (a work practice control that reduces the amount of undiluted acid splashing up)

The above emphasizes the use of engineered controls, safe work practices or administrative controls, and personal protective equipment to maintain exposures at a safe

level. It is a demonstration in the hierarchy of controls, which is a model for the evaluation of protective measures.

Some key points about preventing contamination:

- Always assume gloves are contaminated. You put on gloves to prevent one thing or another from touching your skin. The logical conclusion is that whatever it was you didn't want on your skin is now on the exterior of the glove. Change gloves frequently and never allow a gloved hand to touch a common surface (like a door knob, phone receiver, etc.).
- Lab coats protect you, and the clothes that you own, from becoming contaminated. It is a requirement that lab coats be worn in all labs for any work involving hazardous materials. **Lab coats cannot be worn outside of the research wings in CBS**. If you will need a lab coat at your destination on another floor, simply place your coat in a plastic bag and carry it with you.
- A clean work area goes a long way to reducing cross-contamination. When working with radioisotopes, we have the benefit of being able to detect contamination with a survey meter; with biological and chemical contaminants, we aren't so lucky. For any hazardous agent it is important to consider how the inevitable small spills, droplets and splashes can be controlled. Working over disposable bench paper is an easy way to control contamination. Alternatively, you can work over a low tray that has cleanable surfaces. Regardless of the method you use, be sure to clean your work area when finished, and if there are any small spills, clean them up using an appropriate method as soon as possible (refer to CBS SOPs on spills for more details).
- Another area with high potential for spreading chemical/biological or radiological contamination is the transport of materials through hallways. Make use of carts, secondary containment trays and safety bottle carriers when moving materials around the building.
- Another factor to consider is the storage of your personal belongings; as much as possible, you should keep personal items out of the lab. If you do have items you need in the lab, keep them well separated from potentially contaminated areas.

There are additional aspects of contamination control that pertain to the design of equipment and the laboratory itself, but the list above covers most of the basic responsibilities.

Finally, to manage the potential impact of emergencies, the general responsibilities of lab personnel include:

- Familiarizing yourself with evacuation routes, emergency procedures, as well as the locations of phones, call boxes, and emergency equipment in your work area.
- Notifying others of incidents such as spills or fires; verbally for minor incidents, or by activating an alarm pull station for more serious situations.
- Keeping aisle and exit routes clear.

- Ensuring that the access to eyewash stations, showers, and fire extinguishers is unobstructed.
- Ensuring that fire extinguishers have adequate charge (needle on pressure gauge is in green zone).
- Ensuring spill kits and first aid kits are readily accessible and appropriately stocked.

Further information can be found at the EHS website.

8.2 Workplace Hazardous Materials Information System (WHMIS)

The Workplace Hazardous Materials Information System, or WHMIS, is a very important component of the hazard communication scheme in a university laboratory.

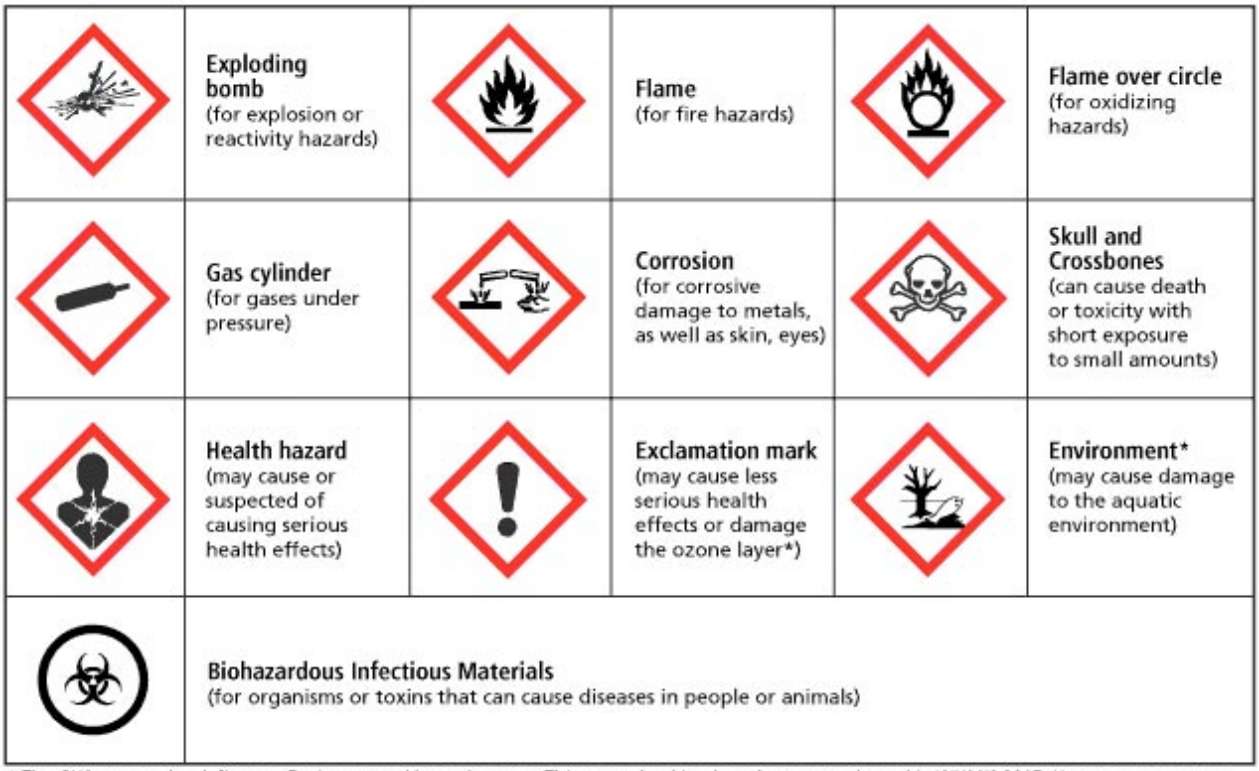
Anyone working in a laboratory environment must receive WHMIS training.

EHS provides online training modules to meet this requirement and offers training modules for WHMIS. To register for EHS courses use the EHS Course Registration System and Training Record Database.

Historically, each lab was required to keep a binder of printed Material Safety Data Sheets, which were only valid for 3 years. To eliminate this labour intensive inventory and updating requirement, the University subscribes to an online SDS subscription service, an extensive searchable online database of Safety Data Sheets. SDS are also available from vendors and from the Public Health Agency of Canada. It is still advised that each lab keep a hardcopy of the 20 most used solvents or chemicals on hand. For most chemicals, SDS can be accessed from the University of Guelph network.

WHMIS 2015, introduced pictograms to replace WHMIS symbols, revised hazard classifications (with prescribed signal words, hazard statements and precautionary statements), and standardized Safety Data Sheets (SDS) to replace Material Safety Data Sheets (MSDS).

Figure 2 WHIMIS 2015 pictograms



* The GHS system also defines an Environmental hazards group. This group (and its classes) was not adopted in WHMIS 2015. However, you may see the environmental classes listed on labels and Safety Data Sheets (SDSs). Including information about environmental hazards is allowed by WHMIS 2015.

All hazardous materials decanted from their original container must be labeled. Containers that will not leave the laboratory require only a product identifier (i.e. the name of the product written on the exterior). If a decanted hazardous material will be moved out of the lab, it requires a workplace label, which needs to include a product identifier, directions for safe handling, and a reference to the SDS. MSDS Online has a template for creating secondary container labels.

8.3 Monthly Laboratory Self-inspections

Key Points:

- Activate eyewash stations weekly to flush out contaminants, discourage microbial growth, ensure adequate water flow and document weekly checks.
- Ensure the access to the emergency eyewash/shower is not obstructed.
- Check the fire extinguisher – it should be easy to access (i.e. unobstructed), and the pressure indicator should be in the green area of the gauge.
- Check the spill kit – it should contain neutralizers (usually 3 – acid, base, and organic solvent suppressant), absorbent materials, gloves, goggles, a dustpan/scraper or dustpan/broom, bags for waste material and other hazard specific materials that may be required depending on the hazards in the lab.
- Check first aid boxes – the kit should contain gloves, tweezers, scissors, adhesive bandages, tape, gauze, and pads or compress bandages.

- Check certification of fume hoods and biological safety cabinets and notify EHS if certification has expired. Ensure work area and airflow is not obstructed.
- Visually inspect chemical storage areas to ensure there is no leakage and incompatibles are separated each month.
- Look for issues with unsecured gas cylinders, poor housekeeping, electrical hazards, and access to exits.
- Report any issues to your supervisor.

It is important that laboratory inspections be completed regularly to monitor and maintain the safety of each work area. In any given lab there can be a combination of physical, chemical, biological and radiological hazards - diligence is required to control these hazards and keep the work environment safe.

8.4 Fume Hoods

Key Points:

- Keep sash closed when not in use.
- Ensure that the fume hood is on prior to use.
- Work with sash as low as possible (less than 18”/50cm).
- Keep all work at least 6”/15cm back from front edge.
- Do not obstruct air vents at rear of hood.
- Do not allow hoods to become cluttered or to be used as extra storage.
- Uncap containers inside the hood; recap them as soon as you are finished.
- Do not use a fume hood if the alarm indicates low flow.
- Completely close the sash if you are working in a hood when the fire alarm goes off.
- To prevent the formation of explosive perchlorate compounds and residues, any solution of perchloric acid above 70% being heated must be handled in a specially designed hood with wash-down features.

Further instructions on the proper use of fume hoods are provided in the SOP.

When a hood is not in use, keep the sash fully closed. This is a simple thing that can conserve a lot of energy - fume hoods exhaust a large volume of air when they are open, and it requires a great deal of energy to heat or cool the replacement air.

When you are working in a hood, keep the sash as low as you reasonably can. This improves ability of the hood to keep airborne contaminants out of your breathing space, offers some protection to your face should there be a splash or spill, and conserves energy.

Fume hoods on campus are equipped with a warning device that will alarm when the airflow is inadequate for the hood to function as designed. The alarm will go off if the airflow falls below a preset threshold (typical a face velocity of 80 feet per minute). Do not attempt to use the hood if the alarm is going off and stop any experiments taking place inside the hood if the alarm persists. Close the sash fully to prevent hazardous vapours from migrating into the lab. EHS coordinates a program for annual calibration and testing of fume hood air flow alarms.

To determine if low flow may be resulting from a disruption of airflow, remove items that may be obstructing the movement of air through the vents at the back of the hood. Also, lower the sash and reset the alarm if possible. Sash position will affect the face velocity, which is an important factor in effective capture of airborne contaminants. Baffles should not be adjusted by users.

Large disruptions in the air around a hood (e.g., the opening/closing of a door) may temporarily affect the airflow through the hood; if this is suspected as the cause of the problem, try resetting the alarm if possible. If the above changes do not rectify the issue, label the hood as 'out of order' and notify Physical Resources (x53854) or the appropriate departmental contact for equipment problems.

8.5 Biosafety Cabinets (BSCs)

Key Points:

- Any time your work requires use of the BSC, you should wear a lab coat and gloves to protect your skin and your clothing from contamination. As well, long hair should be tied back, as required by the Canadian Biosafety Standard.
- Plan your work and minimize movement in and out of the hood.
- Chemically disinfect before and after use.
- Allow time for air currents to stabilize before starting work in the cabinet.
- Review the SOP for additional details on the use and care of this equipment.

8.6 Liquid Nitrogen

Key Points:

- Always wear insulated gloves and eye protection when handling liquid nitrogen.
- Follow the operational practices outlined in the SOP.
- Keep the door open when dispensing from bulk storage dewars.
- If you have a spill, you need to evacuate immediately. Make sure everyone gets out of the immediate area and wait 30 minutes for the air to clear. If a spill is >4L, call EHS, as air testing may be required to verify the oxygen level has returned to normal. Report the spill using the EHS Incident Report Form.

Some storage areas for dewars are equipped with an oxygen monitor. If the alarm sounds, close any open valves immediately and leave the room.

8.7 Chemical Safety

Key Points:

- Know the hazards of the materials with which you are working. Review the SDS prior to handling a new chemical.
- Don't accumulate unnecessary inventory - check to see if your lab already has the chemical, and order only as much as you need.
- Never store incompatible materials together. Acids cannot be stored with bases; flammables cannot be stored with oxidizers.

- Never put flammable solvents in a fridge unless the fridge is specifically designed to accommodate flammables. There are far too many recorded cases of fridges and freezers exploding in laboratories because of improper storage of flammable materials.

8.8 Compressed Gas Cylinders

Key points:

- Changing compressed gas cylinders or working with compressed gases should not be conducted while working alone, or after regular business hours. Transfer of cylinders should be done by TWO PEOPLE.
- Do not attempt to change a tank unless you have been trained to do so. WHMIS training addresses this topic, and further details are provided by your PI. Additionally, as transport of cylinders will usually involve movement to different floors of the building, workers who are required to use freight elevators will also need to complete Freight Elevator Handling training offered through EHS.
- Any gas cylinder that is moved must have a safety cap screwed over the valve on top of the cylinder. This rule applies irrespective of the content (inert, toxic, flammable or corrosive) and status (full or empty) of the cylinder.
- When moving a tank – remove the tank regulator and ensure the safety cap or valve protection cap is completely screwed on. The tank must be chained or strapped to a cylinder cart designed for moving cylinders. A 4-point trolley is recommended. Never drag or roll a cylinder.
- If an elevator must be used for transporting a compressed gas cylinder it must be transported in an unoccupied freight elevator, which can be operated from outside of the elevator. Do not ride in a freight elevator with a compressed gas cylinder. In the event of a gas leak, there may be insufficient ventilation to maintain adequate oxygen levels. A buddy system is recommended. Post a sign to warn people not to enter the elevator during transport and have someone wait for the freight elevator at the destination.
- Always secure tanks vertically using a strap or chain whether in storage or in use.
- Tanks in use must be secured in an upright position with a regulator attached.
- Never store tanks of incompatible materials together (e.g., flammable gases beside oxygen).

Compressed gas cylinders are under high pressure and contain a lot of potential energy. The principle hazards are that a failure in the tank or the valve will cause a rapid release of pressure (i.e. an explosion), and a release of the contents (leaking or open valve) that could be hazardous.

Even non-toxic gases such as nitrogen are potentially harmful, as the leaking gas can displace oxygen and lead to asphyxiation. 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. A leak of a toxic gas can

rapidly reach a hazardous level. Similarly, a leaking cylinder of flammable gas could potentially lead to a fire or explosion.

To prevent leaks, always use the right type of regulator, fittings, and hoses for your application. Inspect all components prior to assembling to ensure they are clean, dry, and functioning properly. When appropriate, check all connections by brushing on a soapy solution to ensure there is no errant gas escaping. In some applications a gas detector may be required.

8.9 Biosafety

All employees and graduate students handling biohazards are required to participate in the Occupational Health and Wellness (OHW) biosafety medical surveillance program as required under the Human Pathogens & Toxins Act and the current Canadian Biosafety Standard.

Risk Groups and Containment Levels

Biological materials are classified into 'Risk Groups' based on their ability to cause disease in humans and/or animals.

Risk Group 1 – low individual and community risk
Risk Group 2 – moderate individual risk, limited community risk
Risk Group 3 – high individual risk, low community risk
Risk Group 4 – high individual risk, high community risk

The Risk Group (RG) indicates the relative level of risk to workers and to public health, but the more relevant classification from an operational perspective is the **Containment Level**. The Containment Level defines the nature of the engineering and procedural controls required for handling different organisms. There are four levels of containment ranging from Containment Level 1 (CL-1) with the lowest level of risk to CL-4 with the highest level of risk.CL-1 and CL-2 facilities are identified by standard signage.

Prions, RG-3 and 4 biohazardous materials are prohibited in University of Guelph facilities.

The University of Guelph does not have CL-3 or CL-4 facilities.

Anyone performing work with human or animal pathogens must familiarize themselves with the Canadian Biosafety Standard (CBS) 2nd edition issued by Public Health Agency of Canada (PHAC). The CBS 2nd edition replaces the CBSG 1st edition, the Laboratory Biosafety Guidelines, the Containment Standards for Veterinary Facilities and Containment Standards for Laboratories, Animal Facilities and Post Mortem Rooms Handling Prion Disease Agents.

ePATHogen is PHAC's new database for biological agents and provides risk group and containment level classifications for human and terrestrial animal pathogens. Containment levels may also be obtained from the Pathogen Safety Data Sheets (PSDSs) posted on

the PHAC website. Visit the Canadian Food Inspection Agency (CFIA) Disease Agent Information page to view the animal disease fact sheets, and obtain information for aquatic animal pathogens and plant pests. Another resource is the BioSafety App which is a free download for Android and Apple devices and provides facility containment requirements.

If you are unable to find information on a pathogen, contact the University of Guelph Biosafety Officer (BSO) for assistance.

The containment level for recombinant DNA and genetic manipulation will depend on a risk assessment that considers the pathogenicity of the donor/source organism and the recipient organism, as well as the properties of the recombinant organism with respect to protein expression and replication. For assistance in determining the proper containment level, contact the U of G Biosafety Officer by email with all the relevant information and documentation.

Cell lines may be biohazardous as a result of the organism's inherent pathogenicity, or due to contamination with other agents such as viruses, fungi, bacteria or prions. At the University of Guelph, the policy is to work with human cell lines/cell cultures under Containment Level 2. In cases where there is a high potential for laboratory-acquired infection (e.g., cell lines derived from macaques that may be contaminated with *Herpesvirus simiae*) Containment Level 3 will be required – the University of Guelph does not have a license to work with Risk Group 3 or 4 material. Conversely in cases where the risk is assessed and deemed to be low, work with animal cell lines may be downgraded to Containment Level 1 in accordance to the Safety Data Sheets provided by the distributor or vendor documentation.

Operational Requirements

The requirements for the various Biosafety Containment Levels are defined in detail in the CBS and reiterated in the reference materials including the Canadian Biosafety Handbook, 2nd Edition, that support the biosafety program.

As discussed in the section on lab safety, the purpose of the various requirements is to keep you, as a worker, from being exposed; to prevent contamination from being carried out of the lab and spread to other parts of our facilities; and to put plans in place to deal with emergencies that may arise.

A few of the essential operational requirements for Containment Level 2 (many of which are applicable in all labs) are listed below:

- All personnel must wear fastened lab coats when working in the lab. Lab coats are not to be worn in stairwells or common areas of the building. Contaminated lab coats should be autoclaved or chemically disinfected prior to laundering (unless laundering has been proven to effectively decontaminate lab coats).
- Eye or face protection is required whenever there is a risk of splashes, aerosols or flying objects. Minimum eye protection in the lab is safety glasses.
- Closed-toe, closed-heel shoes are required when working in all laboratories, including Containment Level 2 areas.

- Gloves must be worn while handling or working with a pathogen and/or infectious materials and removed prior to leaving the work area. Any cuts or scrapes must remain covered at all times with a waterproof dressing. Hands should be washed thoroughly (at least 15-20 seconds of rubbing with soap) whenever gloves are removed, and prior to leaving the laboratory.

- To prevent accidental contamination, legs must be covered to the ankle so there is no exposed skin, long hair must be tied back, and lab coats must be worn by all personnel when working in the lab. Dangling jewelry and spiked rings must not be worn while working in a CL-2 lab.

- To reduce the probability of ingestion, food, drink and cosmetics are not permitted in the lab, and oral pipetting is prohibited.

- To prevent indirect or cross contamination, gloves should be preferably changed or removed before handling items likely to be touched by others not wearing gloves, such as doorknobs, light switches, equipment/computer controls, lab notebooks, written instructions or writing instruments. The use of equipment controls such as flexible keyboard covers that can easily be disinfected is encouraged. Laminated copies of SOP's or instructions lend themselves to decontamination and pens and markers can be cleaned with ethanol after use.

- Routine chemical disinfection of work surfaces is necessary to prevent the spread of potentially pathogenic material. Benchkote should be changed on a regular basis and following any minor spills. Non-essential items and personal belongings must be kept away from areas where biohazards are handled.

- Sharps are to be discarded in containers that are leakproof, puncture-resistant, and fitted with lids, or specially constructed for the disposal of sharps waste. Sharps are never to be disposed in the regular waste.

- All biohazardous waste materials must be decontaminated. Liquid biohazardous materials are to be chemically disinfected or autoclaved prior to release to sanitary sewers. Dry biohazardous materials are to be autoclaved prior to disposal in the regular waste stream or collected by a disposal company specializing in the handling of biohazardous waste. For questions related to chemical and biohazardous waste contact the U of G Lab Safety Officer. For questions related to radioactive waste contact the Radiation Safety Officer.

- Fundamentally RG1 and RG2 waste is to be sterilized in the same manner as described above, however, the reasoning behind these actions is different. In the case of RG2 it is a requirement of the Human Pathogens & Toxins Act to reduce the risk of pathogen release from the containment zone to the environment and community, thus protecting your safety and the safety of others. In the case of RG1 organisms (which are not regulated by PHAC or CFIA) they can act as opportunistic pathogens for immunocompromised or immunosuppressed individuals so all RG1 biological waste should be sterilized and good microbiological laboratory practices followed. Autoclave runs must use a biological indicator i.e. spore strips/vials to ensure efficacy of the sterilization cycle.

Permits

A valid biohazard permit, issued by the University of Guelph Biosafety Committee, must be obtained for all activities involving use or storage of biohazardous materials. For more details and all relevant forms please refer to forms section of the Biosafety Program on the EHS website.

In accordance to the Human Pathogens and Toxins Regulations (HPTR) 4 (1), the Biological Safety Officer (BSO) must be notified before arrangements are made to do the following:

- import/export a human/animal pathogen or toxin
- receive a human/animal pathogen or toxin from another facility
- transfer a human/animal pathogen or toxin to another facility

Import/Export of Pathogens

The Public Health Agency of Canada (PHAC), under the authority of the Human Pathogens and Toxins Act (HPTA), regulates researchers who require a Pathogen and Toxic License document for human pathogens and an importation permit for terrestrial animal pathogens. The Canadian Food Inspection Agency (CFIA) issues permits for aquatic animal pathogens, plant pathogens, bee pathogens, foreign animal pathogens and pathogens causing emerging animal disease, animal products and animal by-products.

More information is available from EHS and their Quick Reference Guide, and at the following resources:

- Government of Canada Laboratory of Biosafety and Biosecurity
- CFIA Animal Pathogen Imports

Material Transfer Agreements

Before we release biohazardous materials to another individual, organization or institution, it is incumbent on us take reasonable steps to ensure that the material will be handled properly.

For materials that fall into Risk Group 2 (the highest level at U of G), we must ensure the destination facility also fulfills all requirements of a Containment Level 2 laboratory, as described in Canadian Biosafety Handbook, 2nd Edition, and that a Biohazard Agent Transfer Notification form is completed. As well, shipments of RG-2 materials may fall under the Transportation of Dangerous Goods (TDG); refer to the CBS SOP on Transport of Dangerous Goods for further details.

For transfers within the University of Guelph, an Internal Biohazardous Material Transfer Agreement (IBMTA) must be completed and authorized by the Biosafety Officer.

Another consideration is the protection of intellectual property. The Material Transfer Agreement governs the transfer of proprietary materials to third parties. A Material Transfer Agreement form can be downloaded from the Research Innovation Office.

Purchases (Commercial)

Pathogens, biological toxins and recombinant DNA cannot be ordered by way of a low value purchase order. Requisitions for biological hazardous materials need to be submitted as a high value purchase order via the iProcurement Online Requisition. The category code for biological hazardous materials is BIOHAZ.SUPP. In order for the Biosafety Officer to complete the purchase process, the Principal Investigators (PI's) must hold a valid University of Guelph Biohazard Permit.

Biosecurity

In recent years the level of concern over the security of pathogenic materials has grown. From the perspective of the end user, the key points surround access and inventory control.

1. Access control is an important aspect of biosecurity. Don't let others come into the building behind you if you don't know them. Never prop open doors or tamper with locking mechanisms, and please report any suspicious activities or behavior to your supervisor. Doors can be unlocked during the day when the lab is occupied, but after-hours lab doors must be securely closed and locked. If freezers or storage rooms are kept locked, be sure to relock them when you are finished using them.
2. To facilitate proper inventory control, make sure you keep your materials well organized, properly labeled, secured and accounted for using the inventory system in your lab. In accordance with the CBS 2nd edition, principle investigators (PIs) must maintain an inventory of - all authorized users and all others who have access to their lab; pathogens (including genus and species), cell lines and microbial toxins. Prior to biosafety inspection, permit application or renewal, PIs will be requested by BSO to submit their inventory records.

8.10 Radiation Safety

Permits

All radioactive materials must be ordered through the Radiation Safety Officer and may only be handled by laboratories that have a permit granted by the campus Radiation Safety Committee.

At the University of Guelph, we have Basic Level Laboratories (BLL) and Intermediate Level Laboratories (ILL). The open quantity of a radioisotope in a BLL is limited to less than 5 times the Annual Limit on Intake. An ILL may be used to handle radioactive material with activity up to 50 times the Annual Limit on Intake.

In addition to quantity limitations within permitted labs, there are extensive requirements for inventory tracking, use of shielding devices and exposure controls, monitoring of exposure and contamination, and management of waste. These topics are covered in detail as part of the Radiation Safety Training and documented in the Radiation Safety Manual. More information is available on the EHS website.

Requirements

Prior to any work with radioactive materials, staff and students must successfully complete Radiation Safety Training which is offered by Environmental Health and Safety. This can mean anything from lasers, to x-rays, to emissions from specialty microwave heaters, to subatomic particles from radioactive materials. For more information on working with ionizing radiation and/or for procedures please refer to the University of Guelph, Radiation Safety Manual. Training must be refreshed every three years.

Personnel who use high powered lasers (Class 3B and 4) and those that work with Radioiodine (I-125, I-131) should refer to the Occupational Health & Wellness Website for information on required pre-assignment eye exams and thyroid bioassay monitoring.

For more information please contact the University of Guelph's Radiation Safety Officers, as listed in the Contacts section of the CBS website. Documentation and forms pertaining to the Radiation Safety Program are accessible to users through their University of Guelph login, and considered the primary reference for operational guidance.

Intermediate Level Laboratories are identified with signage posted on the exterior of the laboratory door. Basic Level Laboratories have the signage posted on the interior of the door and the work areas in which radioactive sources are handled are marked with Radiation Tape. A copy of the radiation permit is to be posted within both the ILL and BLL.

During experiments, in most circumstances it will be appropriate to have a survey meter on hand to periodically sweep the work area, verifying that contamination has been effectively controlled. As well, post-experiment wipe-testing must be performed, and results recorded to confirm the work area is adequately free from radioactive material. These records are maintained in each of the 3 ILL rooms and are corroborated with inventory control documents during annual lab inspections by EHS.

Dosimeters for monitoring radiation exposure are exchanged on a quarterly basis. Dosimeter users will be contacted via email when new dosimeters and rings arrive at the Chemistry Stockroom. Please exchange promptly as there is limited time for return to Environmental Health & Safety.

8.11 Human Research

The use of human participants for research has obvious ethical and safety implications. Any research projects that will involve human participants must be reviewed and approved by the University of Guelph Research Ethics Board for compliance with federal guidelines. Further details are available online at the Office of Research website; Ethics and Regulatory Compliance.

All students and researchers engaging in research involving human participants are required to undergo training. The Course on Research Ethics (CORE), an online self-guided tutorial provides an applied approach to the guidance provided in the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans 2nd Edition (TCPS2). All guidance in TCPS2 is based on its three core principles: respect for persons; concern for welfare; and justice.

Risks in research are not limited to participants and may become a safety concern. There should always be two personnel present when meeting participants for human research, but especially after regular business hours.

8.12 Animal Care

The use of animals in biological research is under the oversight of the Animal Care Services (ACS). Prior to initiating any study involving animals, an Animal Utilization Protocol (AUP) must be approved by the Animal Care Committee (ACC), and participants must successfully complete training as animal users. This training involves:

- 5 compulsory online core modules to be completed with a minimum score of 70%
- Orientation of animal facilities
- Hands on animal training. (Workshop list)

8.13 Laboratory Wastes

Across the College we generate many different types of waste. The proper segregation of waste is an important issue; placing hazardous waste in the normal garbage can put the safety of the custodial staff at risk and may lead to serious fines and penalties to the University. The pouring of chemicals down the drain is irresponsible, damaging to the environment, and is prohibited by law.

If you are unsure of how a certain chemical or material might be classified as a waste, hang on to it and ask for clarification from your supervisor, or the Laboratory Safety Officer in the EHS department.

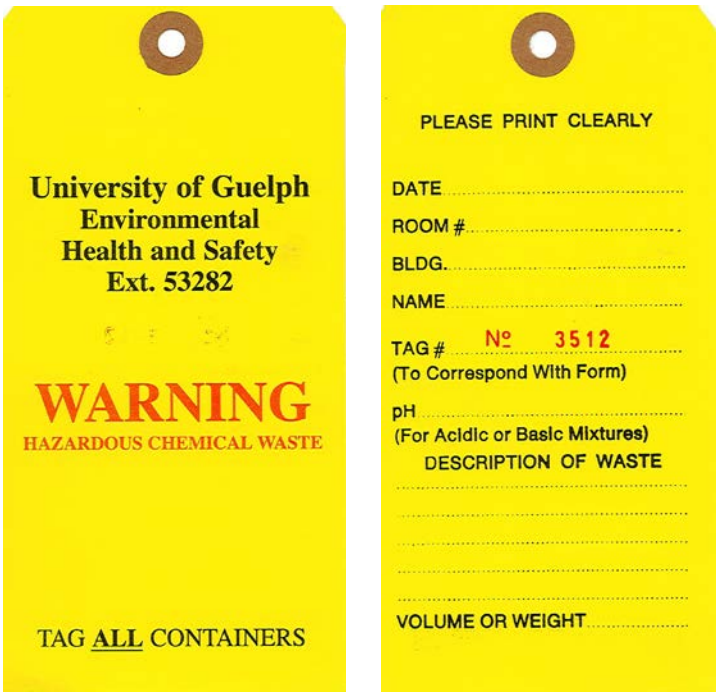


Figure 3 Hazardous Waste Tag

Hazardous Waste tags, like the one shown to the left, (front and back) are available from the Chemistry Stockroom or from the EHS Department.

You may contact EHS at x53282 to request a supply of tags through interoffice mail.

Affix a tag to the waste container when you begin collecting waste.

The following table itemizes the types of waste we routinely have in the College, and what should be done with each.

Table 1 Waste Disposal Procedures

Waste	Examples	Disposal Procedure
Regular, non-hazardous garbage	Paper towel, gloves	Place in garbage container (black bag).
Recyclable materials (not contaminated with hazardous materials)	Fine paper, newspaper	Place in blue bin (clear bag)
Aqueous solutions	Phosphate buffer Tris buffer	Aqueous solutions that contain any hazardous materials (metals, dyes, stains) must be collected and disposed of as hazardous waste. Components of solutions must be identified on the hazardous waste tag and corresponding form. NOTE – if solutions are strongly acidic or basic, label and separate. Do not mix acids and bases in waste jugs. Affix a waste tag and when full submit Surplus Chemical and Sharps Disposal requisition to EHS.
Halogenated organic solvent waste	Chloroform, methylene chloride	Collect in either a safety canister <25L or an empty 4L bottle. Safety canisters will be returned within a week of pick-up. If using a safety canister, affix a waste tag to indicate the type of waste and components. Keep the lid closed except when filling, and store in flammable storage cabinet. If reusing a 4L bottle, ensure it either contained a compatible chemical or has been cleaned of any residue. The original label must be defaced or removed, and the bottle must be labeled with a waste tag indicating the type of waste it contains. Store in the flammable storage cabinet. When canister or bottle is full submit Surplus Chemical and Sharps Disposal requisition to EHS.
Non-halogenated organic solvent waste	Acetone, ethanol, isopropanol	Collect in either a safety canister or an empty 4L bottle. If using a safety canister, affix a waste tag to indicate the type of waste. Keep lid closed except when filling,

Waste	Examples	Disposal Procedure
		and store in flammable storage cabinet. If reusing a 4L bottle, ensure it either contained a compatible chemical or has been cleaned of any residue. The original label must be defaced or removed, and the bottle must be labeled with a waste tag indicating the type of waste it contains. Store in the flammable storage cabinet. When canister or bottle is full submit Surplus Chemical & "Sharps" Disposal Request Form to EHS.
Clean Glass Waste	Clean glassware	Clean/sterilized glass, including broken glassware can be placed in the containers marked as 'Glass' (white pail, yellow bag). Ensure any glass going into this waste stream is clean.
Biohazardous Waste	Used culture plates/tubes/flasks, disposable pipettes	Collect in an autoclavable bag (typically orange or red). Regularly (e.g. daily) close the top of the bag, place in a secondary container, and use a cart to take it to the autoclave designated for waste. Do not pack waste tightly; penetration of the steam is imperative for effective decontamination. Note – in departments/areas where suitable autoclaves are not available, a specialized waste contractor can be contracted to regularly pick up collected biohazard waste. Contact EHS to initiate this type of agreement with an external contractor in this area.
Biohazardous sharps	Syringes, blades, contaminated broken glass (including Pasteur pipettes) or other sharp objects potentially contaminated with a biohazardous material	Sharps must be collected in a puncture-resistant container designed for sharps collection. When the bin has reached the fill line, the lid must be secured shut. The sharps are classified as biohazardous waste hence forward the Surplus Chemical & "Sharps" Disposal Request Form to Lab Safety Officer for an external vendor "Biohazard" pick-up.
Radioactive waste	C14, P32	Waste is collected in designated bins (separated by isotope). Complete the Radioactive Waste Disposal Request Form and submit to EHS to arrange for a radioactive waste pickup.
Expired/Unneeded chemicals	Chemicals that are no longer used, Expired chemicals	Do not remove from original container. Place in a safe area of the lab, affix a waste tag and submit Surplus Chemical & "Sharps" Disposal Request Form to EHS.

Waste	Examples	Disposal Procedure
Compressed gas tanks	Empty N2 cylinder	In most cases, tanks can be returned to the supplier. If you are left with a tank that cannot be returned, affix a waste tag and submit requisition to EHS for disposal.
Formaldehyde	Formalin preservative	Formaldehyde is an irritant and a human carcinogen and must be treated as a hazardous waste. Collect in a suitable container, affix tag and when full submit Surplus Chemical & "Sharps" Disposal Request Form to EHS.
Ethidium bromide waste	Stock solutions	Stained gels and contaminated solid wastes (weigh paper/tray, benchkote) should be collected in a sealable container (e.g. 20L pail with lid, lined with heavy gauge plastic bag & labeled as HAZARDOUS - EtBr WASTE). To dispose of container contents, affix a waste tag and submit Surplus Chemical & "Sharps" Disposal Request Form to EHS. Stock solutions should be collected in a labeled bottle and stored in a safe location. When necessary, submit Surplus Chemical & "Sharps" Disposal Request Form to EHS for disposal. Staining solutions can be treated in the same manner as stock solutions or detoxified by chemical reaction or specialized filtration. By-products of the filtration method must be treated as hazardous waste.
Acrylamide	Stock solutions, polymerized gels	Acrylamide monomer (i.e. powder or in solution) must be treated as a hazardous waste. Uncontaminated polymerized gels can be discarded in the regular garbage.

9. Field Safety

9.1 Overview

Across CBS we have many different researchers coordinating many different projects. There is no standard list of precautions that is going to be applicable in all circumstances – but what is universally critical is to **plan ahead**. If the project requires collection of plant material from the forest canopy, then proper training and climbing equipment are going to be important; if it involves research on the diet of bears, then some form of protection from local predators, such as pepper spray or firearms, is a top priority.

When considering the training, equipment and safety precautions a field team will need, consider all the things which could go wrong – engineers call this type of approach 'failure mode and effects analysis'; we don't need to be so technical, but in concept we are trying to accomplish the same goal – to determine up front the problems that could arise.

Prior to starting a project involving field work:

- Principal Investigators must complete a Field Research (or Field Trip) Safety Plan Form (available on-line) and have it approved by the Department Chair.
- Prior to the start date, all participants must have received all the training or certifications indicated in the Field Research Safety Plan.
- Each field trip student must complete and submit a *Release and Indemnification Form*.
- Anyone intending to use a University Vehicle, must submit a Driver Information Profile Form authorized by the Department Chair, to both Treasury Operations and Transport Services.

9.2 Field Research Safety Plans

A Field Research Safety Plan must be completed by the Principal Investigator and approved by the Department Chair.

The Field Research Planning orientation, available through Courselink, is a good resource to help identify various hazards in field work. The Off-Campus Activities, Research and Field Trips policy is available on the EHS website.

9.3 Remote Locations

Any time you are working away from developed areas, it becomes important that you are prepared to deal with any situation which may occur.

A reliable means of communication is critical. You need to be able to call for help if you find yourself in circumstances that you are not equipped to handle. Communication technologies to consider for two-way communication are access to local phones, cell phones, satellite phones, or radios. Personal locator beacons (PLB) and Satellite Messengers can send a distress signal via satellite communications and may be appropriate. Each system has its limitation and capabilities, and which is most appropriate requires some research into the type of communication network and the coverage

available in the area where the field work or research is being done. It is important to check in regularly – if a schedule is established for calling in, make sure you keep to it.

Emergency assistance may not be readily available, so it's important to have a plan. You must have a first aid kit and a trained first aider on the expedition to deal with minor injuries. You also must have a plan for getting help in the event of a serious injury requiring medical evacuation – know the location of the nearest hospital or medical centre and how to contact them.

Anyone who will be working in the field and taking a medication for pre-existing conditions is strongly encouraged to bring an adequate supply, and preferably extra in case circumstances change. If you would like to consult confidentially with a medical professional on this subject, please contact Occupational Health and Wellness or Student Health Services as appropriate.

For expeditions to very remote locations, contact the emergency search and rescue authority in advance of your trip to let them know when and where your research will be conducted. For example, in northern Ontario the Ministry of Natural Resources coordinates search and rescue; please contact them if you will be doing field work in highly remote areas.

9.4 Sexual Violence in Field Work

Many researchers derive strong satisfaction from participating in field work, and often spend several weeks to months at field sites. Unfortunately, field work and field sites are not inherently safe spaces for the people who work there. Given the prevalence of field work conducted by the College, and the known incidence of sexual violence at field sites, steps can be taken to reduce the incidence of sexual violence in field work and provide improved support for survivors.

Two new documents have been created to provide awareness on this topic and enhance existing safety policies and procedures. They are appendices to the university form Field Research Safety Plan and are available for download on the CBS website in the Safety Forms section.

1. The document Sexual Violence Information and Resources for Field Sites (Appendix A) provides information on sexual violence, consent, advice on survivor support, up-to-date 24-hour phone support information and reporting procedures. It is to be posted at all CBS field sites.
2. The second document; Field Research Safety Plan: Sexual Violence (Appendix B) communicates information on sexual violence including definitions for terms i.e. sexual assault, sexual harassment, stalking, indecent exposure, voyeurism, and sexual exploitation. Prior to engaging in off-campus field work, field trip participants are asked to read and acknowledge understanding of content by signing the form. A copy will be filed in the Lab Safety Binder and a second copy is to be submitted to the departmental Administrative Assistant.

Sexual violence can occur at any time, in any location. Due to their remoteness and isolation, survivors of sexual violence working at field sites may be less likely to seek help.

The University of Guelph takes a **ZERO TOLERANCE** position on any form of sexual violence (sexual assault or sexual harassment) at all field stations used by its faculty, staff, students, or volunteers. Wherever you are working, your PI must ensure your location be equipped with phone service and can access any of the resources listed below. You have the right to be safe.

You can contact these resources for support from <u>any</u> location

- Guelph Wellington Women in Crisis and Sexual Assault Centre
  24-hour Crisis Line; People of all genders are welcome to call for support.
  519-836-5710 (if out of Canada, dial "1" first for country code) or
  1-800-265-SAFE (7233)

- Here 24/7
  Regional crisis line
  1-844-437-3247
  TTY:1-877-688-5501
  Confidential and anonymous

Information related to sexual violence including The University of Guelph Sexual Violence Policy is available at the University of Guelph Sexual Violence Support and Information website. This site also provides opportunities to attend campus-wide training, lectures, workshops or events relating to sexual violence. Additional resources, available supports, reporting procedures and distinctions about reporting requirements are also accessible at this site. The Student Affairs site offers general awareness, information and resources for both staff and faculty around sexual violence through an online training module.

9.5 Disease

Contact the local public health unit for information on travel advisories and vaccines or prophylactic treatments you may need. For insect-borne diseases, controls such as mosquito netting and repellents may also be advisable.

9.6 Sun Safety

Almost everyone enjoys working out in the sun on a nice day, but overexposure to ultraviolet rays can have serious long-term consequences. As well, exposure to direct sunlight increases the risk of dehydration and heatstroke.

When on University business, use typical sun protection measures such as sun glasses, wide-brimmed hats and a broad-spectrum sunscreen, reapplied every 2 hours. Take frequent breaks in the shade and drink plenty of water to stay hydrated. Pay attention to the Environment Canada UV Index and adjust your work schedule accordingly when possible. Where possible, try to minimize prolonged, direct exposure to sunlight during the hours when UV rays are most intense (10am to 4pm).

Figure 4 Heat-Related Illness Poster

This CCOHS poster describes observable warning signs for heat exhaustion and heat stroke.

9.7 Wildlife

Being knowledgeable about the wildlife in the region is a crucial factor in keeping safe when conducting field research. Thoroughly research an area when establishing your field research safety plan and, where necessary, make use of local experts.

In high-hazard circumstances, you may need to obtain anti-venom or antidotes and carry them with you on your trip. In some instances, firearms may be necessary for protection. To lawfully carry a firearm in Canada you must have successfully passed the Canadian Firearms Safety Course and hold a valid Possession & Acquisition License (PAL) from the Canadian Firearms Centre. Information about the Canadian Firearms Program and licensing is available from the RCMP website.

9.8 Working at Height

If the nature of your research requires any work more than 3 metres off the ground, you must have appropriate training and equipment.

Equipment for working at height can come in several forms – make sure you are fully trained on the equipment you will be using, and that all equipment is inspected pre-use and kept in good condition. The type of safety gear required will depend on the type of work being done.

Do not work at height alone. It is imperative there be someone present to get help if you do fall and injure yourself.

9.9 Security

Traveling abroad for research can be a rewarding experience, but it is important to be familiar with the political and socioeconomic conditions of your destination. Make use of local contacts to gain an understanding of the potential issues that may arise. The University of Guelph's Centre for International Programs provides a great deal of information to ensure safe international travel. Travel advisories issued by Global Affairs Canada provide destination-specific travel information.

9.10 Water Hazards

Boats

Any use of watercraft for University activity must be in accordance with the laws and regulations of the applicable region. For use of powered small water craft in Ontario, the operator must have (at least) a valid Pleasure Craft Operator Card.

Basic safety equipment on a boat includes life jackets for all occupants, a bailing bucket, a flashlight or flares, a whistle or air horn, and a fire extinguisher. You should also have oars in case you lose power, an anchor and anchor line, and buoyant rope in case you need to throw a line to another vessel or a person in the water. Depending on the size of your boat, you may also need a radio and navigation equipment. Vessels less than 6m without a motor (such as canoes and rowboats) do not require a Pleasure Craft Operator Card, but do require lifejackets for all occupants, a bailing bucket (or pump), a whistle or horn, as well as 15m of buoyant line and an oar or an anchor. If the craft will be used after dark, navigation lights are required.

More information is available at EHS in the document Boats and Watercraft Policy.

The University has limited facilities for the storage of unused gas and fuel tanks. If you have gasoline left over at the end of the field season, you can transfer the gas into the fuel tank of another vehicle. If you are transferring between two metal containers, be sure to ground and bond the containers to reduce the probability of static discharge.

Marine/Aquatic

In Ontario there are regulations that specifically pertain to diving operations. If doing any work underwater in Ontario involving more than a snorkel, the dive will be subject to Ontario Regulation 629/94. Under the Diving Operations regulation there are very specific and comprehensive training requirements. You must file a notice with the Ministry of Labour and conduct the dive in accordance with the applicable sections of the regulation. Diving outside Ontario must be conducted in accordance with the relevant standards and regulations in that jurisdiction. Dive plans must be submitted to EHS for review and approval. Contact EHS for more information.

If you are working in a marine environment, avoid snorkeling, swimming or diving around piers as you could be seriously injured if you were struck against a pier or pylon. Similarly, one of the major hazards of working in and around streams and rivers is the current. Never wade into water flowing quickly enough to sweep you downstream, and if you have doubts as to whether you can safely walk or stand in the water, don't go in!

If you are using hip-waders, keep the belt cinched at your midsection. Loose waders can increase the risk of drowning if they get swamped with water. It is not recommended to wear hip waders in a boat – if you fall in, they can fill with water and increase the risk of drowning. Be very cautious when wading into any body of water and ensure you know the depth and have good footing.

Electroshocking

The use of electroshocking/electrofishing equipment requires precautions to prevent accidental electrocution of the user. There is a risk of severe electrical shocks and cardiac fibrillation when using this equipment, so never use electrofishing equipment when alone, and ensure at least one member of the team has a valid CPR certification.

Inspect the electroshocking unit, waders and gloves prior to sampling each day in the field. Waders or gloves that fail a leak test must be replaced or repaired before use. If a leak is detected at any point, stop sampling and replace/repair the equipment immediately. No member of the team should contact the water with unprotected skin at any time during sample collection.

Review the manufacturer's instructions for the equipment and familiarize yourself with all necessary safety precautions before using this type of equipment.

Ice

Be wary of ice conditions, particularly during milder periods in fall and spring. The Canadian Red Cross recommends a thickness of 15 cm of clear, solid ice before walking alone on an ice sheet. Snowmobiles require a thickness of 25 cm, and cars and light trucks should not be moved onto ice until it is at least 30 cm thick.

In determining whether it is safe to venture onto the ice, consider more than just ice thickness and consult with local experts. White/opaque ice is only about half as strong as clear/blue ice. The age of the ice, freeze/thaw cycles, and recent climatic conditions like temperature, sunlight and snow cover can all impact the strength of the ice. The common-sense rule is that if you aren't sure it's safe, don't go out on the ice!

9.11 Vehicles

Use of personal vehicles for University business is not recommended. Whenever possible, make use of University-owned vehicles for field work and field trips. Employees, students and volunteers must comply with the University of Guelph policies, procedures and guidelines when driving or using University-owned, leased or rented vehicles while conducting University business. Personal vehicles are not covered under the University's insurance, so if you do intend to use a personal vehicle it is your responsibility to ensure you have appropriate coverage.

Prior to using a University vehicle, submit a Driver Information Profile Form, authorized by the Department Chair, to both Treasury Operations and Transport Services.

If your research requires the transport of dangerous goods, refer to the SOP for further details.

If you must use an all-terrain vehicle, tractor, snowmobile or other form of transport, you must obtain training prior to use in the field.

9.12 Transportation of Dangerous Goods (TDG)

Anyone who ships, carries or receives dangerous goods must be trained and hold a valid Transportation of Dangerous Goods (TDG) Training Certificate. TDG training is offered on-line by Environmental Health and Safety. TDG training certificates are valid for a period of 3 years. Anyone requiring TDG training should contact EHS at x53282.

Review the CBS SOP on Transportation of Dangerous Goods for detailed instructions on training requirement, packaging design, labeling, and documentation.

10. Forms, SOP's and Other Resources

This handbook introduces the basic hazards we face within CBS, and a rudimentary discussion of the types of safety measures that we need to consider. More detailed information on specific procedures and equipment is presented in the EHS policies and programs, the College SOP's and departmental SOP's.

Commonly used forms are also posted on the College website. The table below explains the purpose of the various forms.

Table 2 CBS Forms

Form	*When do you need this form?*
Incident Report Form	You are required to complete an incident report following any injury or spill. It must be signed off by the Department Chair and sent to EHS within 24 hours of the incident. You can also use this form to report a near miss of a hazardous condition.
Chemical/Sharps Disposal Request Form	Submit this requisition for chemical or sharps waste pickup to EHS when you have materials ready for disposal.
Radioactive Waste Disposal Request Form	Submit the radioactive waste disposal requisition to EHS to arrange for in-lab pickup.
Field Research Safety Form	This form must be completed and submitted to the Department Chair for approval prior to any new field work project.
Sexual Violence Information and Resources for Field Sites (Appendix A)	List of resources to be posted at field research station

Form	*When do you need this form?*
Field Research Safety Plan: Sexual Violence (Appendix B)	Acknowledgement of sexual violence terms and safety plan by field team participants.
CBS Safety Orientation Record	The training of new personnel is documented on this form.
CBS Ongoing Safety Training Record	This record is to be updated on a continuous basis as new training is provided.
Unattended Experiment Form	This form identifies health and safety hazards, provides contact information and emergency shutdown instructions.
Release and Indemnification Form for Volunteers	Acknowledgment of risks, restrictions, release of liability and relinquishment of protection during their volunteer engagement with the University.

Appendix A: Changes from the Previous Edition

Changes to the previous edition, (2011) include:

- Minor edits and clarification to the text throughout; updated resources and website links.
- Section 2.1 Working Alone – new section.
- Section 4.0 Safety Training – included Worker Health & Safety Awareness module, and Sexual Violence Referral and Support Training as mandatory.
- Section 6.2 Fire – Evacuation plan is now consistent with the U of G Fire Safety Information.
- Section 6.2 Fire – included that during an emergency Fire Wardens are identifiable by their bright orange hats, replaced fire extinguisher video and elaborated on the PASS technique.
- Section 6.3 Chemical Spills – included the Chemistry Stockroom has 3 chemical handlers available.
- Section 6.5 Medical Emergency – clarified what a critical injury is.
- Section 8.1 General Laboratory Safety – replaced link for unattended experiments and clarified need to post and submit documentation. Fillable form created, link activated.
- Section 8.1 General Laboratory Safety – edited section on control strategies.
- Section 8.2 WHMIS – replaced MSDS nomenclature with SDS to accommodate new legislation.
- Section 8.2 WHMIS – 10 pictograms to replace WHMIS symbols
- Section 8.3 Monthly Laboratory Self Inspection – added certification check for fume hoods and biological safety cabinets.
- Section 8.4 Fume Hoods – provided explanation of perchloric acid handling in fume hoods.
- Section 8.4 Fume Hoods – included annual calibration and testing of fume hood air flow alarms is carried out by EHS.
- Section 8.8 Compressed Gas Cylinders – provided detail to key points.
- Section 8.9 Biosafety – update of Canadian Biosafety Standards and changes in regulatory bodies.
- Section 8.9 Biosafety – clarification of essential operational requirements for Containment Level 2.
- Section 8.9 Biosafety; Import of Pathogens – replacement of Process Maps with Quick Reference Guide.
- Section 8.9 Biosafety; Biosecurity – provided more detail on access and inventory control.
- Section 8.10 Radiation Safety – stipulated requirements for posting BLL and ILL signage.
- Section 8.11 Human Research – restructured language with regards to human participants.
- Section 8.12 Animal Care – oversight is now by Animal Care Services and expanded the training requirements.
- Section 9.0 Field Safety – specified that students need to complete a *Release and Indemnification Form.*

- *Section 9.1 Field Safety and Section 9.11 Vehicles – replaced Insurance Manager with both Treasury Operations and Transport Services.*
- Section 9.4 Sexual Violence in Field Work – added new section.
- Section 9.6 Sun Safety – added link for signs of heat exhaustion and heat stroke.
- Section 10 Forms, SOP's and Other Resources – added 4 forms to table.