Emergency Phone Numbers	For Emergencies: 9-911 UPEI Security: 0384 (9-566-0384) Poison Centre: 9-1-800-565-8161

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UPEI Laboratory Safety Manual Committee Members
Denise Bustard, UPEI Health and Safety Advisor
Pat Doyle, Biology Department
Bryan Grimmelt, Department of Biomedical Sciences
Dawna Lund, Chemistry Department
Debra MacDonald, Department of Biomedical Sciences
Geoffrey Paynter, Department of Pathology and Microbiology
Jillian Westcott, Graduate Student Association

— Charlottetown, Prince Edward Island
September 2007

University of Prince Edward Island
550 University Avenue
Charlottetown, PE C1A 4P3 CANADA

Tel: (902) 566-0516
Fax: (902) 566-894-2895
E-mail: dbustard@upei.ca
www.upei.ca/humanres/safety

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INTRODUCTION

The University of Prince Edward Island is a world-class research and teaching institution in which laboratory-based programs are a vital component. On a daily basis, staff, faculty, and students engage in experimental work that involves hazardous chemicals and equipment. Providing a safe environment in the University's laboratories is a shared responsibility of all those involved in laboratory programs, including the University administration, area leaders, departmental chairs, laboratory supervisors, staff, and students. Recognizing the need for a manual specific to laboratories, the UPEI Health & Safety Steering Committee struck a subcommittee to draft the *UPEI Laboratory Safety Manual*. This manual provides health and safety guidelines and regulations to the employees and students who work in the labs, clinics, and barns of UPEI and who do fieldwork off-campus.

It is the collective aspiration of the subcommittee that drafted the *UPEI Laboratory Safety Manual* to produce a document that will be used extensively. We are confident that it provides the means for employees and students to work together safely, both on-campus in our labs, clinics, and barns, and off-campus in the field.

The University maintains a website with easy access to health and safety information found at www.upei.ca/humanres/safety. This lab manual may be accessed through that site, providing many direct links to referenced sites.

Although available online and accessible to the world, it is not intended to be advice, practice, or legislated compliance for any other organization. The *UPEI Laboratory Safety Manual* is not intended to be all-inclusive for the necessary legal requirements of the University, but a tool used to achieve the highest possible level of safety within the lab, the clinic, the barn, and out in the field.

For further information, a list of additional sources can be found in **Appendix Q.**

For the purposes of this manual, a **laboratory** includes any of the following: research laboratory, teaching laboratory, clinic, field site, and/or barn.

For the purposes of this manual, **worker** includes faculty, staff, students, and visitors.

1. LEGAL FRAMEWORK

The University of Prince Edward Island's Health and Safety Policy (see the UPEI Health and Safety website: www.upei.ca/humanres/safety under "Health and Safety Program") aims to provide a safe environment that supports work and study. However, individuals in laboratories also need to be aware of the laws and regulations that place special responsibilities on them.

To provide a safe and healthy environment, UPEI relies upon the people who work in these laboratories. Everyone must be aware of their responsibilities and must discharge them effectively to create a safe environment

1.1 Regulations

Links to a number of websites for information about regulations affecting Prince Edward Island can be found in **Appendix A**.

1.1.1 Occupational Health and Safety

The Prince Edward Island Occupational Health and Safety Act sets out the general duties of employers, supervisors, and employees, and describes how health and safety programs are to operate. Under the Act, the provincial government issues regulations that detail safety requirements. The Workplace Hazardous Materials Information System (WHMIS) Regulation is one such regulation that has particular application to UPEI laboratories.

1.1.2 Environmental laws

Federal, provincial, and municipal environmental laws affect laboratory operations by regulating the discharge of chemicals and by establishing allowable waste-disposal practices. For example, federal regulations apply to PCBs, hazardous wastes, and ozone-depleting or greenhouse gases.

1.1.3 Building and fire codes

Because they present unique hazards, special provisions of the National Building and National Fire Codes of Canada apply to the design and operation of laboratories. Provincial and municipal agencies administer the Codes, and officers from these agencies periodically inspect UPEI buildings. In some highly specific areas, regulatory agencies use guidelines and codes developed by the US National Fire Protection Association.

1.1.4 Transportation of dangerous goods

Whenever dangerous goods are transported by road, rail, air, or sea, the federal Transportation of Dangerous Goods Regulations and International Air Transportation Association Regulations (IATA) apply. It requires the shipper to classify, label, and package chemicals, and place a dangerous goods placard on the vehicle that will transport them. It also requires receivers to maintain records of shipments received. The regulations specify that shippers and receivers of dangerous goods must receive regular training. For chemicals coming into UPEI laboratories, the shipping/receiving clerk handles much of the work related to the transport of dangerous goods. But when a laboratory ships a chemical for analysis in preparation for a field program or as part of an inter-laboratory collaboration, the TDG Regulations and IATA Regulations still apply. In these cases, the laboratory assumes the responsibilities of the shipper. The laboratory supervisor must ensure that the shipment meets the requirements of the TDGR and/or the IATA Regulations.

1.1.5 Other legislation

Other federal and provincial legislation affect some UPEI laboratories. The Nuclear Safety and Control Act (http://198.103.98.49/en/ShowFullDoc/cs/N-28.3//en) has established a system under which the University is granted a licence so that laboratories may use radioisotopes and radiation-emitting equipment. Other regulations apply to areas such as the use and storage of alcohol, drugs, and infectious agents; boat safety; scuba diving safety; Laboratory Biosafety Guidelines (http://www.phac-aspc.gc.ca/ols-bsl/lbg-ldmbl/index.html), and the health of laboratory animals. Supervisors must be aware that other regulations relating to safety may apply.

1.2 University campus safety contacts

1.2.1 Safety committees

The University of Prince Edward Island Health and Safety Steering Committee oversees the implementation of the health and safety measures on campus. In addition, four local health safety committees deal with the day-to-day safety issues that arise within their respective jurisdictions. These committees are:

- Atlantic Veterinary College Health and Safety Advisory Committee
- Faculty of Science Health and Safety Committee
- Main Campus Health and Safety Committee
- Facilities Management Health and Safety Committee

Committee members represent the University's employee groups, management, and administration, as well as both undergraduate and graduate students. All these committees meet regularly to provide a forum to discuss health and safety concerns and advise the University. Current members and contact information can be found at www.upei.ca/humanres/safety.

1.2.2 University of Prince Edward Island Health and Safety Advisor

The UPEI Health and Safety Advisor is responsible for the general co-ordination, promotion, and education of health and safety on campus. In the event you need information about health and safety or would like to contact any of the members of your local safety committee, the UPEI Health and Safety Advisor can be reached in the Human Resources office at 0516.

1.3 Area leaders and supervisors

> As defined by the UPEI Health and Safety Program:
>
> **Area leader** is a person who has direct supervision of a work unit or area. This term is used throughout this document for simplicity; in many cases the “Area Leader” does not necessarily hold a consistent managerial/supervisory title. For example, an Area Leader may be a Chair, as in Chemistry; a Foreman, as in Physical Plant; or a Director, as in the Sports Centre.

Area Leaders are responsible for ensuring that activities undertaken by supervisors in their laboratories are consistent with the University of Prince Edward Island policy to provide a safe environment for laboratory staff, students, and visitors, and for those who provide services to the laboratory. Area Leaders have been designated by Human Resources and the Senior Management Group. View the list of Area Leaders at http://upei.ca/humanres/safety/supervision

> As defined by the UPEI Health and Safety Program:
>
> A **supervisor** is anyone (V-P, Director, Dean, Manager, Chair, Supervisor, Faculty, or Staff) who instructs, directs, or supervises faculty, staff, or students. Supervisors are responsible for the safety of the workers or students under their direction.

Supervisors must periodically assess the risks posed by laboratory activities to minimize the likelihood that anyone will suffer harm in the laboratory. Controls must be implemented to reduce critical hazards. Refer to the Health and Safety Program for further details.

Although the supervisor may not always be present in the laboratory when faculty, staff or students are working, the supervisor must provide the supervision required to ensure that laboratory personnel follow safe practices and use the equipment that the supervisor has determined to be necessary for safe operations. Area leaders and supervisors must follow the requirements of the UPEI *Working Alone Policy* found on the UPEI Health and Safety website: www.upei.ca/humanres/safety.

2. LABORATORY PRACTICES

2.1 Policy

The University of Prince Edward Island directs all supervisors and staff to minimize risks of injury, illness, and environmental damage related to activities in their laboratories. Laboratory supervisors and staff are instructed to become versed in, and to put into everyday practice, guidelines from this laboratory safety manual which promote the Health and Safety Policy of the University of PEI.

2.2 Supervisor responsibilities

Laboratory supervisors are responsible to supervise all activities in laboratories, providing information, advice, training, and personal protective equipment as required.

Supervisors are required to provide written standard operating procedures (SOPs) for all hazardous processes involving chemicals and/or equipment. (See section 3.1.2 for a guide to writing SOPs.) Special attention must be given to the UPEI *Working Alone Policy* when assessing the hazards of procedures. (See the UPEI Health and Safety website: www.upei.ca/humanres/safety for the *Working Alone Policy* and other SOPs.)

Only activities authorized by laboratory supervisors are permitted in UPEI laboratories.

Supervisors must ensure that in laboratories under their supervision:

- ✓ Site-specific safety training is conducted and documented
- ✓ Staff, working with or around controlled products, have WHMIS training
- ✓ Updated MSDSs are available for all controlled products
- ✓ WHMIS and other safety labels are used as required
- ✓ When required, staff are trained and certified in Transportation of Dangerous Goods
- ✓ Accurate chemical and biohazardous material inventories are maintained
- ✓ Chemicals and biohazardous materials are safely stored
- ✓ Laboratory waste is properly disposed of
- ✓ Equipment is maintained in a safe operating condition

- ✓ Laboratory staff are trained in the use and maintenance of emergency equipment
- ✓ Staff are trained in emergency evacuation procedures for their work areas and building
- ✓ Incident reports are completed and sent to the UPEI Health and Safety Advisor

Supervisors are directed to permit employees to attend all relevant safety information courses.

Supervisors may add site-specific safety rules to the laboratories under their responsibility.

2.3 Laboratory staff and student responsibilities

Laboratory staff and students are responsible for working safely by:

- ✓ following the supervisor's directions and standard operating procedures (SOPs)
- ✓ seeking help before undertaking laboratory activities with which they are not fully familiar and which might pose a hazard to themselves or others
- ✓ conducting only activities authorized by the supervisor
- ✓ completing relevant safety training programs including WHMIS and site-specific safety training, as well as Transportation of Dangerous Goods when required
- ✓ using the WHMIS training to consult MSDS for safe handling, storage, disposal, spill, and first-aid procedures for all hazardous materials
- ✓ ensuring all hazardous products have appropriate WHMIS labels
- ✓ abiding by precautions outlined in this *Manual* to minimize the dangers posed by:
    - chemicals
    - compressed gases
    - infectious materials
    - high or low pressures
    - high voltage
    - extremes in temperature
    - sharps and broken glassware
    - radioisotopes or other sources of radiation
- ✓ working in such a way as to minimize both their own exposure and their coworkers' exposure to any hazardous materials or processes

- ✓ wearing PPE as directed by their supervisor or written into an SOP that they are following
- ✓ only operating equipment as designated by their supervisor and in accordance with SOP's, as applicable
- ✗ not operating any piece of equipment that is missing guards, interlocks, or other safety devices, or has frayed cords or worn switches
- ✓ reporting incidents, as they occur, to the supervisor

Inappropriate behaviour can needlessly put ourselves or other people at risk.

Generally, several common-sense rules below have been used in laboratories for many years.

To avoid harming yourself or others:

- ✓ Warn co-workers about any unusual dangers associated with work you are doing
- ✗ Do not wear personal protective equipment outside the laboratory if there is a risk that it has been contaminated with hazardous chemicals or biohazardous materials
- ✗ Avoid touching doorknobs, computers, telephones, and other common surfaces with contaminated gloves
- ✗ Do not eat, drink, or store food in the laboratory
- ✓ Tie back long hair, remove neck ties/scarves/long jewelry, and avoid loose clothing around mechanical equipment
- ✓ Keep work space tidy
- ✓ Clean up spills promptly, using approved procedures
- ✓ Keep volumes of music low to enable staff to hear any sounds of trouble
- ✓ If working alone, follow appropriate procedures below
- ✓ When leaving procedures unattended, follow appropriate guidelines below

2.4 Working alone

Some laboratory procedures require long hours as it is often not possible to work a "9 to 5" schedule. But working alone can be dangerous. Without someone around who is able to help, an incident that would ordinarily be fairly minor could be very serious.

If you must work alone

Refer to the university *Working Alone Policy* to develop safe work procedures. This policy can be found on the UPEI Health and Safety website: www.upei.ca/humanres/safety.

2.5 Unattended operations

Some laboratory procedures must run for extended periods and people may not always be present throughout the procedure. Most unattended procedures do not pose significant health or safety risks when carried out properly. However, in some cases, the failure of a control, the interruption of utilities, or a mechanical failure could cause damage. In serious cases, such a failure could endanger building occupants, custodians or service people, security officers, or other emergency responders.

Failures that could cause damage or health or safety hazards include:

- loss of cooling capacity resulting from interruption in supply of coolant or leakage in coolant lines
- interruption in supply of propane, electricity, compressed air, or other gas
- failure of a stirrer, thermostat, level indicator, pump, motor, fumehood, or other mechanical device
- failure of a flow regulator or temperature controller

When planning an unattended operation, laboratory staff and students should carefully consider the possible implications of such failures. A protocol should then be developed that minimizes the likelihood and the consequences of a failure.

The protocol requires the posting of a notice at the work station that indicates an unattended experiment is in progress and includes the following information:

- the nature of the experiment and the hazard
- the services required for safe operation (e.g., water cooling, vacuum, heating)
- name and phone number of the emergency contact person
- name and phone number of the supervisor or alternate contact

When a heater is used in an unattended experiment, a variac (variable transformer) can sometimes be a safer means of controlling the heater than a thermostat.

If particularly dangerous unattended experiments must be undertaken, fail safe controls or interlocks are required.

For an example of a form to use for leaving experiments unattended, *Unattended Operations Notice*, see **Appendix B**.

2.6 Laboratory inspections

Inspections are an important part of any laboratory safety program. Workers should continuously inspect their lab surroundings to ensure the safety of themselves and others. A formal laboratory inspection is normally carried out once a year by members of the various Health and Safety Committees and others, all of whom have been trained to conduct inspections.

The purpose of an inspection is twofold. The inspection surveys the physical facility as well as the laboratory's work practices to identify situations that could lead to an incident or an injury. Having identified a problem, the inspection also includes a follow-up component that corrects the problem. Area leaders for each department have been designated, as the liaison for the inspection team, to facilitate the timing of the inspection and follow-up actions that may be required.

Laboratory supervisors and Area Leaders demonstrate their commitment to and support for laboratory safety by following up on the actions recommended in the inspection report.

To assist those who wish to use an inspection form, the *Laboratory/Barn/S&R form for Laboratory Employees* can be found in **Appendix C**. Additional copies are available from the University Health and Safety website: www.upei.ca/humanres/safety.

Although the form was designed primarily for use by the inspection team in formal inspections, area leaders, laboratory supervisors, laboratory staff, and students may wish to use it in less formal but more frequent inspections of their laboratories.

2.7 Laboratory security

UPEI requires that supervisors, staff, and students prevent unauthorized access to their laboratories in order to restrict others from entering these areas where hazardous materials and equipment are used.

It is required that:

✗ no hazardous material be handled or equipment operated in any laboratory without the permission of the laboratory supervisor

✓ all areas with hazardous materials and equipment shall be locked or otherwise secured at all times

- ✓ appropriate signage is used to indicate restricted access and identify where hazards exist (e.g., UV light, radiation, laser, biohazards, etc.)

2.8 Procurement procedures

2.8.1 Purchasing chemicals

Many hazardous and non-hazardous chemicals are routinely used at UPEI. In the past, there has been a tendency to purchase large quantities because of the decreased cost per unit. Upon project completion, excess quantities of chemicals are often stored for long periods of time. Sometimes these older chemicals are no longer fit for use. Labels may get worn or fall off. Some chemicals may become unstable or extremely reactive. When they are needed again, new lots must be ordered and the old stored chemical disposed of. Before being disposed of, their presence may clutter limited spaces, detract from an overall safe environment, and increase the risk of incidents. Excess chemicals increase the labour required to maintain inventories and material safety data sheets. Costs incurred as a result of these unneeded chemicals include analysis, storage, packaging, transport, and disposal.

Prior to purchasing chemicals supervisors and staff should:

- ✓ Conduct a risk assessment for any new chemical, to ensure that risks due to exposure are minimized. See **Appendix N** for *A Quick Guide to Risk Assessment for Hazardous Chemicals*
- ✓ Anticipate the upcoming needs and order chemicals and quantities accordingly
- ✓ Borrow small quantities from another lab to test new procedures that may not be repeated
- ✓ Substitute hazardous materials with less hazardous or nonhazardous materials whenever it is possible to do so
- ✓ Reduce the scale of experiments and protocols to the minimum size necessary to achieve research objectives
- ✓ Be aware that import permits or external notifications may be required when ordering certain chemicals or biological materials

For further reference

Frederick M. Garfield, Eugene Klesta, Jerry Hirsch. *Quality Assurance Principles for Analytical Laboratories*, 3rd Edition, 2000, Ch. 6, pp. 75–90.

2.8.2 Purchasing biological materials/microorganisms

Prior to purchasing biological materials/microorganisms, ensure all applicable regulations are followed. For example, import permits may be necessary. For information on the UPEI Biosafety in Research and Teaching Policy or the UPEI biosafety forms, please visit the Biosafety Committee information on the UPEI Research and Development website:http://upei.ca/research/biosafety

2.8.3 Purchasing equipment

A UPEI Equipment Purchase Information Form must be completed prior to ordering a major piece of equipment. The information will be used by Facilities Management to assess the intended location, electrical, plumbing, venting, heating, cooling, and structural requirements of the equipment before it is ordered. Facilities Management must approve the order before Procurement Services will order the equipment. This form is available through both departments.

2.9 Creating new or altering laboratory space

Before a new laboratory space is created at UPEI in a previously non-lab space, it is important that the design be considered during the planning stages. This is also true for lab spaces that are being renovated or severely altered. Contact Facilities Management regarding the mechanical/structural aspects of a new or renovated lab space. Consideration needs to be taken regarding the following safety items:

- ✓ **Hazard assessment** — Have hazards been identified, assessed, and controlled?
- ✓ **Ventilation** — Is the room sufficiently ventilated for the determined use of that area?
- ✓ **Engineering controls** — What type of fume hood is needed, if any?
- ✓ **Chemical storage** — Will chemicals be properly stored/secured? Is a chemical storage cabinet required?
- ✓ **Plumbing** — Is proper plumbing in place for the needs of this lab space?
- ✓ **Safety equipment** — Is a safety eyewash station and/or safety shower required for this lab space? Is a first aid kit needed? Are proper spill containment supplies available?
- ✓ **Fire Safety** — Is an appropriate fire extinguisher(s) located in the lab or readily available?

- ✓ **Signage** — Is proper signage in place? E.g., exit signs, personal protective equipment requirements, hazard signs, do not eat or drink in the lab, emergency contact name(s) & number(s) on the doors, etc.

- ✓ **Documentation** — Are appropriate documents, resources, procedures, standards, regulations, MSDS, manuals, etc. available in the lab?

- ✓ **Electrical, lighting, heating & cooling** — Is the electrical capacity appropriate? Is emergency lighting or backup power for certain equipment (freezers, etc.) needed?

- ✓ **Proper surfaces** — Are counters, lab benches, walls, flooring, etc., made of appropriate materials for your lab setting (e.g., cleanable, chemical resistant)?

- ✓ **Containment** — Is the lab space designed so that processes take place safely within the space and will not adversely affect surrounding areas?

- ✓ **Room Occupancy** — Does the room size fit the air space (8.3 m^3 /employee) requirements of the PEI Occupational Health and Safety Regulations (Part 11, Ventilation) for the number of expected occupants?

The NFPA 45 Standard states in Section 9.2.1.1: Chemicals shall not be brought into a laboratory work area unless design, construction, and fire protection of receiving and storage facilities are commensurate with the quantities and hazards of chemicals involved.
(REFERENCE: *NFPA 45 Standard*, Section 9.2.1.1)

2.10 Vacating laboratory spaces at UPEI

A decommissioning process must occur when faculty, staff, graduate, and/or research students are planning to vacate their laboratory at UPEI for any reason.

The purpose is to ensure that hazardous chemicals (including all solutions and synthesized products), radioactive materials, infectious agents, gas cylinders, and laboratory equipment are either safely disposed of, removed from campus, or assigned to a responsible person, who will be subsequently responsible for their safe handling.

The person leaving is required to:

- ✓ Make an inventory list of the chemicals, radioactive materials, infectious agents, gas cylinders, and equipment for which he/she is responsible

- ✓ Meet with his/her Supervisor or Chair to decide which items will be disposed of, removed from UPEI, and which will become the responsibility of another faculty or staff member, or graduate student

- ✓ Make the appropriate arrangements together with his/her Supervisor and/or Chair

- ✓ Fill out a *Vacating a Lab Form for Laboratory Employees* (see **Appendix D**) to be left with the Department Chair.

2.11 Fieldwork

2.11.1 Policy

As an institution of scholarship and research, it is part of the University's mission that its faculty, staff, and students engage in field-related teaching and research activities outside the conventional laboratory setting. These activities for the most part occur outside the boundaries of the University, and in many cases outside the province or country. It is the policy of the University to encourage and support such activities and to take every reasonable precaution to protect the personal health and safety of its participating members.

2.11.2 General field safety guidelines

Fieldwork covers a range of activities that can occur outdoors. These activities may be terrestrial, aquatic, or marine-based. The risks associated with these may include transportation of related items, physical and environmental hazards, animals and pests, and diseases. There are also special licences, certified training requirements, insurance issues, as well as government and institutional regulations which must be considered when working in the field. One of the most important aspects when contemplating fieldwork is the planning and preparation for the fieldwork itself, to ensure a safe trip. A written plan should be prepared and left with a responsible contact in your home department. The plan should include information on the general nature of your activities and an itinerary with locations, arrival and departure times, and the names of all the fieldwork participants. You should also learn about potentially hazardous plants, animals, terrain, and weather conditions and prepare a hazard and risk assessment of your proposed activity, particularly if it is a new activity or in an unfamiliar location.

Whenever possible, fieldwork activities should be performed in teams of a least two people. Solitary fieldwork should be strongly discouraged, particularly when it involves remote or hazardous locations, high-risk activities, or unusual conditions. Refer to the university *Working Alone Policy* on the UPEI Health and Safety website: www.upei.ca/humanres/safety**.** The participants should be in a satisfactory state of fitness, and any health issues including allergies should be acknowledged with appropriate mitigable measures put in place.

General safety provisions may include:

- first aid kit (including someone trained in First Aid/CPR)
- insect repellent & allergy treatments (if you have allergies)
- sun screen and hat
- vehicle emergency kit
- flashlight
- flares
- cell phone or two-way radio
- gloves, warm hat, dry clothes (wintertime)
- matches or a lighter
- PPE for fieldwork activities (glasses/goggles, gloves, sturdy boots, etc.)

Transportation

Transportation safety relates to the movement of participants to/from and within field sites. University motor vehicle operation is governed by the **University Vehicle Use Policy** /www1.upei.ca/policy/content/governance/brd/govbrdrmt0008). Operators must have the appropriate licence (class IV for a 15- passenger vehicle) and are solely responsible for the safe operation of the vehicle they are driving. Trailers towed by vehicles are also the responsibility of the operator and this includes ensuring that they are safe to use (tires properly inflated, load secured, lights operational, and safety chains secured) and that they have a safety inspection sticker (this applies to PEI; other jurisdictions may have different regulations). Operators who transport dangerous goods must also ensure that they comply and are certified with **TDG** training.

Boats and watercraft

Fieldwork may involve the use of boats and other types of watercraft such as canoes. Water safety is particularly important as conditions can be unpredictable and unforgiving. All operators of watercraft must comply with the safety regulations from the **Office of Boating Safety** at **Transport Canada,** including acquisition of a **Pleasure Craft Operators Card.** See Transport Canada for details (website: www.tc.gc.ca/BoatingSafety/menu.htm). It is also important to check with **Environment Canada** for up-to-date weather forecasts and current marine conditions.

Physical demands

Physical demands could include the following activities:

- manual lifting, carrying, or handling of heavy loads
- climbing (cliffs, trees, etc.)
- extreme cold or heat

- high altitude
- diving and other underwater activities

Most of the above activities require special training and in some cases certification. There are specially designed safety equipment and procedures to reduce risks and in the case of diving, the **UPEI SCUBA Diving Safety Manual** (www.upei.ca/humanres/safety) must be consulted. The fitness of the individuals should always be considered when undertaking any activity with extraordinary physical demands.

Physical hazards

Physical hazards could include the following :

- dehydration
- sunburn
- heat exhaustion/heat stroke
- frostbite
- hypothermia
- drowning
- poisonous plants (poison ivy)
- hunting season (be aware of the seasons)

Animals, pests, and diseases

Dangerous wild animal encounters may not be a significant problem on PEI. However, appropriate safeguards should be in place when live-trapping both small (rodents) and large mammals (coyotes). Regular farm visits by AVC staff and students working with domestic livestock places many individuals in situations where safety could be compromised. Appropriate safety procedures must be practised, including ensuring that students and employees follow the *UPEI Working Alone Policy*.

Local pests can present some problems. Mosquitos are a vector for **West Nile Virus** ***(use insect repellant)***. Fleas and ticks can carry diseases, including **Lyme disease** ***(wear clothing of tightly woven material, tuck pants into boots)***. Bee and wasp stings can be lethal for those individuals with severe allergies ***(carry an epi-pen or antihistamine)***. Deer mice, including their feces, urine, or saliva, can be vectors for **Hanta virus** ***(keep areas clean to avoid attracting rodents, wear a mask and gloves if you are handling rodents or their feces).***

Canadian and international fieldwork

Travel and fieldwork outside the province and country adds a whole new dimension for safety and minimizing risks. In some countries there is little or no provision for occupational health and safety. Insurance coverage varies and access to health care is not guaranteed. Regulations and certification standards for many types of fieldwork activities should be researched before traveling abroad to ensure compliance. The environmental and climatic conditions can be very different. Extremes in temperatures, unfamiliar dangerous animals, poisonous plants, pests, and diseases can pose a serious threat to the health and safety of individuals. All participants must be properly immunized. Water quality can be a serious problem. Political unrest and crime can seriously compromise personnel safety. Before any international fieldwork is carried out, the **Federal Department of Foreign Affairs** should be consulted and the **Canadian Embassy** in the host country contacted. Veterinary students and staff should also refer to the **AVC Foreign Travel and Foreign Animal Disease Policy** (http://www1.upei.ca/policy/content/avc/do_/avcdo_er_0002) The UPEI Human Resources Department should also be contacted regarding group insurance implications.

2.12 Children in labs

2.12.1 Purpose

UPEI is a fascinating environment for minors (persons under 16 years of age), but it also can be a dangerous one.

Teaching and research laboratories often use hazardous materials and are equipped with sensitive, expensive, and sometimes dangerous equipment. Minors in laboratories may inadvertently be exposed to biohazardous waste, dangerous chemical substances, and ionizing radiation, or be injured by or damage laboratory equipment.

Animals presented to the Veterinary Teaching Hospital (VTH) may have zoonotic disease and may be dangerous to individuals untrained in their restraint. Heavy equipment used to manage large animals may pose physical risk to those in the immediate vicinity. Minors present in the VTH are most vulnerable to these risks. Minors in the VTH may also inadvertently compromise patient care and the learning experience by directing the attention of students, staff, and clinicians away from the patient.

2.12.2 Policy

With the exception of special events such as guided tours and open houses, then:

✗ Minors are not permitted in UPEI laboratories or the VTH animal holding units, unless accompanied by a UPEI employee or student or, in the case of the VTH, an adult owner of a VTH patient

✗ Minors are prohibited in areas of UPEI buildings posted with a radiation hazard symbol, including areas in the AVC, Physics, Biology, and Chemistry.

✗ Minors are not permitted to attend clinical rotations in the VTH.

2.13 Health Concerns

Individuals who are pregnant or who have health issues/concerns, such as allergies, sensitivities, respiratory problems, immune deficiencies, injuries, or other illnesses, are recommended to contact their physician and to notify their supervisor.

3. CHEMICAL SAFETY

3.1 Chemical hazards

3.1.1 Chemical Hazard Awareness

Chemicals used routinely in laboratories at UPEI include organic solvents, acids and bases, dangerously reactive chemicals, toxins, and compressed gases. These are all controlled products that fall into six classes regulated under WHMIS (see **Appendix R**).

Before using any of these products, employees are required to:

- ✓ Complete WHMIS training (available online. For access instructions see the UPEI Health and Safety Website: http://www.upei.ca/humanres/safety/training
- ✓ Read the MSDS to learn safe handling, storage, disposal, spill, and first aid procedures
- ✓ Use the appropriate personal protective equipment
- ✓ Ensure that all products have WHMIS labels
- ✓ Complete site-specific safety training

Some of these chemicals have serious health effects, such as a number that are *Known, Probable and Potential Carcinogenic Chemicals* (see **Appendix E** for a partial listing).

Before purchasing a new chemical, see **Appendix N** for a *Quick Guide to Risk Assessment for Hazardous Chemicals*.

3.1.2 Standard Operating Procedures

Standard operating procedures (SOPs) are required for working with all hazardous chemicals. In order to help supervisors implement the safety requirements of the UPEI Health and Safety Policy, certain generic SOPs are made available for the University community through the UPEI Health and Safety Website: www.upei.ca/humanres/safety.

Seven Laboratory Safety SOPs are available:

1.	Acids and Caustics	SOPS5101
2.	Organic Solvents (Non-Halogenated)	SOPS5102
3.	Halogenated Solvents	SOPS5103
4.	Toxic Compounds	SOPS5104
5.	Reactive Compounds	SOPS5105
6.	Documenting Safety Training Records	SOP2.102
7.	Site Specific Training with LS-SOPs	SOP2.103

Since Laboratory Supervisors are required “to provide staff and students with written standard operating procedures for all hazardous processes”, these SOPs are designed to help Laboratory Supervisors meet this requirement.

Laboratory Supervisors are also required “to document that laboratory workers have been educated in relevant safety issues”. The following SOPs are available on the Health and Safety website to assist with documenting this training:

- SOP2.102, *Documenting Safety Training at UPEI*
- SOP2.103, *Using UPEI Laboratory Safety SOPs For Site Specific Training*

Recommendations for establishing new Laboratory Safety SOPs can be made by contacting the UPEI Health and Safety Steering Committee.

These SOP’s are meant to compliment, but not to replace other classes of SOP’s which are required in laboratories (such as those related to specific equipment and procedures) and which must also contain relevant safety information and/or references.

3.2 Chemical inventory

To comply with provincial legislation and to aid the fire department and other emergency responders, laboratory supervisors and managers of units within the University must maintain current inventories of their respective hazardous chemicals. The inventory update procedure for each area or department will be part of site-specific safety training. UPEI Security is responsible for ensuring that the total inventory for each area is available as required by emergency responders and others who may need this information.

Chemical inventory maintenance requires that:

✓ Laboratory supervisors and managers of support units that use chemicals shall create and maintain up-to-date inventories of chemicals present in their laboratories or work areas. Ideally, the inventory should contain:

- the name of the chemical

- container size
- room number
- storage location (e.g., cupboard, freezer)
- hazard assessment

✓ The inventory shall be readily available to staff and students who work with or in the vicinity of the chemicals

✓ At least annually, the laboratory supervisor shall provide an updated inventory at the request of the building co-ordinator. In laboratories where the chemical holdings change rapidly, the supervisor should provide updated inventories more frequently.

3.3 Storage of chemicals within the laboratory

The way in which chemicals are stored can have a major impact on laboratory safety.

Storage of chemicals and chemical wastes in UPEI laboratories is guided by the National Fire Code of Canada and the National Fire Protection Association (NFPA):

a) *Flammable and Combustible Liquids Code 30*, ANSI and NFPA
http://www.ansi.org/default.aspx
www.nfpa.org/aboutthecodes/list_of_codes_and_standards.asp.)

b) *NFPA Standard 45 — Fire Protection for Laboratories Using Chemicals*
www.nfpa.org/aboutthecodes/list_of_codes_and_standards.asp.

3.3.1 General storage procedures

When not in actual use, chemicals in UPEI laboratories shall be stored according to the following procedure:

✓ Upon receipt, chemicals shall be entered into the laboratory chemical inventory. It is good practice to label all chemicals with both the date of receipt and the owner's name or initials. For chemicals that degrade over time, the date of opening should be noted on the label.

✓ Chemicals should be purchased in safety-coated bottles when possible

✓ Chemicals should be stored in the supplier's original container or in a container that provides adequate protection for the contents

- ✓ Chemicals may be stored in ground glass stoppered containers only when the stopper does not create a hazard

- ✓ Chemicals shall be stored in containers bearing a label showing the chemical name, safe handling instructions, and reference to the MSDS

- ✓ Chemicals shall be stored securely, in the minimum practical quantities, away from entrances and protected from exposure to excessive heat, cold, or damage

- ✗ It is not recommended that chemicals be stored on the floor (with the exception of large containers such as drums) or on shelves higher than shoulder height. Shelving should not have an open back or sides which could allow the chemical to fall off the shelf

- ✓ Chemicals should be stored away from incompatible items

- ✓ The MSDS of all hazardous chemicals should be consulted for compatibility and proper storage information

- ✓ Synthesized products also require proper labeling and storage. A record of products and the coding system used must also be kept in a prominent location.

3.3.2 Containers

Most laboratories store their chemicals in the containers they came in. These containers are usually acceptable for storing chemicals in UPEI laboratories. However, because of their flammability and toxicity, solvents may be stored only in glass containers with capacities no greater than 5 L. Because of its extreme flammability and its ability to form explosive peroxides, diethyl ether may be stored in glass containers only, preferably with volume 1 L or less. If the laboratory must store a larger volume of a solvent, it may only be stored in an approved safety can with a capacity no greater than 25 L.

It is important to carefully choose containers for stock solutions and reagent preparations. Many laboratories use plastic containers. When there are concerns about leaching contaminants from plastic containers, glass containers are probably a better choice. Although less popular today than in the past, some laboratories still use ground glass stoppered containers, e.g. peroxides. However, some chemicals, such as concentrated sodium hydroxide, attack the glass and may “freeze” stoppers, particularly following prolonged storage.

There are several instances in which ground glass stoppered containers are dangerous. Ground glass can catalyze the violent decomposition of some reactive chemicals. Other chemicals, such as some perchlorates, many peroxides, and picric acid, can be detonated by the friction of removing the stopper.

Although its use is declining, some UPEI laboratories use picric acid solutions. When picric acid is stored in glass stoppered bottles, a film of the solid yellow acid can be deposited around the stopper. Removing the ground glass stopper could detonate the acid and cause very serious injuries. Laboratory staff and students working with such dangerous chemicals should always check the material safety data sheet before beginning work.

3.3.3 Solvents, flammable, and combustible liquids

The National Building Code of Canada (www.nationalcodes.ca/nbc/index_e.shtml) classifies liquids according to their fire hazards:

> ***Flammable liquids*** — liquids with flash points below 37.8 °C and which have vapour pressures less than 275.8 kPa
>
> ***Combustible liquids*** — liquids with flash points greater than 37.8 °C but less than 93.3 °C.

See appendices F and G for a listing of various flammable liquids, solids, and gases. See **Appendix F** for *Fire Properties of Some Common Laboratory Liquids and Volatile Solids*.

Solvents

Solvents (including non-combustible, largely halogenated solvents) present serious fire and toxicity hazards. Although many factors influence the extent of the hazard, quantity is an important one. In recognition of the risk that solvents present, UPEI will follow the standards (national building/fire codes) that limit solvent container sizes and volumes of solvents. Container sizes or volumes in excess of these limits must be stored in approved solvent storage rooms.

Refluxing, and particularly refluxing over reactive materials, shall not be used for the ongoing preparation of solvents. When solvent preparation is required on an ongoing basis, commercial, low-temperature units shall be used.

Solvents in laboratories shall be stored:

- ✓ in approved safety cans, or in the supplier's original container or equivalent
- ✓ in maximum solvent container sizes: glass — 5L, safety can — 25L (with the exception of diethyl ether that is not inhibited to reduce chances of peroxide formation, which should not be stored in containers exceeding 1L capacity).
- ✓ in no quantities above the following (based on the National Building Code of Canada):

(Source: National Building Code of Canada)

Total Solvent Volume (L. per sq. m. of lab area)	
Excluding quantities in safety cans or safety cabinets	Including quantities in safety cans or safety cabinets
0.8	2.5

The following table lists commonly used flammable and toxic solvents to which storage limitations apply. Specialty solvents with low flash points must also be kept in limited quantities. Consult the chemical MSDS.

Ethers:	Diethyl ether, Tetrahydrofuran, 1,2-Dimethoxyethane, p-Dioxane
Aliphatic Hydrocarbons:	Pentanes, Hexanes, Petroleum ether, Ligroin, Cyclopentane, Cyclohexane
Aromatic Hydrocarbons:	Benzene, Toluene, Xylene
Ketones:	Acetone, Methyl ethyl ketone
Alcohols:	Methanol, Ethanol, Propanols, Butanols
Esters:	Ethyl acetate, Butyl acetates, Amyl acetates
Chlorinated Solvents:	Carbon tetrachloride, Chloroform, 1,2-Dichloroethane, Methylenechloride, Tetrachloroethylene, 1,1,1-Trichlorethane
Other Solvents:	Pyridine

Flammable and combustible liquids

Many laboratories use flammable and combustible liquids as reagents rather than solvents. Although these materials are generally used and stored in relatively small volumes, they nevertheless present a fire risk.

Storage of flammable liquids at a reduced temperature poses some special hazards. Ordinary household refrigerators contain thermostats, lamps, and other electric components that are potential sources of sparks. These electrical connections are a serious hazard if flammable solvents are present — particularly in the event of a power failure. Cooling a flammable liquid in a refrigerator or freezer reduces the vapour pressure sometimes to the point where the flash point is below the temperature in the unit. Under such conditions, a spark would not ignite the vapours. However, should the power fail, the temperature in the unit will rise as will the flammable vapour levels. For many common flammable liquids, vapour concentrations in the fridge could climb, reaching the lower flammable limit. When the power is restored and the unit restarts, a spark could easily cause an explosion.

Flammable chemicals may not be stored in a refrigerator or freezer unless the unit was manufactured for flammable chemical storage or has been appropriately modified to eliminate possible solvent vapour ignition. Refrigerators and freezers that are used to store flammable liquids must carry a notice indicating that flammable liquids are present.
Staff and students should understand that even water-based solutions of flammable liquids can still have flash points below room temperature. For example, 24 °C (75 °F) is the flash point of a 50 per cent solution of ethyl alcohol in water. Thus a 50 per cent solution still meets the flammable liquid criteria and may only be stored in refrigerators or freezers designed for storing flammable liquids.

Flammable and combustible liquid reagents shall be stored with regard for their flammability, reactivity, and toxicological properties.

3.3.4 Separation of incompatible chemicals

Storing incompatible chemicals separately is an important means of avoiding inadvertent contact between them.

Generally, chemicals are grouped into the following incompatibility classes.

- acids and bases
- solvents
- dangerously reactive chemicals
- oxidizers
- toxins
- other reagents

Professional judgement must be exercised in devising a storage system that properly separates incompatible chemicals in any particular laboratory, but, in general, chemicals in each of these incompatible classes should be stored separately.

See **Appendix I** for a listing of some incompatible chemicals.

Acids and bases

✓ Store acids and bases separately and away from other chemicals

✓ Provide a secondary means to contain a liquid spill

- ✓ Exercise care when removing acids or bases or returning them to storage as mixing of acids and bases can generate a good deal of heat
- ✓ Store acetic acid and formic acid as flammable liquids rather than as acids
- ✓ Store perchloric acid as an oxidizer rather than as an acid.

Solvents

- ✓ Follow guidelines such as the National Building Code of Canada regarding container size and laboratory volume limit
- ✓ Store solvents where possible in a flammable liquid cabinet
- ✓ Provide a secondary means of containment to control a liquid spill, if solvents are stored outside of a flammable liquid cabinet
- ✓ Protect solvents from exposure to flames or other sources of heat
- ✓ Refrigerators or freezers storing solvents must be designed for storage of flammable liquids

Dangerously reactive chemicals

- ✓ Store reactive chemicals, with regard to their reactive properties, well apart from incompatible chemicals. See **Appendix I** for a listing of *Some Incompatible Chemical Combinations.*
- ✓ Do regular peroxide testing on ether and other peroxide forming materials. See **Appendix H** for a list of some *Peroxide-Forming Chemicals* and a *Test for Peroxides in Ethers***.**

Oxidizers

- ✓ Store oxidizers separately from combustible materials and particularly from reducing agents

Toxic and infectious materials

- ✓ Store toxic chemicals in a secure location

- ✓ Refer to *Health Canada Laboratory Biosafety Guidelines*, 3rd edition, 2004, for information on safe handling and storage of all biohazardous materials (www.phac-aspc.gc.ca/publicat/lbg-ldmbl-04/index.html**)**

3.4 Compressed gas safety

Compressed gas cylinders are used in laboratories across campus. Because they are so common, it is easy to forget that they pose a hazard. Gas cylinders present several hazards, including asphyxiation by displacing breathable air, sudden decompression resulting in a cylinder being propelled across a laboratory, and mechanical injuries.

A full-sized cylinder can be pressurized to 2,500 pounds per square inch, which is a lot of potential energy just waiting to be released. A broken valve on a fully charged cylinder can produce a rocket or shrapnel that can do a great deal of damage or claim a life**.**

It is also easy to lose sight of the fact that there is a lot of gas in a cylinder. A leak in a small, poorly ventilated room or an elevator car can easily create an explosive or toxic atmosphere. Even if the cylinder contains non-toxic nitrogen or helium, a leak in a small room could reduce the oxygen levels to less than that required to support life.

And, of course, compressed gases such as fluorine, hydrogen fluoride, and nickel tetracarbonyl are sufficiently toxic or reactive that they, along with similar gases, need to be used very carefully. Some gases, including acetylene and hydrogen, are explosive. To prevent an accident, it might be prudent to use flow limiting valves (with some very toxic gases) and antiflash back devices (with flammable gases). More information on these devices is available from the Health and Safety Advisor or your supplier of compressed gases.

Acetylene is explosive but becomes more dangerous as the acetylene tank loses pressure. This is because acetone is used as a solvent for the acetylene inside high-pressure acetylene cylinders and begins to vent when the pressure of the acetylene tank decreases. For this reason, acetylene tanks must be changed when the pressure reaches 500 KPa ≈ 72 Psi.

See **Appendix J** for *Hazards of Common Laboratory Gases Obtained in High Pressure Cylinders* and **Appendix G** for *Fire Properties of Some Common Laboratory Gases.*

To avoid compressed gas accidents:

- ✓ Move a cylinder by securing it to a cart designed for that purpose. Ensure that the regulator is removed and the valve cap is in place.
- ✓ Secure all cylinders to a bench or a wall with a strap or a chain before removing the cylinder cap

- ✓ Store and use cylinders in a well-ventilated area away from exposure to strong sunlight or other sources of heat
- ✓ Check Material Safety Data Sheets to ensure that incompatible compressed gases are not being stored together
- ✓ Use only the regulator designed for use with the particular gas. To be sure, check that the cylinder's CGA (Compressed Gas Association) designation matches the regulator's CGA#. If you have any doubts, contact the supplier. See **Appendix K** for *Compressed Gas Association Fitting Designations*.
- ✓ Treat all cylinders as if they were full
- ✓ Minimize quantities of cylinders required
- ✗ Never allow a cylinder to fall or bang against another cylinder
- ✗ Never use grease or oil on a regulator or valve
- ✗ Never transfer gases between cylinders

3.5 Cryogenic liquids and dry ice

The very cold cryogenic liquids (liquid nitrogen, liquid oxygen, and liquid helium), as well as dry ice (solid carbon dioxide), can all do immediate damage to exposed skin on contact. People who work with these materials need to be continually aware of the potential for an incident. They need to follow proper procedures when dispensing these chemicals — particularly the liquids — and wear the appropriate protective equipment, i.e., cuffed gloves, face shields, etc. Appropriate containers must be used to store and transport these substances. Storage areas must be well-ventilated.

Cryogenic liquids and dry ice present several other hazards. Evaporation of these materials can release very large volumes of gas. In closed containers, there is the potential for pressurization and, possibly, explosion. Although none of these gases is toxic, in confined spaces there is potential for changes in atmospheric composition. "Inert" nitrogen, helium, and carbon dioxide can all displace oxygen to produce an atmosphere in which the oxygen component is less than the 12 per cent needed to support life. Someone inadvertently entering a confined, unventilated room, where there has been a leak of only a few litres of one of these inert cryogenic gases, could lose consciousness almost immediately. Without immediate assistance, death is possible.

3.5.1 Unique hazards of liquid oxygen

Liquid oxygen presents a particular hazard. Evaporation enriches rather than depletes the oxygen content of the air in the room. Enriched oxygen atmospheres can create an extreme fire hazard. Similar situations could develop if oxygen were to leak into a confined space from a compressed gas cylinder. Liquid oxygen is, of course, a very powerful oxidizer. Contact between liquid oxygen and easily oxidizable materials can result in a violent explosion. Use of liquid nitrogen and liquid helium can result in the formation of liquid oxygen through condensation from air. This can create a high risk of fire and/or explosion. Care and caution cannot be stressed enough.

3.6 Moving chemicals, compressed gases, and toxic and infectious materials

3.6.1 Between UPEI buildings

Laboratory staff or students should not move chemicals, compressed gases, toxic, or infectious materials between UPEI buildings without supervision by a UPEI employee who is trained and certified in Transportation of Dangerous Goods (TDG) regulations. Check the Health and Safety website (www.upei.ca/humanres/safety) for the list of individuals who are certified in your building. Moving chemicals, compressed gases, toxic or infectious materials to or from UPEI property is subject to the Transportation of Dangerous Goods Act. Extensive labeling, placarding, and documentation rules apply to such shipments. Federal government regulations require that only staff who have received TDG training may ship items regulated as dangerous goods. All staff who unpack dangerous goods must do so only under the direct supervision of someone who has had TDG training.

A guide to classes of dangerous goods regulated under the TDG Act can be found in **Appendix R.**

3.6.2 Within UPEI buildings

Care is needed to prevent incidents while moving chemicals, compressed gases, and toxic and infectious materials within a building, and particularly through public areas of UPEI buildings. Exercise extreme care if you must use an elevator. Because elevators are so confined, a spill or leak of a chemical or other substance could result in a severe exposure. In addition, a liquid spill could contaminate the entire elevator shaft.

To move chemicals safely in UPEI buildings:

- ✓ Use a cart to move chemicals in containers larger than can be carried easily in one hand
- ✓ Move liquids in a leak-proof secondary container

- ✓ Move inorganic acids and other corrosive liquids in “rubber buckets”
- ✓ Moving chemicals as received in the supplier's original shipping package is permitted
- ✓ Be careful using elevators or stairs to move chemicals

To move compressed gases safely in UPEI buildings:

- ✓ Move a cylinder by securing it to a cart designed for that purpose. Ensure that the regulator is removed and the valve cap is in place.

To move toxic and infectious materials safely in UPEI buildings:

- ✓ Refer to the *Health Canada Laboratory Biosafety Guidelines*, 3rd edition, 2004 (www.phac-aspc.gc.ca/publicat/lbg-ldmbl-04/index.html)

3.7 Hazardous waste

Policy

The University of Prince Edward Island is committed to dealing with hazardous laboratory waste in a fashion that does not endanger the health and safety of the individual and complies with all environmental protection legislation. **For further information on UPEI's laboratory waste disposal methods, please view the *UPEI Waste Disposal Protocol* and the *UPEI Summary of Waste and Disposal Methods* (one page summary sheet to post in labs) at www.upei.ca/humanres/safety.**

Laboratory waste can include the following categories :

- ✓ Lab waste
- ✓ Autoclaved waste
- ✓ Incinerated Waste
- ✓ Biomedical waste
- ✓ Glass
- ✓ Hazardous chemicals for external disposal

- ✓ Metal sharps
- ✓ Empty chemical containers
- ✓ Radioactive materials

3.7.1 Lab waste

Lab waste is all waste generated by a lab EXCEPT that covered in the other categories. It includes waste potentially contaminated with trace amounts of chemicals from paper towels, disposable pipettes, plastic bottles, gloves, masks, etc. It is non-biologically contaminated medical type products such as bandages, syringe barrels, gauze, etc.

3.7.2 Autoclaved waste (biohazardous)

This waste is or may be contaminated by biologocal materials that is potentially harmful to human or animal health. Waste to be autoclaved includes biohazard sharps containers (needles, blades, etc.) and other biohazardous waste from labs (contaminated paper towel and bench covers, disposable test tubes, media/plates, cell and microbial cultures, etc.).

All waste that might contain a pathogen must be handled in such a way as to minimize the risk of infection. These types of waste should be placed in biohazard bags or sharps containers labeled with the Biohazard symbol for short-term storage and transport. Eventually these will have to be autoclaved to render the waste non-infectious. Once the waste has been autoclaved, the entire bag or container should be placed inside a plain orange bag which will be treated as Lab Waste. Any of the above waste containing needles/metal sharps containers will be disposed of as metal waste. Autoclaved glass waste will be treated as uncontaminated glass.

3.7.3 Incinerated waste (biohazardous)

Incinerated waste is material which is **grossly** contaminated with blood, feces, urine, and other bodily fluids. Examples include animal tissues, body parts, carcusses, bedding, saturated sponges, samples for diagnosis, surgery, treatment, etc. Waste to be incinerated must be sealed in leak-proof, robust packaging and be clearly labeled . This waste is incinerated at the University's incineration facility (post mortem, AVC). Properly packaged animal waste may be stored in specifically designated cold or freezer storage pending disposal/incineration.

3.7.4 Biomedical waste

Biomedical waste is material contaminated with **trace** amounts of blood, feces, urine, and other bodily fluids. This waste includes surgical masks, gloves, booties, plastic aprons, absorbents, syringe barrels, surgery materials with trace amounts of animal blood, sample containers, test tubes, etc. This waste goes into a Biomedical Waste box and is incinerated off site.

3.7.5 Glass and broken glass

Cleaned chemical glass containers and uncontaminated broken glass for disposal should be packaged in sturdy, puncture-resistant containers such as plastic tubs or heavy cardboard boxes with open sides taped. The containers must be clearly labeled, such as **"CAUTION — GLASS FOR LANDFILL"** (include point of origin). These containers must be segregated from regular waste (cardboard boxes are not to be stored outside). **Facilities Management** will co-ordinate their pick-up and delivery for disposal.

Biologically contaminated glass container, slides, glass pipettes, etc. must be autoclaved prior to being handled as the above.

Reference for AVC Sharps Waste Disposal Policy:
http://www1.upei.ca/policy/content/avc/do_/avcdo_plt0005

3.7.6 Hazardous chemicals for external disposal

Certain chemicals cannot be discarded with regular refuse or flushed down a drain. The University has a program that collects and disposes of surplus and hazardous waste chemicals; the program is administered through the Office of Procurement Services, along with building coordinators.

Waste chemicals that are excess or contaminated must be either:
a) treated to neutralize hazards, e.g. Formalex neutralized formalehyde, or
b) recovered through distillation, e.g. some solvents, or
c) packaged and stored for external disposal

When there are no alternatives, hazardous chemicals must be appropriately packaged, labeled and safely stored until they can be picked up/shipped for external disposal. An up-to-date inventory of waste chemicals should be maintained according to site-specific procedures*. Each container label must be **WHMIS**-compliant and the following labeling format should be used:

> HAZARDOUS WASTE
> Name(s) of the chemical(s) (avoid the use of abbreviations)
> rough percentages, if applicable
> total mass or volume of the chemicals (for reactives include total mass of chemical and container)
> laboratory room number/generator's initials
>
> e.g., HAZARDOUS WASTE

Chloroform/Phenol
40%/60%
4 litres
315S / J.S.

The inventory will include the above information, as well as the type and size of container.

Chemically contaminated material, such as ethidium bromide contaminated gloves and absorbants, or acrylamide waste, must be properly labeled and stored in a secure container until it can be sent for disposal at the University incinerator facility.

Contaminated solvent waste may be blended with other compatible waste solvents. It should be collected separately as halogenated solvent waste and non-halogenated organic solvent waste, and held for disposal with the other chemical waste.

Hazardous waste chemical storage is subject to the same safety regulations as regular chemical storage regulated by the National Fire Code of Canada (http://www.nationalcodes.ca/nfc/index_e.shtml). This may include restrictions on the total volume of chemicals. It may also limit the volume of individual containers to 25L for solvents. Further information about the procedure for storage of hazardous waste, particular to each building on-campus, will be given during site-specific safety training.

* Site specific procedures are those locally formulated by area, building or Department. They should be reviewed during site specific training sessions for new and current workers in the areas of concern.

3.7.7 Metal sharps

Metal sharps include needles, scalpel blades, razor blades, etc. They must be packaged in a rigid, puncture resistant container.

3.7.8 Empty chemical containers

Chemical containers (glass, metal, and plastic) that have contained hazardous chemicals may be recycled for use in the laboratory only, but must first be cleaned to remove chemical residues, and labels must be removed or defaced. Plastic and metal containers may be discarded in regular waste once this has been done. In the case of disposal, clean glass containers will be handled in the same fashion as uncontaminated glass (see above).

3.7.9 Radioactive waste

UPEI is licenced to handle radioisotopes by the Canadian Nuclear Safety Commission. Strict guidelines are in place with regard to disposal of radioactive waste. These guidelines can be found in the **UPEI Radiation Safety Manual,** pages 24–26, or by contacting the **UPEI Radiation Safety Officer** directly at 0635.

3.7.10 Battery Disposal

Batteries can be disposed of by dropping off at Facilities Management. At AVC, batteries can be dropped off at Central Services.

4. PROTECTIVE EQUIPMENT

The objective of personal protective equipment (PPE) is to protect workers from the risk of injury by creating a barrier against workplace hazards. PPE is not a substitute for good engineering, administrative controls, or good work practices, but should be used in conjunction with these controls to ensure the safety and health of workers.

This section addresses hearing protection, eye and face protection, protective clothing, hand protection, foot protection, respiratory protection, and fume hood safety.

Scope

This program covers any worker who may be exposed to potentially hazardous conditions during the course of work at UPEI.

4.1 Responsibilities

Principal investigators/supervisors and all others in authority shall:

- ✓ Identify situations where personal protective equipment is required
- ✓ Determine the types of personal protective equipment required for the specific hazard and identify site-specific standard operating procedures
- ✓ Provide employees with appropriate personal protective equipment
- ✓ Ensure that workers wear appropriate personal protective equipment at all times in hazardous areas
- ✓ Ensure that workers are informed about the proper use, care, and maintenance of personal protective equipment

Workers shall:

- ✓ Properly wear appropriate personal protective equipment at all times in hazardous areas
- ✓ Maintain personal protective equipment in good condition
- ✓ Report to their supervisors about any PPE concerns or defects

4.2 Cleaning and maintenance

- ✓ All PPE must be kept clean, inspected, and properly maintained at regular intervals, as indicated on the SOP
- ✗ PPE shall not be shared between workers until it has been properly cleaned and sanitized
- ✓ PPE will be distributed for individual use whenever possible/practical
- ✓ Contaminated PPE which cannot be decontaminated should be disposed of in a manner that protects employees from exposure to hazards

4.3 Signage

Personal protective equipment requirements shall be posted at the entry to labs or hazardous areas.

4.4 Hearing protection

Hearing protective devices

Occupational noise-induced hearing loss may be prevented through the effective use of appropriate hearing protection. Appropriate hearing protection must protect against the level of noise hazard, provide a comfortable fit, and comply with CSA Standard Z94.2-M1984, *Hearing Protectors* (available in the office of the Health and Safety Advisor).

A worker is noise-exposed if he/she experiences regular exposure to sound levels greater than an eight-hour time-weighted average (TWA) of 85 A-weighted decibels (dBA) or an equivalent noise exposure. The American Congress of General Industrial Hygienists (ACGIH) states that no exposure of an unprotected ear in excess of 140 db (impulsive/impact noises) should be permitted.

Two general categories of hearing protection devices include:

1. Earmuffs

Earmuffs are external hearing protection devices consisting of a headband and earcups. The earcups are cushioned and are intended to fit snugly (but not uncomfortably tight).

To ensure optimal protection:

- ✓ The earcup must completely encircle the ear in order to provide a good seal and thereby protect the noise sensitive inner ear

✓ Earmuff fit must not be compromised by the use of other safety equipment such as hard hats, goggles, glasses, etc.

✓ The user must regularly inspect and maintain the earmuffs in good condition. For example, earcup cushions which are cracked or hardened, or a headband with inadequate tension, must be replaced.

2. Earplugs

Earplugs are hearing-protection devices that are inserted into the ear canal. The most common earplugs are expandable foam or preformed plugs with flanges. Earplugs are either disposable (used only once) or reusable (with proper care, this type of earplug can be used for up to six months).

To ensure optimal protection:

✓ Earplugs must fit snugly and seal the ear canal to provide adequate noise attenuation and protect the noise-sensitive inner ear
✓ Earplugs should be inserted using clean hands, by pulling back the ear with the opposite hand to straighten the ear canal
✓ Reseat earplugs periodically since they can work loose through the day (from talking, etc.)
✓ Reusable earplugs must be regularly inspected and cleaned (washed in mild soap and allowed to dry in a clean environment)

Use of earphones

✗ Recreational earphones used for music are not a replacement for properly fitted and appropriate hearing protection

✗ Earphones can impede hearing during high-risk activities and are not allowed when acute attention is required

4.5 Eye and face protection

In many university workplaces, flying particles, dusts, vapours, chemicals, or harmful rays can create a potential for eye or face injury. Appropriate protective eyewear and facewear must protect against the specific hazard present, provide a comfortable and secure fit, and comply with CSA Standard Z94.3-02, *Eye and Face Protectors* (available in the office of the Health and Safety Advisor).

The general categories of protective eyewear and facewear include:

1. Safety glasses

Safety glasses have lenses that are impact-resistant and frames that are far stronger than those of regular eyeglasses. Safety glasses or goggles are used when working with flying objects or flying particles (eg. chemicals in solid form).

To ensure optimal protection:

- ✗ Regular eyeglasses must not be used in place of protective eyewear
- ✓ Over-the-glasses safety glasses must be worn over regular eyeglasses
- ✓ Non-prescription or prescription safety glasses (for those who need corrective lenses) with attached side shields must be worn by those who require protection

2. Safety goggles

Safety goggles are contoured for full facial contact and are held in place by an elastic or strap; therefore, they offer greater eye protection than safety glasses. Safety goggles are used when there is potential of being exposed to flying objects or particles, chemicals splashes or sprays, or when working near abrasive blasting. Safety goggles have impact resistance and may have direct or indirect ventilation to protect against fogging.

To ensure optimal protection:

- ✓ Goggles must be worn when there is potential for chemical splashes or when working near abrasive blasting.
- ✓ Use goggles with indirect ventilation against splash hazards and flying particles

3. Face shields

Face shields are designed to provide general protection to the face and front of the neck against flying particles, aerosols, and sprays of hazardous liquids. Aerosols are produced from chemical reactions, necropsy of infected animals, harvesting of tissues or fluids from infected animals, and manipulations of high concentrations or large volumes of infectious materials, etc. Note that face shields do not fully enclose the eyes.

To ensure optimal protection:

- ✓ Wear a face shield and goggles whenever procedures with a high potential for creating flying particles, aerosols, and sprays are conducted

- ✓ **Face shields are to be used in conjunction with primary eye protectors such as safety glasses or goggles**

4. Special filter lenses

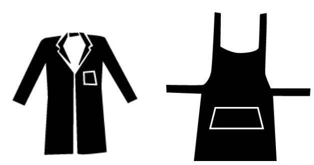
To ensure optimal protection:

- ✓ Protective eyewear equipped with approved filter lenses must be used to protect against harmful light or other rays, e.g., infrared, ultraviolet, laser light

- ✓ Laser protective eyewear must be clearly labeled with the optical density and the wavelength for which protection is afforded

NOTE: **Contact lenses**
Current evidence indicates that the use of contact lenses in the workplace, on the whole, does not place the wearer at additional risk of eye injury. **Contact lenses are not protective devices, and must be used only in conjunction with appropriate protective eyewear.**

4.6 Protective body clothing: lab coats, aprons, overalls, etc.



Protective body clothing includes apparel such as aprons, laboratory coats, shirts, pants, jackets, sleeve protectors, leggings, coveralls, and full-body suits. Protective body clothing material and design must protect against the specific hazards encountered in the workplace, cover and protect the areas of the body potentially exposed to the identified hazards, and provide a comfortable and secure fit.

Appropriate protective clothing must be worn in labs where chemical, biological, or other hazardous materials are used and stored to prevent skin from being exposed to splashes and other contact. Note that no single material will protect against all hazards.

The general categories of protective body clothing include:

1. Lab Coats

Lab coats are made of materials (e.g., cotton or cotton/polyester blend) suitable for the work environment, the materials handled, and the tasks performed.

To ensure optimal protection lab coats must:

- ✓ Fit properly, be fastened when worn, and provide appropriate flexibility to carry out tasks
- ✓ Be worn in order to protect against minor splashes or spills, and to minimize contamination of street clothing
- ✓ Be regularly cleaned and maintained, and replaced when worn or exhibiting significant deterioration
- ✓ Be decontaminated/sterilized prior to laundering when contaminated with hazardous materials
- ✓ Be removed when leaving the laboratory working environment to reduce the potential for contamination of the external lab environment by chemicals or other hazardous agents
- ✘ Not be used in eating areas, in administrative office areas, or in public areas (e.g., washrooms, seminar rooms, public meeting places), except where clean lab coats are used as barrier clothing for biocontainment practices

2. Coveralls and overalls

Coveralls and overalls are loose-fitting garments worn over regular clothes for protection. Coveralls provide more coverage, including the torso, arms, and legs, whereas overalls cover the legs and lower torso (from the chest down). Coveralls and overalls are used as protection against abrasion, small particles, greases, etc., which are common exposures in barns, post mortem, or during maintenance tasks, etc.

3. Aprons, protective sleeves, etc.

Aprons, protective sleeves, etc., may be required when a higher degree of protection is required. For example, plastic or rubber **aprons** should be used for greater splash protection when handling concentrated corrosive materials. Appropriate protective body clothing must demonstrate low penetration, no significant degradation, and a low permeation rate.

4. Full body suits

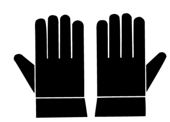
Where potential exists for exposure to highly toxic dusts, or where the potential of body and skin contamination is high, wear appropriate full body suits that are resistant to retention or penetration of hazardous particles (e.g., disposable Tyvex™ suits). Disposable suits can be purchased with attached hoods and foot covers. After use, disposable suits must be discarded as hazardous waste.

5. Temperature-resistant clothing

Heat: Where potential exists for exposure to heat, appropriate heat-resistant clothing must be worn. Depending on the source of heat, this may include apparel made of leather, aluminized fabric, or other heat-resistant material.

Cold: Where the potential exists for exposure to cold, such as work conducted in refrigerated environments or outdoors, or work with cryogenic materials, appropriate thermally insulated clothing (e.g., gloves, coats, vests, aprons) must be worn.

4.7 Protective Gloves



Appropriate protective gloves must be worn in all situations where the hands are potentially exposed to hazards such as chemicals, infectious agents, cuts, lacerations, abrasions, punctures, burns, and harmful temperature extremes.

Appropriate protective gloves must protect against the specific hazards presented, and provide a comfortable and secure fit. The performance characteristics of a particular glove and its ability to protect against the specific hazards encountered are based on a number of factors, including the type of glove material, the manufacturing process, and its thickness, design, and size.

Appendix L outlines *Classification of Hazards and Recommended Glove Protection*

Chemical-resistant gloves
Chemical-resistant gloves provide an effective barrier against the specific chemicals and must be worn whenever hands are potentially exposed to chemicals.
Refer to **Appendix M** for the *Guide to Selection of a Chemical Resistant Glove.*

Disposable gloves

Disposable gloves are usually made of lightweight plastic or rubber materials, and offer greater sensitivity and dexterity to the user. Disposable gloves are generally intended to guard against mild chemicals or other materials, and provide little or no protection against many chemicals.

To ensure optimal protection:

- ✓ Be aware of the limitations of such gloves in protecting against chemical or physical hazards
- ✓ Replace frequently and never reuse

Selection requirements: The selection of the proper chemical-resistant glove begins with an evaluation of the job application.

Factors that influence this selection are the:

- Type of chemicals to be handled, in terms of the degree of toxicity, the types of health effects, and the severity of the effects
- Frequency and duration of chemical contact
- Ones that demonstrate no significant degradation upon contact with the specific chemicals, and have an appropriately high breakthrough time and a low permeation rate under the conditions of use
- Concentration of chemicals
- Temperature of chemicals
- Abrasion/resistance requirements
- Puncture, snag, tear, and cut resistance requirements
- Length to be protected (hand only, forearm, arm)
- Dexterity requirements
- Grip requirements (dry grip, wet grip, oily)
- Colour requirements (to show contamination)
- Thermal protection (e.g., handling anhydrous ammonia)
- Size and comfort requirements
- Price

Glove limitations

- No single glove material will protect against all chemicals
- No glove material is totally impermeable
- Glove performance can vary with product and manufacturer

Reusable gloves

Of principal concern are cuts, tears, and punctures. Discolouration or stiffness may indicate non-uniformities in the rubber or plastic or chemical attack resulting from previous use.

To ensure optimal protection reusable gloves must be:

- ✓ **Routinely inspected,** as chemical-resistant gloves will break down after repeated chemical exposures
- ✓ Thoroughly rinsed and allowed to air-dry
- ✓ Replaced on a regular and frequent basis
- ✓ Replaced immediately upon signs of degradation, and particularly after contact with toxic chemicals

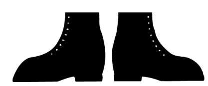
Barrier creams

Current research shows that barrier creams offer little protection against chemical hazards, and can increase the likelihood of contact dermatitis. Such products often contain mineral oil lubricants that can weaken glove materials such as natural rubber latex.

Latex allergies

The widespread use of latex gloves has resulted in an increase in irritant and allergic reactions to the glove material. Reactions may be due to exposure to the natural latex proteins or to the chemical additives added to the latex.

4.8 Protective footwear



Appropriate protective footwear must be worn in all situations where foot hazards exist, such as chemicals, infectious agents, radioactive materials, harmful dusts, heavy or sharp objects, burns, and other hazards. Note that footwear must be chosen that will provide the needed level of protection. Different working environments may present different hazards and some environments contain multiple hazards.

This standard is based on the Canadian Standards Association (CSA) Standards Z195-02, *Protective Footwear* and Z195.1-02, *Guideline on Selection, Care, and use of Protective Footwear* (both are available in the office of the Health and Safety Advisor).

Recommended foot protections to be worn when exposed to specific hazards include:

1. Protective footwear in chemical and biological laboratories

To ensure optimal protection:

- ✓ Wear appropriate protective footwear where chemical, biological, or other hazardous materials are used and stored

- ✘ Do not wear perforated shoes, sandals, or similar-type shoes in labs
- ✓ Appropriate shoes must cover and protect the entire foot
- ✓ Shoe materials, including soles and uppers, must be compatible with the lab environment, the materials handled, and the tasks conducted

2. Rubber boots

Rubber boots are required in areas such as barns where manure is present. Boots, shoe covers, or other protective footwear, and disinfectant footbaths, are required for biocontainment areas (e.g., Post Mortem, AVC).

To ensure optimal protection, rubber boots must be:

- ✓ **Cleaned prior to leaving the designated areas**
- ✓ **Removed immediately upon leaving the identified boot areas within the barn**

3. Protective toecap and metatarsal protector impact-resistant footwear

Such protective footwear is required where there are hazards of falling objects, rolling objects, sharp objects, hot objects, and saw cutting (e.g., Post Mortem). This includes workplaces where heavy materials are handled (e.g., large animals, furniture, boxes, etc.), heavy equipment is used, and on construction sites.

To ensure optimal protection:

- ✓ Safety footwear that protects feet from impact must be worn by those who are exposed to such hazards.

4. Protective sole puncture resistance

Appropriate protective footwear is required to protect against penetration of sharp objects into the bottom of the foot (e.g., nails, glass) or hot objects, or saw-cutting.

5. Static dissipative footwear

The sole allows small charges of electricity to be dissipated into the walking surface, thus reducing the accumulation of static electricity.

To ensure optimal protection:

✓ Workers may be required to wear static dissipative footwear in areas where flammable materials are present or where the buildup of static electricity must be minimized

4.9 Respiratory Protection Program

The respiratory system provides the quickest and most direct route of entry for toxic materials. Although **elimination or reduction of respiratory hazards through substitution or engineering controls is preferred**, there may be instances in which University workers require the use of appropriate respiratory protection for work, which involves exposure to potentially hazardous environments, such as airborne contaminants (dusts, fumes, mists, gases, vapours, aerosols). <u>The use of a respirator is a last resort where other controls cannot be implemented to control the hazard</u>.

Appropriate respiratory protection must protect against the specific hazard(s) present, provide a comfortable and secure fit, and comply with Canadian Standards Association (CSA) Standard Z94.4-02, "*Selection, Use and Care of Respirators*."

It is imperative that workers receive proper training prior to the initial use of respiratory protection devices (contact the UPEI Health and Safety Advisor for further details).

NOTE: Material Safety Data Sheets (MSDS) for chemicals/products and the manufacturer's instructions for respiratory equipment must be referenced prior to selecting a respirator.

RESPONSIBILITIES:

<u>Areas Leaders/Principal investigators/supervisors and all others in authority shall:</u>

- Identify situations where respirators are required;
- Ensure that the proper type of respiratory protection required for the specific respiratory hazard(s) has been chosen;
- Provide employees with appropriate respiratory protection;
- Ensure that workers are able to use a respirator by completing the *UPEI Respirator User Screening Form,* and that training and fit testing of workers is completed prior to assigning workers a task that requires a respirator;
- Ensure that workers use the respirators in accordance with the instructions and the training received;
- Ensure respirators are cleaned, sanitized, inspected, maintained, repaired, and stored in accordance with training and manufacturer's recommendations;
- In case of a tight-fitting facepiece, ensure that respirator users are clean-shaven and do not have any object or material that would interfere with the seal or operation of the respirator;

- Be receptive to respirator users' concerns, identify changes in processes, equipment, or operating procedures that have impact on environmental conditions, and respiratory protection requirements;
- Notify the Health and Safety Advisor of the incidents where the use of a respirator may have prevented or contributed to an incident (Eg. hazardous respiratory exposure).
- As necessary, provide details of the type of respirator selected and the anticipated working conditions to the health care professional conducting the medical assessment of a respirator user; and
- Ensure that workers wear appropriate respiratory protection at all times in respiratory hazard areas.

<u>UPEI Health and Safety Advisor shall:</u>
- Arrange annual fit testing and keep records of testing;
- Keep records of respirator users;
- Arrange initial group training and refresher training every 2 years. Keep training records;
- Keep completed *UPEI Respirator User Screening Forms*.

<u>Respirator Users shall:</u>
- Wear appropriate respiratory protection at all times when performing tasks or working in an area where respiratory hazards exist;
- Check that respirator is clean and in good operating condition prior to each use;
- Perform negative and positive pressure check after each donning of a tight-fitting respirator;
- Report any damage or malfunction of the respirator to their supervisor;
- Report to their supervisor or other person any condition or change that may impact on their ability to use a respirator safely(medical surveillance screening form will need to be updated);
- When using a tight-fitting facepiece respirator, be clean shaven and refrain from having any object or material that would interfere with the seal or operation of the respirator; and
- Use the respirator in accordance with the manufacturer's instructions and training received.

RESPIRATORY PROTECTION

This section includes:

- Training
- General Categories of Respirators
- Selection of Respirators
- Cautions and Limitations
- Care of Respirators
- Health Surveillance
- Fit Testing

TRAINING

Training is required prior to the respirator user being fit tested and using a respirator. Training should include, as a minimum, information within this Respiratory Protection Program. Refresher training is required at least every 2 years.

GENERAL CATEGORIES OF RESPIRATORS:

1) Air Purifying Respirators

A. Disposable Particulate Air Purifying Respirators

The respirators are made of light cotton and have a specific protection rating. For example, N95 indicates a 95% filter efficiency level against particulate aerosols free of oil. Disposable particulate respirators can provide protection against a variety of non-toxic dusts and mists, whose permissible exposure level are greater than 0.05 mg/m^3. Note that dust masks and surgical masks are not considered to be respirators.

To ensure optimal protection:

✓ Read the manufacturer's instructions before use to determine if the selection is suitable for the specific application.

✗ **Do Not use for**: concentrations of contaminants which are unknown, or are immediately dangerous to life or health, gases, fumes, harmful levels of vapors and/or toxic dusts.

B. Non-Disposable Air-Purifying Respirators

Air-purifying respirators can be used to protect against airborne contaminants such as dusts, mists, fumes, smokes, aerosols, gases and vapors. Since these respirators are air-purifying only, this type of respiratory protection must NEVER be used in oxygen-deficient atmospheres or situations which are immediately dangerous to life and health (IDLH).

The general categories of air-purifying respirators are:

- Dust, fume and mist (particulates)
- Gas and vapour
- Combination

The air-purifying respirators are available in two modes of operation:

I) Nonpowered

The nonpowered respirators come in 2 designs:

a) half-face APR: Only provides protection to the nose and mouth.

b) full-face APR: As well as providing protection to the nose and mouth, a full-face APR provides protection against eye irritation. A full-face APR is used in the same atmosphere as the half-face. Full-face APRs are easier to fit than the half-face.

II) Powered

The powered respirators contain a blower and are equipped with a facepiece, helmet or hood.

Selection of the most appropriate air-purifying respirator and cartridges/filters depends on factors such as the frequency of use, the type of contaminants and the anticipated concentration of those contaminants. Other considerations regarding the appropriate selection and use of air-purifying respirators are adequate warning properties of gases or vapours, whether the area is a confined space (as defined in the University's Confined Space program - contact Facilities Management), humidity levels and the potential presence of unknown contaminants.

Any worker who is required to use a respirator must be trained with respect to the limitations of that respirator, as well as: proper fit, inspection, maintenance, cleaning and storage.

2) Atmosphere Supplying Respirators

Self-Contained Breathing Apparatus (SCBA)

SCBAs use a full facepiece connected to a source of air carried by the wearer. The SCBA provides respiratory protection in oxygen-deficient environments and in situations where high or unknown concentrations of toxic gases, vapours or particulates are present. The SCBA can also provide protection in emergency situations. When using the SCBA, the user's respiratory system is isolated from the surrounding atmosphere because no outside air is admitted into the mask.

SCBAs are the most complex respirators in use today so training in the proper use and maintenance of SCBAs is crucial, particularly given the conditions in which these units are used (contact the equipment supplier for further details).

NOTE: If atmosphere supplying respirators, or respirators not mentioned within this document, are to be used at the University, then the departmental manager is responsible to ensure that a standard operating procedure (SOP) has been created for the specific respirator and that appropriate training and maintenance takes place. The supervisor must forward a copy to the UPEI Health and Safety Advisor.

SELECTION OF RESPIRATORS

Air Purifying Respirators are assigned a **protection factor (PF).** The half-face PF is 10 times and the full-face PF is 50 times. This means that a person correctly wearing the respirator who has been properly fit-tested and using a canister/cartridge that will quantitatively remove the contaminant in the atmosphere, can expect to be inhaling one-tenth or less for the half-face (PF of 10) and one-fiftieth or less for the full-face (PF of 50) of the concentration of the contaminant in the environment. If the canister/cartridge fails, the seal is broken, or any other part of the respirator fails, the rated protection factor can no longer be expected.

To determine the concentration at which the respirator can be worn, the TLV is multiplied by the PF. Canisters/cartridges are assigned a maximum use concentration of 1000 ppm and have a limited life service.

Replacing Cartridges
Canisters/cartridges are used up faster as the following rise:
1) Contaminant Concentration
2) Workplace Temperature
3) Relative Humidity
4) Breathing Rate

A cartridge change out schedule shall be determined for the specific conditions present during respirator use. The change out schedule may include end-of-service-life indicators, maximum use time, reliance on good warning properties, and breathing resistance as appropriate. The supplier of safety equipment/services should be able to assist with this information.

Canisters/cartridges can be purchased for respiratory protection against specific gases. Some combination canisters/cartridges are available and are approved for acid gases and organic vapors. Confirm that the appropriate cartridge is in place prior to use.

An Occupational Hygienist or other qualified professional may need to be consulted to do a hazard assessment of the work area (as per Section 5 of the CSA standard) and assist with the selection of the proper respirator and cartridges as the following criteria listed below may not be available to base the selection on. These processes must be documented.

Respirator selection is based on (4) factors:

1. Results from atmospheric monitoring, contaminant monitoring, or sampling for 0_2 content and gas concentration to indicate levels present
2. Accepted ACGIH, OSHA or NIOSH TLV's for the substance(s) present.
3. Maximum use Concentration (of a substance) for which a respirator can be used.
4. If the contaminant is unknown or the requirements for using APRs cannot be met, then a Supplied Air Respirator (SAR or SCBA) is required.

Situations When an APR Should be Worn

A flow chart is attached to aid in the selection of the proper Air Purifying Respirator. Please refer to Appendix S.

Note: For the organic chemicals that have a boiling point below 65°C (such as Acetone), you are required to dispose of your filter cartridges at the end of your work shift. During periods of storage or non-use, this type of contaminant has a tendency to migrate through the canisters/cartridges which can result in additional exposure of the respiratory user.

CAUTIONS AND LIMITATIONS

The following applies to BOTH Air Purifying Respirators and Disposable Particulate Respirators.

1. Do not use when the Odor Threshold is greater than the TLV (Threshold Limit Value). If the respirator fails, you may be unaware you are being exposed to contaminant levels above the TLV. **Note**: Check Material Safety Data Sheet (MSDS) for odor thresholds.
2. Protection Factor does not reduce contamination level below the TLV.
3. Not for use in atmospheres containing less than 19.5% oxygen.
4. Do not use if the identity and concentration of the contaminants are unknown.
5. Not for use in IDLH (Immediately Dangerous to Life and Health) atmospheres.

The following applies to Air Purifying Respirators only.

1. Organic canisters/cartridges respirators can only be used for those organics that have adequate warning properties and do not generate high heat or react with the sorbent material in the cartridge.
2. Organic vapor canisters/cartridges are designed for a maximum exposure level of 1000 ppm.
3. Only use approved canisters/cartridges for the contaminant and concentrations that are available.
4. Cartridges should be changed if any odor is detectable or when deemed necessary by the user.
5. Filters should be visually inspected every week. They should be discarded if dust is caked on or breathing becomes difficult.
6. It is recommended that the date the cartridges were opened is written on the cartridges.

The following applies to Disposable Particulate Respirators only.

1. Do not use if concentrations of particulates exceed the maximum use concentration or 10 times the OSHA Permissible exposure Limit (PEL).
2. Do not use for gases, vapors, asbestos, paint spray, sandblasting or particulate materials which generate harmful vapors.
3. Do not use for any oil based mists.
4. Dispose of the respirator no later than 30 days after first use.
5. Do not use respirators after the expiration date printed or stamped on the box.

An adequate face to face piece seal must be attained in order to receive full benefits from any respirator. **Each time a respirator is worn you are required to perform user seal checks.** Follow the instructions for the user seal checks provided on the manufacturers box for the Disposable Particulate Respirators. For Air Purifying Respirators see the below instructions.

CARE OF RESPIRATORS

A commitment to properly clean and disinfect any respirator will ensure the greatest chance it will deliver the assumed protection.

1. Disposable Particulate Respirators

Disposable Particulate Respirators should not be altered, modified or abused. When they get dirty, they should be disposed and replaced. Unused respirators should be stored in the manufacturers box in a non-contaminated area.

Nondisposable Air Purifying Respirators

Do not clean canisters/cartridges. Respirators should be kept in a storage bag and stored in a convenient, non-contaminated, dry location. Cartridges that are stored in a contaminated environment can absorb the contaminants, thus unknowingly reducing the life of the cartridges. **NOTE**: If respirator shows sign of excessive wear or damage, replace immediately.

When to Clean

1. Any respirator which is used exclusively by one employee shall be cleaned and disinfected as often as necessary to be maintained in a sanitary condition. At a minimum the respirator must be cleaned at the end of each day of use.

2. Any respirator used by more than one employee shall be cleaned and disinfected before they are worn by another user and cleaned at the end of each day the respirator is used.

Procedures for Cleaning and Disinfecting Air Purifying Respirators

1. Remove filters and/or cartridges from connectors.

2. Inspect headbands for wear. Check all elastomer and rubber parts for pliability and signs of deterioration.

3. As applicable, remove the facepiece breathing tubes, inhalation connectors, inhalation valves, headband assembly, exhalation valve guard, valve and seat from the facepiece.

4. Remove the inhalation valves from inhalation connectors.

5. Prepare a solution of cleaner/sanitizer according to the manufacture's or cleaner/sanitizer instructions.

6. Wash the facepiece and components in the cleaning solution.

7. Rinse components completely in clean warm water, then air dry in a clean area.

8. Visually inspect the exhalation valve for damage. If damage or wear is evident, replace.

9. Reassemble the facepiece. Follow steps 2 through 4 above, in reverse order.

NOTE:
Respirators may also be cleaned and sanitized according to the respirator manufacturer's instruction. However these procedures must be documented. Respirator cleaning wipes may be used as an interim method in the cleaning schedule.

HEALTH SURVEILLANCE

Prior to fit testing and respirator use, documentation must be completed that confirms the individual is free from any physiological or psychological conditions that may preclude him or her from being assigned the use of the selected respirator. The *UPEI Respirator User Screening Form* (see Appendix T) will assist in identifying such a conditions. The screening form will be kept in confidentiality by the UPEI Health and Safety Advisor. Note that medical information is NOT to be offered on the form This form will trigger whether an opinion is needed from a health care professional regarding the person's ability to use a respirator. If this opinion is required, then it shall be obtained prior to use of a respirator or if a change in conditions warrants this opinion. The written opinion shall indicate whether the user meets medical requirements, meets medical requirements with limitations (state limitations), or does not meet medical requirements to use the selected respirator. The health information will be maintained confidentially by the health care professional.

Fit Testing - General Requirements

A qualitative or quantitative fit test will determine the ability of a user to obtain a satisfactory fit and an effective seal when using a tight-fitting facepiece. Respirator users must be trained prior to being fit tested for their respirator and they must pass the respiratory fit test prior to wearing a respirator. Respirator fit tests must be repeated annually and when a new respirator (with a different model or size) is purchased/used or if major facial alterations occur (eg. severe weight loss, jaw surgery, dentures, etc.).

Facial Hair: The fit test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface, such as stubble beard growth, beard, mustache or sideburns which cross the respirator sealing surface. Any type of apparel which interferes with a satisfactory fit shall be altered or removed.

PPE: When other personal protective equipment (PPE), such as eye, face, head, and hearing protectors are required to be worn, they shall be worn during the respirator fit tests to ensure they are compatible with the respirator and do not break the facial seal.

Fit testing will be performed by an external agency. A copy of the fit test document must be kept by the UPEI Health and Safety Advisor.

Qualitative Fit Test: A pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.

Quantitative Fit Test: Means an assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

User Seal Check Procedures - Facepiece Positive and Negative Pressure Checks

The individual who uses a tight-fitting respirator is to perform a user seal check to ensure that an adequate seal is achieved each time the respirator is put on. User seal checks are not substitutes for qualitative or quantitative fit tests.

a. Positive Pressure Check

Close off the exhalation valve and exhale gently into the facepiece. The face fit is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at the seal. For some models of respirators this method of leak testing requires the wearer to first remove the exhalation valve cover before closing off the exhalation valve and then carefully replacing it after the test.

b. Negative Pressure Check

Close off the inlet opening of the canister or cartridge(s) by covering with the palm of the hand(s) or by replacing the filter seal(s), inhale gently so that the facepiece collapses slightly and hold the breath for ten seconds. The design of the inlet opening of some cartridges cannot be effectively covered with the palm of the hand. The test can be performed by covering the inlet opening of the cartridge with a thin latex or nitrile glove. If the facepiece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is considered satisfactory.

REFERENCES:

American Conference of Governmental Industrial Hygienists (ACGIH): 2005 TLV's and BEL's, p.108.

Canadian Standards Association (CSA) Standards Z94.4-02, "Selection, Use and Care of Respirators."

OSHA: www.osha.gov

NIOSH: www.cdc.gov/niosh

4.10 Fume hood safety

In many laboratories, the fume hood is the single most important safety feature. In essence, they are ventilated boxes with a movable transparent "window" through which one can see what is happening in the hood. In some cases, you access the hood interior by raising the front window. In others, a transparent pane is slid to one side. As fires and explosions can happen in fume hoods, the window is made to withstand most fume hood incidents.

Fume hoods are vented to the outside where dilution reduces exhausted contaminant concentrations to acceptable levels.

Fume hoods must work properly in order to protect humans from exposure to chemicals. To pull air through the fume hood and force it out of the building, the fan must be mounted in the exhaust duct. The fan should be placed outside the building and near the end of the exhaust stack. This arrangement places the hood and the duct at reduced pressure so that if there is a leak, air flows into, rather than out of, the exhaust duct.

A fume hood is supposed to efficiently trap contaminants that are released in the hood. To trap these contaminants, fume hoods channel the air into the hood with a minimum of turbulence. Fume hoods achieve this smooth, turbulence-free flow by incorporating a contoured face on the side walls and a lower front edge that is shaped like an air foil. In a properly designed unit, air sweeps into the hood and across the working surface. Some of the air is expunged through openings in the rear baffle near the fume hood floor. The remaining air rises along the back wall to exhaust through baffle openings in the upper part of the hood. If there is an imbalance between the air flow through the lower and upper baffle openings, a vortex develops in the upper part of a hood. This vortex actually moves contaminated air toward the face of the hood. In the worst case, the vortex will propel contaminated air back into the lab.

The rate at which air flows into the fume hood is an important factor in determining the unit's effectiveness. As with many things, more is not necessarily better. When the window is fully open, air should flow into the fume hood at speeds of between 80 and 120 feet/minute (or 0.5m/sec.). Higher air speeds create turbulent air flow that can cause contaminated air to spill out of the hood. As the window is closed, the fume hood face opening decreases. Since most fume hood fans operate at constant volume, the velocity of the air flowing into the hood would increase when the window is lowered. To prevent the air velocity from increasing and turbulence developing, most hoods have a compensating baffle over the window that keeps the face area constant.

Persons walking in front of a hood, the opening of laboratory doors, and even the position and design of the diffuser that supplies fresh air to the laboratory, can all cause air currents at the fume hood face. These currents can impair fume hood performance.

Work practices can also dramatically affect hood performance. Fume hoods most effectively capture vapours created at least six inches into the fume hood. Placing sources of contaminants closer to the face of the hood can allow toxic materials to escape into the lab. Obstructions within the hood also influence air flow patterns and can impair performance. Placing bulky pieces of equipment or allowing excessive accumulation of stored materials in the hood can disrupt design airflow patterns. Shelves along the walls also interfere with air flow. They can all contribute to an escape of contaminants into the lab. When you need to put a bulky piece of equipment in a fume hood, you should raise it about 1½ inches, using rubber stoppers or similar spacers. Raising the equipment in this way allows air to sweep the floor of the hood and minimizes the disruption in air flow.

Air flow to laboratories is generally balanced to maintain a negative pressure to the lab. This is intended to prevent movement of air from laboratories to corridors and other building areas. It is important that windows and doors to laboratories are kept closed so that this negative pressure is maintained, and that the flow of air from the lab occurs through the proper exhaust system.

Fume hoods and biological safety cabinets on campus are certified annually, but site-specific safety training will provide information on how to recognize failure that may be noted by either an audible alarm or visible gauge. A dated and signed certification sticker must be readily visible on each fumehood.

Refer to the *Health Canada Laboratory Biosafety Guidelines*, 3rd edition, 2004, for guidelines on the safe use of biological safety cabinets and laminar flow hoods (www.phac-aspc.gc.ca/publicat/lbg-ldmbl-04/index.html).

In the event that work must be done outside a fumehood and room ventilation does not provide safe exposure limits, a **respirator** may be required. Further information regarding required fit testing and proper respirator and cartridge selection can be obtained by contacting the Health and Safety Advisor (telephone: 0516).

For further reference

Laboratory Fume Hoods, G. T. Saunders, John Wiley and Sons, 1993.

4.11 Emergency Eyewash and Shower Stations

Introduction

The first 10-15 seconds after exposure to a hazardous substance, especially a corrosive substance, are critical. Delaying treatment, even for a few seconds, may cause serious injury. Chemical exposure incidents can still occur even with good engineering controls and safety precautions in place in laboratories or other areas where hazardous materials are used or stored. As a result, a properly functioning emergency eyewash and shower are an essential backup to minimize the effects of accidental exposure.

The following recommendations are generally based on the US ANSI standard Z358.1-2004. Although not carrying force of law in Canada, the ANSI standard is nevertheless recognized as the Industry Standard. Adherence to this standard would be an indication of efforts to ensure due diligence at UPEI.

Policy

Suitable units for drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use where any person may be exposed to injurious chemicals (e.g. corrosives). These units shall not be a substitute for the use of appropriate personal protective devices (e.g. goggles).

Definitions

<u>Emergency Shower:</u> Referred to as either a drench or deluge shower, it is designed to have water cascade over the entire body. It should not be used to flush eyes because the high rate of pressure of water flow could damage the eyes. Emergency showers are hands-free, as they remain activated until turned off, freeing the hands. Most emergency showers are cold water serviced.

<u>Eyewash or Eye/face wash station:</u> Designed to flush the eyes and face only. Units used at the University are referred to as plumbed, as they are connected to an uninterruptible water supply. They are hands-free, in that, once activated, they remain activated until turned off, freeing the hands. At UPEI**,** these units are either wall mounted or bowl style.

<u>Faucet mounted Eyewash station</u>: Device that is connected to a faucet, designed to irrigate the eyes.

<u>Combination units:</u> A unit that combines a shower with an eyewash, into one common assembly. Although physically connected, they are activated independently.

Responsibility

• Each Departmental Chair or Area Leader is responsible for assigning responsibility to maintain the <u>emergency eyewash stations</u> located in their laboratories or areas and ensure that procedures are followed. Testing of emergency eyewash stations located in hallways is the responsibility of the department located in the area or having the laboratory nearest to the unit.

• Individuals in each of the work areas designated responsible for the monthly testing and inspection of eyewash stations must keep a written record of this maintenance. They must advise Facilities Management of any deficiencies observed.

• Facilities Management is responsible for maintaining the <u>emergency shower stations</u> on a monthly basis.

• Facilities Management will perform <u>annual preventive maintenance of both eyewash and shower stations</u> to check for such problems as clogged openings and lines, and adequacy of the fluid volume. A record of these inspections must be kept. If an eyewash or shower is non-functional, the workers in the area should be properly warned and protected.

Training

• All individuals assigned maintenance tasks for emergency eyewash and shower units are to be trained.
• All individuals working in labs are to be trained on using the stations.
• Training should include instruction in contact lens removal.
• Training should include a "hands-on" drill.
• Document training.

Maintenance Procedure

• ANSI standard Z358.1-2004 requires that eyewash and shower units be tested (activated) and verified weekly, but UPEI has adopted the requirement that as a minimum, eyewash and shower stations be tested and verified on a monthly basis. The responsible person must keep a signed and dated record. The monthly testing/verifications will be supplemented by a complete annual preventive maintenance inspection performed by Facilities Management and in accordance with the manufacturer's instructions.
• A monthly check helps ensure that there is flushing fluid available, helps to clear the supply line of sediments and minimizes microbial contamination caused by 'still' or sitting water.

NOTES:

<u>Hand-held drench hoses</u> support shower and eyewash units, but shall not replace them.
<u>Personal eyewash units</u> (i.e. eyewash bottles) can be used as support to plumbed eyewash units or where there is no access to plumbing (i.e. field trips). The eyewash solution expiry date must be affixed to the bottle and the solution must be replaced prior to expiration.

<u>Eyewash Station Monthly Maintenance:</u>
Eyewash stations should be <u>inspected monthly</u> and maintained according to the manufacturer's instructions, which may include but are not limited to the following:
• Ensure access is unobstructed.
• Ensure unit is free from sharp projections in the operating area.
• Verify protective eyewash covers are properly positioned, clean, and intact.
• Check that the bowl and spouts are clean and free of trash.
• Place a pan or bucket under non-plumbed drainpipes to collect water during flushing.
• Check that flow is effective and continuous by activating the unit (bowl style: push the paddle or foot pedal, wall mounted unit: pull handle downward to open unit).
  o Verify that protective eyewash covers come off when the eyewash is activated (bowl style).
  o Check that water flows from both eyepieces.
  o Evaluate for adequate flow based on manufacturer's instructions.
  o Verify that flow continues until deactivation or according to manufacturer's instructions.
• Allow the water to run at least 3 minutes.
• Ensure the flow of water is clear. If not, does the flow become clear after 2 minutes?
• Check that water drains from the bowl.

• Document the inspection and performance test. See **Appendix R** for a testing/maintenance record. It's convenient to post this record on the wall in a plastic sleeve near the eyewash station.
• Report problems with eyewash stations or safety showers to Facilities Management.

NOTES:
- Some eyewash stations are on alarm systems to UPEI Security (e.g. Duffy Building), therefore arrangements may need to be made prior to doing maintenance.
- Some useful items to have near eyewash stations are a bucket, mop and wet floor sign.

Safety Shower Station Monthly Maintenance:
Safety shower stations should be inspected monthly and maintained according to the manufacturer's instructions, which may include but are not limited to the following:
• Ensure access is unobstructed.
• Ensure unit is free from sharp projections in the operating area.
• Place a pan or bucket under non-plumbed drainpipes to collect water during flushing.
• Check that flow is effective and continuous by activating the unit (pull handle downward).
  o Evaluate for adequate flow based on manufacturers instructions.
  o Verify that flow continues until deactivation.
• Allow the water to run at least 3 minutes.
• Ensure the flow of water is clear. If not, does the flow become clear after 2 minutes?
• Document the inspection and performance test. See **Appendix R** for a testing/maintenance record. It's convenient to post this record on the wall in a plastic sleeve near the shower unit.
• Report problems with safety showers to Facilities Management for follow-up.

NOTES:
- Some shower stations are on alarm systems to UPEI Security (e.g. Duffy Building), therefore arrangements may need to be made prior to doing maintenance.
- Some useful items to have nearby for maintenance are a curtain funnel, a bucket, mop and wet floor sign.

5. OTHER LABORATORY HAZARDS

5.1 Laser safety

5.1.1. Laser use at UPEI

Lasers present many safety risks. The most common damage is to the eyes. Other common laser concerns include skin damage, electrical hazards from high-energy power sources, and exposure to cryogenic materials used for cooling the laser during operation. Also, in the presence of high levels of oxygen, primarily used in surgical procedures, there is a potential hazard for fire and burn injuries as a result of the laser igniting the gas. This is most common when a patient is given oxygen during laser surgery and the gas trapped under surgical drapes ignites when in contact with the laser beam. One cannot use too much caution in these circumstances.

A Laser Safety Committee regulates the use of lasers on campus. Users at UPEI must be trained in laser safety. Only trained users are authorized to operate class 3 and 4 lasers.

Information regarding upcoming sessions on campus is available through the Health and Safety Advisor, or check the UPEI Health and Safety website**.**

Relevant standards: *American National Standard for the Safe use of Lasers*
ANSI Z136.1-2000 (located in the Radiation Safety Office, AVC, phone:566-0635).

5.1.2. Laser classification

Class 1: These lasers are incapable of producing damaging radiation levels during operation and maintenance and are exempt from control measures and other forms of surveillance (e.g., laser printers, CD players). Note: these lasers are labeled as Class 1 due to the housing of the instrument. It is not accessible under normal operating conditions. If housing is opened or damaged, it becomes a higher class of laser.

Class 2: These are low-power visible lasers (0.4-0.7 um). They pose a hazard only when viewed directly unprotected for extended periods of time. Eye protection is normally afforded by the aversion response, including the blink reflex. Examples include laser pointers and supermarket bar code scanners.

Class 3: These lasers may be hazardous under direct and reflected viewing conditions. Diffuse reflection is usually not a hazard. They are usually not a fire hazard. These lasers pose moderate risk and can cause injury. Examples of Class 3A lasers include higher-powered laser scanners, laser pointers, and laser surveying instruments. Most research lasers are class 3B.

Class 4: These are high-power, high-risk lasers, and are hazardous to view under any conditions. They present a potential skin and fire hazard. These lasers include surgical, cutting, and welding lasers.

5.1.3. Potential hazards

Despite precautions, serious eye and skin injuries from lasers are common. The most frequently occurring laser injuries to research investigators are to the interior tissues of the eyes, from the thermal effects of visible and near infrared wavelengths. These incidents often occur during beam alignment procedures. The most effective controls include a rigorous alignment protocol at low output power and total enclosure of the laser and all beam paths. When total enclosure is not possible, partial beam enclosure, restricting access to the beam paths, and laser protective goggles, specific to the wave length in use, may be necessary. Burns, fire, and electrical shock are other potential hazards associated with high-power laser systems used in research. Beam stops and protective enclosures are standard preventative measures.

5.1.4. Safety guidelines for using lasers

✓ Before operating any Class 3 or 4 laser, an employee MUST be trained in laser safety. Training must be refreshed on a regular basis

✓ All precautions specified by the supplier of the instrument must be studied and implemented before using it

✓ Eye protection appropriate for the wavelength of laser in use must be worn. This information is written on the goggles themselves. All goggles are not the same.

✗ Never look directly at the beam or pump source

✗ Do not allow any objects that cause reflections to be present in or along the beam path. Even buttons or screw heads can be dangerous.

✓ Always display proper warning signs in laser areas. Proper shielding is also required.

5.2 Ultraviolet lamps

Investigators on campus must ensure that individuals, under their supervision, who will be using UV sources are adequately informed of the hazards related to these sources, and in the safe methods of using the equipment. This is especially true when UV-B and UV-C sources are used. Investigators must supply protective equipment to UV equipment users when such equipment is deemed necessary and appropriate.

Manuals supplied by the manufacturer of the UV-generating equipment should be consulted for instructions concerning safe operation. These manuals provide specific safety-related information (such as the type of eye/skin protection needed, ventilation requirements, etc.) that must be completely understood prior to energizing the equipment.

5.2.1. Types of UV radiation

The UV radiation portion of the electromagnetic spectrum lies approximately between 100 nm and 400 nm in wavelength. The UV spectrum has been subdivided into three distinct spectral bands:

1. UV-A radiation (315 nm to 400 nm),
   called “near UV” and "black light"; is the least photobiologically active, but exposure can produce tanning and some burning of the skin, and can lead to the formation of cataracts (opacities in the lens of the eye). It is efficiently transmitted by air and common glass. (Tanning parlours generally expose patrons to UV-A radiation.)

2. UV-B radiation (280 nm to 315 nm)
   called “middle UV” and "erythemal UV"; causes skin tanning and “sunburn,” photokeratitis (inflammation of the cornea of the eye), photoconjuctivitis (inflammation of the mucus membrane which lines the inner surface of the eyelids), and cataracts. It is transmitted by air, but can be blocked with common glass.

3. UV-C radiation (100 nm to 280 nm)
   called “far UV” and "germicidal UV"; also causes photokeratitis and photoconjunctivitis, with maximum effects occurring at 270 nm. It is blocked by common glass and by air (for wavelengths < 200 nm).

5.2.2. UV protective equipment

Operators of UV-generating equipment, for which the radiation is not totally enclosed and exposures are possible, must wear UV-filtering face shields, safety glasses, or safety goggles and protective clothing. Although these items may not completely eliminate the exposure to UV radiation, they substantially reduce the risk of a severe burn. Most UV-filtering face shields and glasses are made of *polycarbonate* plastic, which is capable of absorbing 99 per cent of UV radiation.

5.2.3. Safety guidelines for UV radiation

- ✓ Only authorized personnel familiar with the potential hazards and control measures may use such units. Serious and painful eye and skin injuries can result if UV lamps are used improperly.

- ✓ Wear the appropriate personal protective equipment

- ✗ Never view the UV lamp directly. Needless exposures should be avoided, even in cases in which the eyes and skin are covered. Take all necessary steps to reduce the exposure time to as short as is reasonably achievable, and use barriers/enclosures/shields to their maximum advantage.

- ✓ Use UV lamps only in designated areas with limited access, which afford protection to passers-by. Operation from within a closed, well-ventilated room or a draped area reduces the risks of exposure.

- ✓ Post appropriate warning signs in any area where UV lamps are in use

5.3 Radiation safety

5.3.1 Authority

The University has appointed a Radiation Safety Committee to carry the advisory responsibility for the overall operation of the radiation safety program. This program is directly administered by the Radiation Safety Officer. We are governed by the guidelines outlined in our Radioisotope licence issued by the Canadian Nuclear Safety Commission.
http://198.103.98.49/en/ShowFullDoc/cs/N-28.3//en

5.3.2 User permits

All projects involving radioactive material must first seek approval from the radiation safety committee. Applications for user permits can be obtained from the Radiation Safety Officer.

5.3.3. Radiation safety training

Radiation safety training is offered on-site several times per year. The University is obligated to ensure that all personnel, staff, students, and faculty who come in contact with radioactive materials through the course of their work must attend radiation safety training. Anyone not trained will not be permitted to work in a radioisotope lab. Dates, times, and locations of upcoming sessions are available from the Radiation Safety Officer.

5.3.4 Radiation safety guidelines

- ✓ The handling of radioisotopes must be confined to areas designated for radioisotope use

- ✓ Radioactive materials, the vessels in which they are used, and the work area must be clearly marked with the radiation warning symbol

- ✓ Always know the properties of the isotopes you are working with. This information is readily available from the Radiation Safety Officer.

- ✓ Always wear gloves, lab coats, and any other protective equipment deemed necessary according to the radioisotope in use

- ✓ Use proper shielding when storing and working with radioactive materials

- ✓ Keep a copy of the UPEI Radiation Safety Manual in all labs using radioactive materials

Note: Anyone using radioactive materials improperly will be prohibited from working with radioisotopes and working in areas containing these materials.

For further reference
Please refer to the *University of PEI Radiation Safety Manual* for all guidelines outlining all aspects of radioisotope use on campus. This manual is available through the Radiation Safety Office 1166N AVC, phone: 566-0635.

5.4 Electrical hazards

5.4.1 Maintaining electrical equipment

Laboratories are full of complex equipment. If it is improperly maintained or worn out, this equipment can pose a safety hazard. Frayed wires and damaged plugs are examples of such hazards, and should be repaired or replaced immediately.

Typical laboratory circuits carry 15 amps of current. Few people are aware that contact with as little as 0.1 amps can cause fatal electrocution. Therefore, even ordinary laboratory electrical equipment carries enough current to severely injure or even kill. Maintenance of all electrical equipment helps to ensure that you prevent contact with electricity.

5.4.2 Electricity and water

Most people are aware that water and electricity don't mix. Of particular concern is a ground fault, a defect that allows electrical current to leak to an exposed metallic surface of a tool or appliance. Touching this metal surface allows electricity to pass through a person on its way to the ground with serious and possibly fatal results. Ground faults are particularly dangerous if a person is around water. To prevent such incidents, Ground Fault Circuit Interrupters (GFICs) must be used in laboratories that work with large amounts of water, i.e., Aquatic Sciences and Fish Health. A GFIC is sensitive to leakage of very small amounts of current. When it detects leakage it quickly interrupts the flow of current, preventing harm to the individual. If you have any concerns about the electrical safety of your lab or any laboratory equipment, speak with your supervisor or contact facilities management.

5.4.3 Preventing contact with electricity

- ✓ Inspect electrical equipment regularly. Remove from service and appropriately label damaged equipment.
- ✓ Report any equipment whose operation trips circuit breakers or blows a fuse
- ✗ Do not use extension cords for anything other than very temporary installations. When it is necessary to use an extension cord, always ensure that the cord is rated for use on the piece of equipment you plan to use.
- ✗ Do not remove the third prong of an electrical plug
- ✓ Ensure that all electrical equipment is approved by the Canadian Standards Association
- ✓ Repairs to electrical equipment should ONLY be made by competent personnel. Facilities Management or Biomedical Engineering personnel are properly trained to perform such tasks

5.5 Mechanical hazards

5.5.1 Identifying mechanical hazards

Mechanical hazards are commonplace in most laboratories. Any equipment with moving parts could pose a risk to the safety of the operator and/or lab personnel. Rotating equipment, in particular, can entangle clothing, hair, or hands. An unguarded vacuum pump drive belt is an example of one such entanglement hazard. A centrifuge is another mechanical hazard. A high-speed centrifuge stores enormous amounts of mechanical energy in the rapidly turning rotor. If these centrifuges are not operated, maintained, and cared for properly, the rotor can fracture and fragments can become lethal projectiles. No one may operate mechanical equipment in laboratories without proper training and authorization from, or on behalf of, their supervisor.

5.5.2 Safety guidelines for using mechanical equipment

- ✓ Develop and use standard operating procedures for all hazardous mechanical equipment, such as centrifuges, orbital shakers, and rotary vacuum pumps
- ✓ Only use lab equipment that you have been trained to use
- ✓ Some equipment can be dangerous when operated alone. Take necessary precautions.
- ✓ Operate equipment with all guards and safety devices in place
- ✓ Always use safety eye wear and other protective equipment as specified in the manufacturer's operating manual or as specified by standard operating procedures
- ✓ Exercise extreme caution when work requires the use of saws or any equipment with rapidly rotating blades

5.5.3 Using pressurized equipment

Pressure is another form of mechanical energy that can be released suddenly. Equipment that operates above or below atmospheric pressure can explode or implode with alarming results. Examples of such equipment include items such as compressors, vacuum apparatus, and some distillation equipment.

5.5.4 Avoiding injuries from pressurized apparatus

- ✓ Guard all laboratory equipment that operates at reduced or elevated pressure. In the event of a rupture, the guard will protect laboratory staff from flying debris.
- ✓ When setting up distillation or similar equipment, double-check that you are not inadvertently about to heat a closed system
- ✗ When heating materials NEVER use a tightly closed container (capped bottles, sealed flasks, etc.). Microwave ovens and hotplates are especially hazardous in these instances.

5.6 Extremes in temperature

5.6.1 Extreme high temperatures

Many operations and many pieces of equipment found in laboratories operate at a high temperature, presenting risk of both burns and fire. Planning work in advance, having appropriate PPE, and paying attention to work in progress are normally sufficient to prevent incidents. Ensuring that insulation is undamaged and that equipment is maintained are important parts of a burn prevention program.

Some laboratory activity involves the use of very high temperatures or equipment that can become very hot under normal operating conditions. Plasma research and high-temperature pyrolysis are examples of high temperature activities. Laboratories involved in such activity should carefully review their practices to ensure they do not place individuals at risk.

5.6.2 Extreme low temperatures

Very low temperature experiments are common in some laboratories. Direct skin contact with very cold surfaces or coolant can burn the skin in a fashion quite like heat. The potential for harm increases with decreasing temperature. Many freezers in UPEI labs operate at temperatures well below an average household freezer. Many maintain temperatures as low as -80 degrees Celsius. Always wear protective gloves when retrieving or adding items to these freezers. Quite often, regular lab gloves will not offer enough protection and heavier cryo-gloves should be worn. **Avoid direct skin contact**. For further information about working with cryogens such as liquid nitrogen, liquid helium, or dry ice, see Section 3.5.

5.7 Biological hazards

A biological hazard or biohazard is an organism, or substance derived from an organism, that poses a threat to health. This can include medical waste, samples of a mircoorganism, virus or toxin (from a biological source) that can impact human health. It can also include substances harmful to animals. The term and its associated symbol are generally used as a warning, so that those potentially exposed to the substances will know to take precautions.

Resources:
- For information on the UPEI Biosafety in Research and Teaching Policy or the UPEI biosafety forms, please visit the Biosafety Committee information on the UPEI Research and Development website:http://upei.ca/research/biosafety.
- Laboratory Biosafety Guidelines: (http://www.phac-aspc.gc.ca/ols-bsl/lbg-ldmbl/index.html)
- Containment Standards for Veterinary Facilities:
http://www.inspection.gc.ca/english/sci/lab/convet/convete.shtml

6. RESPONDING TO EMERGENCIES

UPEI requires that laboratory staff shall be trained and able to respond effectively to incidents that are reasonably foreseeable.

Where the laboratory activities warrant, site-specific safety training must ensure that staff have ready access to and are trained in the use of: fire extinguishers, first aid supplies, eye wash fountains and emergency showers, chemical spill kits, emergency equipment, and personal protective equipment.

6.1 Responding to a fire

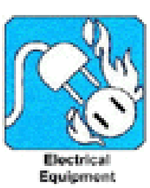
If you suspect a fire (i.e., smell smoke or burning), call UPEI Security at 0384.
If you discover a fire, call 9-911 for emergency services response.
For further information, refer to the UPEI Emergency Procedures manual available online at: www.upei.ca/humanres/safety under "Emergency Preparedness".

6.1.2 Choosing the right extinguisher

Fire Extinguisher Ratings

Class A: Extinguishers will put out fires in **ordinary combustibles**, such as **wood and paper**. The numerical rating for this class of fire extinguisher refers to the amount of water the fire extinguisher holds and the amount of fire it will extinguish.

Class B: Extinguishers should be used on fires involving **flammable liquids, such as grease, gasoline, oil, etc.** The numerical rating for this class of fire extinguisher states the approximate number of square feet of a flammable liquid fire that a non-expert person can expect to extinguish.



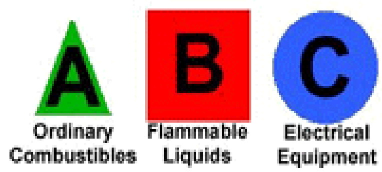
Class C: Extinguishers are suitable for use on **electrically energized fires.** This class of fire extinguishers does not have a numerical rating. The presence of the letter "C" indicates that the extinguishing agent is non-conductive.

Class D: Extinguishers are designed for use on **flammable metals** and are often specific to the type of metal in question. There is no picture designator for Class D extinguishers. These extinguishers generally have no rating nor are they given a multi-purpose rating for use on other types of fires.

Carbon dioxide extinguishers are effective in extinguishing both flammable liquid and electrical fires. Carbon dioxide extinguishers are red with a large-diameter black nozzle. Using a CO_2 extinguisher releases very cold carbon dioxide which cools the extinguisher's black horn. Touching either the horn or the CO_2 "snow" can cause serious skin injury.

Multi-purpose extinguishers

Some UPEI laboratories are equipped with dry chemical extinguishers that may be used on fires involving ordinary combustibles, flammable liquids, or energized electrical equipment. Dry chemical extinguishers are orange or red resembling CO_2 extinguishers but with a simple black hose instead of the large black plastic horn of a CO_2 extinguisher. Discharging a dry chemical extinguisher releases lots of fine, fire-retardant powder that effectively extinguishes many fires. However, the powder may present a significant clean-up problem, particularly if it gets into sensitive electronic equipment.



At UPEI, **all silver-coloured extinguishers contain pressurized water for use on ordinary combustible fires.**

Warning: **Using water on burning solvents, oils, fats, or other flammable liquids might spread the fire and ignite other, nearby materials. Similarly, water should not be used to fight fire in electrically energized equipment. As a water stream can conduct electricity, someone using water on a fire in energized electrical equipment could be electrocuted.**

6.1.3 Using a portable extinguisher

Choose the correct extinguisher for the type of material that is burning and ensure that you have a safe escape route.

P PULL the pin to release the handle.
A AIM the nozzle at the base of the fire.
S SQUEEZE the handles together.
S SWEEP the nozzle back and forth to extinguish the fire.

To prevent harming others, never unnecessarily discharge an extinguisher in the direction of any person. Evacuate immediately if you cannot completely extinguish the fire with one extinguisher.

For further reference:

Hanford Fire Dept., *All You Ever Wanted to Know about Fire Extinguishers*
Retrieved August 11, 2005, from www.hanford.gov/fire/safety/extingrs.htm

6.2 Dealing with Chemical Spills

Spill response requires a knowledge of the physical, chemical, and toxicological properties of spilled chemicals. Always consult the chemical MSDS sheet prior to chemical use to determine the materials required for a spill clean-up. Planning ahead and equipping the laboratory with the required equipment usually ensures a quick, safe, and effective response.

Laboratories with chemical hazards are required to have appropriate spill kits which contain absorbent and protective equipment for use in responding to chemical spills. Information on the location of these spill kits and a list of the contents will be given during the site-specific safety training. Spill kits should be readily available and tailored to meet the specific spill control needs of each laboratory. A safety supply catalogue may assist with the standard types of spill materials that are currently available.

When a spill occurs, laboratory occupants must immediately assess the situation to see if the spill has created a serious or even life-threatening situation requiring an immediate building evacuation. A spill of a few millilitres of a solvent may not present a major hazard. A spill of an appreciable volume of a flammable liquid might call for a building evacuation. For example, a spill of 4L of a volatile, flammable liquid in a small room might produce vapour levels in the flammable range. A spark, a flame, or even a hot surface could cause a fire that might engulf the room. A total evacuation might also be required in the event of a leak of an appreciable quantity of a flammable or toxic gas.

Spill kit supplies may include, but are not limited to:

- signs/tape to indicate a spill has occurred (i.e., “Caution: Spill — Please keep out”)
- brush and scoop for mixing and cleanup
- heavy-duty plastic bags
- paper towels or absorbent pads
- tongs to pick up broken glass/sharps and appropriate leak- and puncture-proof containers for safe removal of such materials
- absorbent materials
- appropriate personal protective equipment (i.e., face shield, goggles, lab coat, gloves, etc.)

For large ignited or hazardous chemical spills:

- ✓ Immediately evacuate the area, closing the door behind you
- ✓ Activate the building fire alarm system and exit the building
- ✓ Move to your designated emergency assembly point or a minimum of 200 metres from the building
- ✓ When safe to do so, consult the Material Safety Data Sheets or applicable Standard Operating Procedures
- ✓ Brief Emergency Response staff on the nature of the situation
- ✗ Do not re-enter the building until instructed by Security Services Personnel

For small ignited or hazardous chemical spills:

- ✓ Consult Material Safety Data Sheets or applicable Safety Manuals
- ✓ Contain the spill
- ✓ If combustible, extinguish or remove sources of ignition
- ✓ If you are uncertain about how to deal with a spill or require assistance, call Security Services Central Dispatch at 4357 or 0384.
- ✓ Begin clean-up wearing protective equipment, including lab coat, impervious gloves, safety glasses or goggles, face shields, aprons, and shoe covers or impervious boots as needed

Some common treatments used in spill clean-up include:

Universal Spill Absorbent, a 1:1:1 mixture of common kitty litter, sodium bicarbonate, and sand is sufficient for most chemical spills including **solvents, acids (not good for hydrofluoric acid), and bases.**

Acid spills may be neutralized with sodium bicarbonate and sodium carbonate.

Base spills may be neutralized by diluting the spill with water and using a base neutralizer such as citric acid.

Small spills of oxidizers (i.e., peroxides, nitrites, nitrates, chlorates, chlorites, etc.) may be treated by first removing any readily oxidizable materials from the spill area, then destroying the oxidizer by cautiously adding sodium bisulfite solution.
Be sure to consult the Material Safety Data Sheet before attempting this procedure.

Spills of potentially infectious material should be treated with a dilute solution of household bleach and allowed to stand for 10 minutes. Prepare the bleach solution by a tenfold dilution of household bleach with water.

Mercury spills should be cleaned up using a commercially available spill kit and/or following the site-specific Standard Operating Procedure.

Even small mercury spills should be considered hazardous as mercury is toxic and has significant chronic impacts on human health. The best way to avoid mercury spills is to limit the presence of mercury-containing items in the laboratory. Mercury thermometers are not to be used in UPEI laboratories unless absolutely necessary.

To dispose of waste from spill clean-up:

- ✓ Refer to your area's site-specific protocol for the appropriate Hazardous Waste disposal method.

6.3 First aid for chemical exposure

For serious injuries, immediately call 9-911.

A list of **University employees** who are **trained as Emergency First Aid Responders** and **locations of First Aid kits** can be found on the UPEI Health and Safety website: www.upei.ca/humanres/safety

Although many minor injuries can await the arrival of medical assistance, some require immediate action. If a person is bleeding excessively or has stopped breathing, delayed first aid could prove fatal. Similarly, delay in responding to a splash or spill of a corrosive chemical could result in permanent skin or eye damage.

First aid focuses on dealing with life-threatening conditions and arranging for medical assistance. Although medical help is usually available within a matter of minutes, the person providing first aid needs to be ready to render life-saving help. Where the victim is not in immediate danger, the first aid provider should be careful not to unwittingly make injuries worse.

In responding to any incident, the first aid provider should first quickly assess the situation to ensure that, in trying to help, he or she is not at risk. A toxic air contaminant and an electrical hazard are two hazards that will influence how a first aid provider should safely respond to an incident.

To help when someone has stopped breathing:

- ✓ Immediately call 9-911 and have someone alert security (0384)
- ✓ Perform emergency first aid (if trained)
- ✓ Tilt the victim's head back by gently pushing back on the forehead while lifting the chin to clear the victim's airway
- ✓ Begin artificial respiration or CPR
- ✗ Never give anything by mouth to someone who is unconscious

In cases of chemical inhalation:

- ✓ If a person who has inhaled a dangerous material is able to move with only minor assistance, move him/her to fresh air while awaiting the arrival of an ambulance
- ✓ Call 9-911 and have someone alert security (0384)
- ✓ Keep the victim comfortable and calm while awaiting assistance
- ✓ Be prepared to provide the ambulance attendants with information on the chemical involved in the incident

To control bleeding:

- ✓ Apply firm pressure to the wound using bandage, gauze, or even a clean lab coat
- ✓ Call 9-911 and have someone alert security (0384)
- ✓ Have the victim recline and elevate the wound if there is no sign of a broken bone and movement does not cause pain
- ✓ Keep the victim warm and comfortable until medical assistance arrives
- ✗ Avoid contact with the victim's blood by wearing clean disposable gloves
- ✗ Do not cut off blood circulation beyond the wound
- ✗ Except in the most severe cases a tourniquet will not be needed. Using one improperly could cause added harm

Minor burns sometimes occur in laboratories. Immediately following the burn, there may not be any sign of skin damage. But within a very few minutes the skin will appear pink (or reddish), and slight swelling and small blisters may be present.

To treat minor burns:

- ✓ Immerse the burn in cool water until pain subsides
- ✓ Cover the burn with a clean and sterile dressing
- ✗ Do not apply butter or ointment as these may interfere with medical treatment
- ✓ Seek medical assistance for all serious burns

A spill, a splash, or an explosion that gets a chemical on someone's clothing, skin, or in their eyes is another type of incident that requires an immediate response. Corrosives, including mineral acids, bases, and many strong oxidizers begin to damage skin immediately. Other chemicals can even be absorbed in harmful quantities through unbroken skin. In some cases, skin contact with harmful chemicals does not cause pain. The victim may not appreciate the seriousness of the situation. When any of these chemicals contaminate clothing or the skin or get in the eye, prompt first aid is essential.

To remove skin contamination due to spills, splashes or explosions:

- ✓ Contaminated clothing should be removed immediately and the affected area flushed with large amounts of water
- ✓ When a significant portion of the body is contaminated, use an emergency shower to completely wash away the chemical
- ✓ Flush for at least a full 15 minutes
- ✗ Do not attempt to "neutralize" the contaminant by applying a second chemical. Do not use any fluids, other than water.

To use an emergency shower:

- ✓ Step under the shower. Pull the cord or step on pedal to activate the shower.
- ✓ Remove contaminated clothing
- ✓ Shower for at least 15 minutes
- ✓ Seek medical assistance

- ✓ Be prepared to provide the ambulance attendants with information on the chemical involved in the incident

Damage to the eye begins immediately, making it essential to respond quickly to an eye contact with a chemical. Laboratory staff and students should be familiarized with the location and operation of eye wash stations and emergency showers during their site specific safety training.

To use a portable eye wash bottle:

- ✓ Place the eye cup of the bottle over the affected eye and squeeze the bottle to flush the eye**.**
- ✓ Continue to flush the eye until you are able to reach a fountain eye wash station that has continual water flow.
- ✓ Continue to flush the eye for a full 15 minutes.
- ✓ Seek medical assistance.

To use a fountain eye wash station:

- ✓ Activate water supply.
- ✓ Adjust the proportion of hot and cold water to provide a comfortable temperature if possible.
- ✓ Hold eye lids open, being careful not to introduce foreign material into the eyes.
- ✓ Flush eye for a full 15 minutes.
- ✓ Seek medical assistance.
- ✓ Be prepared to provide the ambulance attendants with information on the chemical involved in the incident.

Inadvertent ingestion of a chemical requires immediate attention. Common reasons for chemical ingestion were the consumption of food or beverages in the laboratory and pipetting by mouth. These practices are not permitted in UPEI laboratories.

In cases of chemical ingestion:

- ✓ Call 9-911 and have someone alert security (0384)
- ✓ Have the victim rinse his or her mouth with large amount of water while avoiding swallowing the water
- ✓ Keep the victim comfortable and calm while awaiting the ambulance
- ✓ Be prepared to provide the ambulance attendants with information on the chemical involved in the incident.

For inquiries regarding potential toxic exposure, call the Poison Control Centre at 1-800-565-8161.

APPENDICES