

Safety, Health, Environment & Risk Management

BIOSAFETY MANUAL



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Disclaimer

The materials contained in this document have been compiled from sources believed to be reliable and to represent the best opinions on the subject. This document is intended to serve only as a starting point for good practices and does not purport to specify minimal legal standards. No warranty, guarantee, or representation is made by Laurier as to the accuracy or sufficiency of information contained herein, and Laurier assumes no responsibility in connection therewith. This document is intended to provide basic guidelines for safe practices. Therefore, it cannot be assumed that all necessary warning and precautionary measures are contained in this document and that other or additional information or measures may not be required. Users of this document should consult alternate sources of safety information prior to undertaking specific tasks.

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This manual was prepared for Laurier. Any corrections, additions or comments should be brought to the attention of the Biosafety Officer in Safety, Health, Environment & Risk Management at 519-884-1970 ext. 3108.

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911 or 9-911 from any campus phone

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Health Services	519-756-8228 ext. 5803	519-884-0710 ext. 3146
Physical Resources	519-756-8228 ext. 5761	519-884-0710 ext. 6280
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1. Introduction

1.1 SCOPE

This manual describes requirements and procedures established by Laurier for work with potentially hazardous biological agents. These are applicable to all laboratory research activities and teaching labs that may involve exposure to these agents. The manual is based upon the Public Health Agency of Canada *Laboratory Biosafety Guidelines* (2004 edition) and reflects best practices.

1.2 REGULATORY FORCES AND GUIDELINES

1.2.1 Human Pathogens and Toxins Act

The *Human Pathogens and Toxins Act* (HPTA) came into force in 2009 and addresses safety and security risks associated with the:

- | | | |
|--------------|-------------|--------------------|
| ■ production | ■ storage | ■ release |
| ■ possession | ■ access to | ■ abandonment |
| ■ handling | ■ transfer | ■ import or export |
| ■ use | ■ disposal | |

of human pathogens and toxins, whether imported or domestically acquired.

The development of regulations is currently in process and will become part of Laurier's Biosafety Program when implemented. Until that time, the *Laboratory Biosafety Guidelines*, Canadian Food Inspection Agency Containment Standards and the Human Pathogen Importation Regulations remain fully in effect.

1.2.2 Public Health Agency of Canada *Laboratory Biosafety Guidelines*

The *Laboratory Biosafety Guidelines* (LBGs) developed by the Public Health Agency of Canada form the basis for the biosafety practices included in this manual. These guidelines must be followed to ensure the continuation of granted funds from federal agencies.

The purpose of the *Laboratory Biosafety Guidelines* is to:

- Mandate the establishment of an Institutional Biosafety Committee (IBC) for the review and oversight of biological research.
- Outline roles and responsibilities for biosafety.
- Establish the practices, procedures, and conditions under which work with biological agents must be conducted.

1.2.3 Canadian Food Inspection Agency

The *Health of Animals Act* and its regulations give the Canadian Food Inspection Agency (CFIA) the authority to control the use of significant animal pathogens associated with reportable animal diseases.

The CFIA has published several containment standards documents that must be followed when working with applicable biohazardous agents. The *Containment Standards for Veterinary Facilities* must be followed when using biohazardous agents that are animal pathogens and pathogens associated with reportable animal diseases. When importing agents that are pathogenic to animals, the CFIA must also be consulted to receive an import permit.

Additionally, *Containment Standards for Facilities Handling Aquatic Animal Pathogens* and *Containment Standards for Facilities Handling Plant Pests* must be adhered to when using aquatic animal or plant pathogens.

1.2.4 Human Pathogen Importation Regulations

The Human Pathogen Importation Regulation (HPIR) requires that every person importing a human pathogen in Risk Group 2, 3 or 4, or toxins must obtain an import permit. These regulations also make the LBGs mandatory in all facilities dealing with imported human pathogens and toxins. Applicants wishing to import human pathogens or toxins must have facilities that comply with the operational practices and physical requirements for a containment laboratory detailed in the LBGs.

1.2.5 Additional Regulatory Forces

Disposal of biohazardous waste is regulated and monitored by the Ontario Ministry of Environment.

The requirements for packaging and shipment of biomedical materials are governed by the Transportation of Dangerous Goods (TDG) Act and Regulations, which are administered by Transport Canada.

1.3 RESPONSIBILITIES

1.3.1 Institutional Biosafety Committee (IBC)

- Reviews and approves all procedures, policies, and guidelines regarding the storage, usage, transport and disposal of biohazardous materials.
- Provides technical advice to users of biohazardous materials.
- Reviews permit applications and risk assessments involving biological agents and materials.
- Meets quarterly or as needed at the request of any Committee member.

1.3.2 Responsibilities of the Biosafety Officer

- Provides a liaison between Laurier and the Office of Laboratory Security, Public Health Agency of Canada.
- Provides technical support, consultation, and advice on all aspects of biohazardous work.
- Develops effective procedures for the implementation of current standards and guidelines.
- Oversees a biosafety program that complies with the regulations for use of or exposure to biohazardous materials.
- Provides training for persons using biological hazards.
- Develops procedures for shipping all biohazardous materials.
- Provides guidance for appropriate decontamination procedures for transport and after a spill or an accident involving biohazardous materials.
- Provides guidance on the proper disposal of biohazardous waste and recommends waste disposal procedures.
- Ensures the university's registration and license for the *Human Pathogens and Toxins Act* is up to date and accurate, and completes renewals and annual reporting as necessary.
- Advise the Director, SHERM, on policy matters concerned with the protection of personnel from biohazardous agents.

1.3.3 Responsibilities of the Supervisors/Principal Investigators

Supervisors or Principal Investigators (PIs) are responsible for implementing the Biosafety Program within the scope of their projects. They must:

- Ensure that all biohazardous materials are registered and that appropriate permits and risk assessment forms are completed prior to purchasing/obtaining the agent(s). In the case of environmental isolates and genetically modified organisms, identification of the organism should be established for isolates and a risk assessment conducted for both isolates and genetically modified organisms (GMOs).
- Ensure that appropriate containment levels are established in consultation with the Biosafety Officer; ensure adherence to these levels.
- Implement engineering controls to the extent feasible including containment equipment (primary barriers) and facility design (secondary barriers) appropriate for the laboratory function, hazard and risk.
- Ensure strict adherence to biosafety practices and techniques.
- Implement procedures for safe handling of specimens of human or primate origin.
- Ensure that all individuals under their supervision are trained and knowledgeable about the hazards associated with handling biohazardous materials.

- Direct laboratory activities.
- Ensure appropriate training of personnel about the potential hazards of biohazardous materials and the practices and techniques required for their safe handling.

1.3.4 Responsibilities of the User

Individuals are responsible for their own safety and the safety of others they may affect with biohazardous agents/substances. Users must:

- Work with biohazardous agents/substances using the appropriate containment level, as directed by the Lab Supervisor and the Biosafety Officer.
- Review containment level requirements with their Supervisor.
- Work with strict adherence to biosafety practices and techniques.
- Participate in health surveillance programs where appropriate.
- Report unsafe conditions or any reason that duties cannot be completed safely.
- Report any accidents/incidents to the Lab Supervisor and SHERM.

1.3.5 Membership

The Institutional Biosafety Committee (IBC) is composed of representatives from technical and scientific staff and faculty members and the Biosafety Officer. Representatives of other support departments may be invited to join at the discretion of the Committee. New members are appointed by the Chair and are approved by the Dean of Science. The term of committee membership is 2 years and it is renewable.

The Committee members will select a Chair and a Vice-Chair. Each should have at least one year of Committee experience. The Vice-Chair shall succeed the Chair, whenever possible.

Each Committee member shall appoint a substitute representative who is qualified to attend Committee meetings in their absence.

1.3.6 Voting Rights of the Committee

Each Committee member has full voting rights including substitute members. A majority vote of those present is required for an issue to be approved or passed by the Committee. At least 2/3 of the members or their substitute(s) must be present for a quorum.

1.3.7 Meetings and Minutes

The IBC shall meet at least quarterly and more often if needed. The meetings shall be run by the Chair or by the Vice-Chair in the absence of the Chair.

The minutes of each Committee meeting shall be published and distributed to all the Committee members, the appropriate senior management, and the Co-Chairs of the Institutional Biosafety Committee.

1.4 COMPLIANCE ENFORCEMENT POLICY

Laurier assumes the responsibility of ensuring to the Public Health Agency of Canada (PHAC) and the Canadian Food Inspection Agency (CFIA) that the use of biohazards will be undertaken in a safe manner and in compliance with the PHAC and CFIA guidelines.

All deficiencies must be in writing to the Biosafety Officer, including the corrective action taken. Any offence occurring twice in any one-year period will be considered a second offence.

All compliance violations are categorized as major or minor offences. The categories aid in determining the level of risk or immediate danger to safety and health, and suggest the response that may be required when issues of non-compliance are identified.

1.4.1 Minor Offence

A minor offence is an infraction that poses no immediate risk or threat to safety, health, or the environment. Examples include:

- Inadequate signage
- Inadequate posting (i.e. permit posting)
- Inappropriate use of biohazard warning labels

ACTIONS FOLLOWING A MINOR OFFENCE:

First Offense: A written notification will be sent by the BSO on behalf of the IBC to the Permit Holder, with a copy to the Department Chair, the Director, SHERM. Corrective action of the violation is required, with a written reply in 21 days. If the written reply is not received within 21 days, a second notice will be copied to the Dean of the Faculty. If there is no response within 14 days of the second notice, a meeting will be arranged the BSO with the Permit Holder, the Department Chair, the IBC Chair, and the Director, SHERM.

Second Offence: A meeting will be arranged by the BSO with the Permit Holder, the Department Chair, the IBC Chair and the Director, SHERM, to review the issues.

Third Offence: The Permit Holder will be notified in writing by the BSO that the permit will be suspended until a meeting with the IBC can be held.

Fourth Offence: The BSO will recommend permit cancellation to the IBC.

Note: For the second, third and fourth occurrences, notification of the actions outlined above will be copied to the Dean of the Faculty, the Department Chair, the Director, SHERM and the IBC Chair.

1.4.2 Major Offence

A major offence is a violation that causes immediate risk or danger to safety and health, or could cause a release of biohazards into the environment or the community. Examples of major offences include:

- Use or storage of food/drink or smoking in the laboratory.

- Inadequate training of new staff.
- Refusal to participate in the Level 2 Inspection Program.
- Unauthorized possession/use of biohazards.
- Inadequate or unsafe storage areas for biohazards.

ACTIONS FOLLOWING A MAJOR OFFENCE:

First Offense: A written notification will be sent to the Permit Holder by the BSO on behalf of the IBC with a copy to the Department Chair and the Director, SHERM. Immediate correction of the violation is required, and a written reply to the IBC in 3 days. If the written reply is not received within 3 days, a second notice will be sent, with a copy to the Dean of the Faculty. If there is no response within 3 days to the second notice, a meeting will be arranged with the Permit Holder, Department Chair, the IBC Chair and the Director, SHERM.

Second Offense: The Permit Holder will be notified in writing by the BSO on behalf of the IBC that the permit will be suspended until a meeting with the Institutional Biosafety Committee can be held to discuss the offence(s).

Third Offence: The BSO will recommend to the IBC that the Permit Holder's permit be cancelled. This recommendation will be copied to the Dean of the Faculty, the Department Chair, and the Director, SHERM.

1.5 PATHOGEN SAFETY DATA SHEETS

A limited number of Pathogen Safety Data Sheets (PSDSs) are available on the Public Health Agency of Canada website at <http://www.phac-aspc.gc.ca/lab-bio/res/psds-ftss/index-eng.php>.

PSDSs contain health hazard information, recommended precautions, spill clean-up procedures, and other information that is relevant specifically to the laboratory setting. They serve as an additional safety resource for laboratory personnel working with biological agents.

1.6 BIOHAZARDOUS MATERIALS PERMITS AND RISK ASSESSMENTS

Research at Laurier involving Risk Group 1 (RG1) and/or Risk Group 2 (RG2) agents as defined by the *Laboratory Biosafety Guidelines*, must be approved by the Institutional Biosafety Committee (IBC).

There are two documents to be submitted in an application package; a permit and a risk assessment form. Application packages must be submitted to the BSO, with sufficient notice to allow for the review process to be completed before laboratory activities commence.

Amendments to the permit and risk assessment must also be submitted to the BSO, prior to the submitted changes taking place. The [permit and risk assessment documents](#) can be found on the SHERM website under Biosafety.

1.6.1 Biological Materials Permit

For use of either RG1 and/or RG2 agents, a Biological Materials Permit must be completed. An editable copy of the permit can be found on the SHERM website, under Biosafety.

1.6.2 Risk Assessment Form

A risk assessment form for the highest level of containment must also be completed. For example, if both RG1 and RG2 agents are in use, complete the permit form along with the risk assessment form for containment level 2 (CL2). Example documents are also available, to illustrate what the IBC will be looking for during a review. The risk assessment forms along with the example forms are available on the SHERM website, under Biosafety.

2. Classification of Biological Agents

2.1 RISK GROUPS

Biological agents are categorized into risk groups based on the relative hazards they pose. The factors used to determine an agent's risk group includes its pathogenicity, infectious dose, mode of transmission, host range, availability of effective preventive measures and availability of effective treatment.

These classifications presume ordinary circumstances in the research laboratory or growth in small volumes for diagnostic and experimental purposes.

Risk Group 1 (low individual and community risk)

A biological agent that is unlikely to cause disease in healthy workers or animals.

Risk Group 2 (moderate individual risk, limited community risk)

A biological agent that can cause human or animal disease but, under normal circumstances, is unlikely to be a serious hazard to laboratory workers, the community, livestock, or the environment. Laboratory exposures rarely cause infection leading to serious disease; effective treatment and preventative measures are available and the risk of dissemination is limited.

Risk Group 3 (high individual risk, low community risk)

A biological agent that usually causes serious human or animal disease, or can result in serious economic consequences, but does not ordinarily spread by casual contact from one individual to another, or can be treated by antimicrobial or antiparasitic agents.

Risk Group 4 (high individual risk, high community risk)

A biological agent that usually produces very serious human or animal disease, often untreatable, and which may be readily transmitted from one individual to another, or from animal to human or vice-versa, directly or indirectly, or by casual contact.

As a general precaution, the risk group for agents should be raised when manipulation may result in the production of infectious droplets or aerosols. Agents with similar pathogenic characteristics that are not included in these lists should be considered in the same risk category. Since many agents may be referred to in the literature by a variety of names, the Laboratory Supervisor must fully verify an unlisted organism's characteristics before determining a classification.

Any pathogens that are both animal and human pathogens will require an importation permit from both the Canadian Food Inspection Agency (CFIA) and the Public Health Agency of Canada (PHAC). If a pathogen is infectious to only humans, only the PHAC import permit is required.

3. Containment Levels

Classification of biological agents into Risk Groups does NOT establish guidelines for handling agents safely in the laboratory setting. Therefore, Containment Levels have been established to provide end users with a description of the minimum containment required. Containment Levels describe the characteristics of the agent and the engineering, operational, technical and physical requirements for manipulating it safely.

Risk assessment is a critical step in the selection of an appropriate Containment Level for any biohazardous work. A detailed assessment should be conducted to determine both containment level facility requirements and operational practices requirements. The risk assessment should include the Risk Group information, the potential for aerosol generation, the quantity and concentration of the agent, the agent's stability and the type of work (e.g., *in vitro*, *in vivo*).

It is the responsibility of the Principal Investigator (PI)/Supervisor to conduct risk assessments and to require the highest appropriate level of containment available for manipulation of specific infectious agents. The BSO and IBC may be consulted to determine the appropriate containment level.

3.1 CONTAINMENT LEVEL 1 (CL 1)

Containment Level 1 (CL1) applies to the basic laboratory, which handles agents requiring no special design features beyond those suitable for a well-designed and functional laboratory. Biological Safety Cabinets (BSCs) are not required. The laboratory is designed so that it can be easily cleaned and bench tops are impervious to water and resistant to acids, alkalis, and organic solvents. Work may be done on an open bench top, with procedures performed to minimize the creation of aerosols. Containment is achieved through the use of practices normally employed in a basic microbiology laboratory

3.1.1 Operational Practices for Containment Level 1

- Eating, drinking, smoking, storing of food, personal belongings, or utensils, applying cosmetics, and inserting or removing contact lenses are not permitted in any laboratory; the wearing of contact lenses is permitted only when other forms of corrective eyewear are not suitable; wearing jewellery is not recommended in the laboratory.

- Long hair is tied back, or restrained in such a way so that cannot come into contact with hands, specimens, containers or equipment.
- Access to the laboratory is limited or restricted to authorized personnel at the discretion of the Principal Investigator or Lab Supervisor when experiments are in progress.
- Doors to the laboratory must not be left open.
- Open wounds, cuts, scratches and grazes should be covered with waterproof dressings.
- Laboratories are to be kept clean and tidy. Storage of materials that are not pertinent to the work and cannot be easily decontaminated (i.e. journals, books) should be minimized; paperwork and report writing should be kept separate from biohazardous materials work areas.
- Protective laboratory clothing, properly fastened must be worn by all personnel, including visitors, trainees and others entering or working in the laboratory; suitable footwear with closed toes and heels must be worn in all laboratory areas. Protective laboratory clothing must not be worn in non laboratory areas; laboratory clothing must not be stored together with street clothing.
- Where there is a known or potential risk of exposure to splashes or flying objects, whether during routine operations or under unusual circumstances (e.g., accidents), eye and face protection must be used. Careful consideration should be given to the identification of procedures requiring eye and face protection, and selection should be appropriate to the hazard.
- Gloves (e.g., latex, vinyl, co-polymer) must be worn for all procedures that might involve direct skin contact with biohazardous material or infected animals; gloves are to be removed when leaving the laboratory and decontaminated with other laboratory wastes before disposal; metal mesh gloves can be worn underneath the glove.
- Hands must be washed after gloves have been removed, before leaving the laboratory and at any time after handling materials known or suspected to be contaminated.
- If a known or suspected exposure occurs, contaminated clothing must be decontaminated before laundering (unless laundering facilities are within the containment laboratory and have been proven to be effective in decontamination).
- The use of needles, syringes and other sharp objects should be strictly limited; needles and syringes should be used only for parenteral injection and aspiration of fluids from laboratory animals and diaphragm bottles; caution should be used when handling needles and syringes to avoid auto-inoculation and the generation of aerosols during use and disposal; where appropriate, procedures should be performed in a BSC; needles should not be bent, sheared, recapped or removed from the syringe; they should be promptly placed in a puncture-resistant sharps container before disposal.
- Work surfaces must be cleaned and decontaminated with a suitable disinfectant at the end of the day and after any spill of potentially biohazardous material; work surfaces that have become permeable (i.e., cracked, chipped, loose) to biohazardous material must be replaced or repaired.

- Contaminated materials and equipment leaving the laboratory for servicing or disposal must be appropriately decontaminated and labelled or tagged-out as such.
- All contaminated materials, solid or liquid, must be decontaminated before disposal or reuse; the material must be contained in such a way as to prevent the release of the contaminated contents during removal.
- Disinfectants effective against the agents in use must be available at all times within the areas where the biohazardous material is handled or stored.
- Leak-proof containers are to be used for the transport of infectious materials within facilities (e.g., between laboratories in the same facility).
- Spills, accidents or exposures to infectious materials and losses of containment must be reported immediately to the Laboratory Supervisor; written records of such incidents must be maintained, and the results of incident investigations should be used for continuing education.
- An effective rodent and insect control program must be maintained.

3.2 CONTAINMENT LEVEL 2 (CL 2)

The primary exposure hazards associated with organisms requiring Containment Level 2 are through ingestion, inoculation and mucous membrane routes. Agents requiring CL2 facilities are not generally transmitted by airborne routes, but care must be taken to avoid the generation of aerosols (aerosols can settle on bench tops and become an ingestion hazard through contamination of the hands) or splashes.

Primary containment devices such as BSCs and centrifuges with sealed rotors or safety cups must be used, along with appropriate personal protective equipment (i.e., gloves, laboratory coats, protective eyewear). Environmental contamination must be minimized through the use of handwashing sinks and decontamination facilities (autoclaves).

The laboratory is designed so that it can be easily cleaned. Bench tops are imperious to water and resistant to acids, alkalis and organic solvents. The laboratory should have a sink for handwashing.

3.2.1 Operational Practices for Containment Level 2

In addition to working within the operational practices for containment level 1, the following describes the additional minimum operational practices required for containment level 2.

- Good microbiological laboratory practices intended to avoid the release of infectious agents are to be employed.
- BSCs must be used for procedures that may produce infectious aerosols and that involve high concentrations or large volumes of biohazardous material. Laboratory Supervisors, in consultation with the Biological Safety Officer/Institutional Biosafety Committee, should perform a risk assessment to determine which procedures and what concentrations and volumes necessitate the use of a BSC.
- Appropriate signage indicating the nature of the hazard being used (e.g., biohazard sign, containment level) must be posted outside each laboratory; if infectious agents used in

the laboratory require special provisions for entry, the relevant information must be included on the sign; the contact information of the Laboratory Supervisor or other responsible person(s) must also be listed.

- Entry must be restricted to laboratory staff, animal handlers, maintenance staff and others on official business.
- All people working in the containment area must be trained in and follow the operational protocols for the project in process. Trainees must be accompanied by a trained staff member. Visitors, maintenance staff, janitorial staff and others, as deemed appropriate, must also be provided with training and/or supervision commensurate with their anticipated activities in the containment area.
- Emergency procedures for spill clean-up, BSC failure, fire, animal escape and other emergencies must be written, easily accessible and followed. A record must be made of other people entering the facility during an emergency.

All biological agents used at Laurier require Containment Level 1 or 2.

NOTE: NO EMPLOYEE WILL PERFORM CONTAINMENT LEVEL 3 OR 4 WORK AT LAURIER.

4. Additional Safety Considerations for Biological Laboratories

4.1 HUMAN PATHOGENS (INFECTIOUS AGENTS)

Some microorganisms (viruses, bacteria, fungi, etc.) are species-specific, selectively infecting and causing disease in one or a limited number of host species. Unrelated and distantly related species may not be similarly affected by the same infectious microorganism due to differences in physiology, metabolism, biochemistry, etc. In general, the risk to a laboratory technician working with a virus that only infects and causes disease in rodents is lower than the risk to a laboratory technician working with tissues and cells from humans or other primates. If the human material contains a viable pathogen, it will likely be a human pathogen, with the potential to infect and cause disease in another human.

Although a single mode of transmission may predominate, disease-causing microorganisms can be spread or transmitted from one host to the next, directly or indirectly, by a number of methods, including aerosol generation and inhalation, ingestion of contaminated food and water, skin and mucous membrane contact with contaminated surfaces, contact contamination of an open wound or lesion, and autoinoculation via a cut, laceration or puncture with a contaminated instrument.

4.2 PLANT PATHOGENS

The *Containment Standards for Facilities Handling Plant Pests*, published by the Canadian Food Inspection Agency, describes the minimum acceptable physical and operational requirements for facilities that work with plant pests other than weeds, soil, genetically modified plants and arthropod biological control agents. Any persons who grow, raise, culture or produce anything that is a pest or is infected or infested with a pest must adhere to these containment standards. They provide guidance on the operation of plant pest containment facilities such as laboratories, greenhouses and screenhouses. Compliance with these standards and with documents such as import permits will help to ensure that economically and environmentally significant plant pests do not inadvertently escape into the environment and become established in Canada.

4.3 AQUATIC ANIMAL PATHOGENS

The *Containment Standards for Facilities Handling Aquatic Animal Pathogens*, published by the Canadian Food Inspection Agency, applies to facilities importing aquatic animal pathogens, aquatic animal product(s) and by-product(s) or other substances that may carry an aquatic animal pathogen or part thereof. The standards provide general guidance on the design and operating requirements for any aquatic animal containment facility. All persons wishing to import aquatic animal pathogens and related infectious materials for *in vitro* or *in vivo* work must comply with these standards along with any import requirements established by the Canadian Food Inspection Agency (CFIA) and, where applicable, by the Public Health Agency of Canada.

4.4 HUMAN BLOODBORNE PATHOGENS

Human blood is recognized as a potential source of pathogenic microorganisms that may present a risk to workers who are exposed during the performance of their duties. Although the hepatitis B virus (HBV) and the human immunodeficiency virus (HIV) are often cited as examples, a "bloodborne pathogen" is any pathogenic microorganism that is present in human blood or other potentially infectious materials and that can infect and cause disease in persons who are exposed to blood or other potentially infectious materials containing this pathogen.

"Other potentially infectious materials" means material that has the potential to transmit bloodborne pathogens. This includes infected human tissues and the following body fluids: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, amniotic fluid, saliva in dental procedures, and any other body fluid that is visibly contaminated with blood.

4.4.1 Universal Blood and Body Fluid Precautions

The possibility of undiagnosed bloodborne disease such as hepatitis B virus (HBV) and human immunodeficiency virus (HIV), led the Center for Disease Control to recommend that blood and certain other body fluids from all humans be considered potentially infectious and that precautions be taken to minimize the risk of exposure. This approach, called "Universal Precautions", is a method of infection control, intended to prevent parenteral, mucous membrane, and non-intact skin exposure of workers to bloodborne pathogens. All human blood, certain human body fluids, and other materials are considered potentially infectious for HBV, HIV, and other bloodborne pathogens. Precautions must be consistently used.

Body fluids to which universal precautions apply include blood, body fluids containing visible blood, semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, and amniotic fluid.

Universal precautions generally do not apply to faeces, breast milk, nasal secretions, sputum and saliva, sweat, tears, urine, and vomitus unless they contain visible blood. The risk of transmission of HIV and HBV from these fluids is extremely low or non-existent. Although these materials are not implicated in the transmission of bloodborne pathogens, it is prudent to minimize non-intact skin and mucous membrane contact with these materials.

Hepatitis B immunization is recommended as an adjunct to universal precautions for workers who have occupational exposure to human blood or other potentially infectious materials. This immunization is provided to employees at risk, free of charge.

4.4.2 General Precautions

- All workers should routinely use appropriate barrier precautions to prevent skin and mucous membrane exposure when contact with human blood or other body fluids is anticipated.
- Gloves must be worn when touching blood and body fluids, mucous membranes, or non-intact skin, for handling items or surfaces soiled with blood or body fluids, and for performing venipuncture and other vascular access procedures. If a glove is torn or damaged during use, it should be removed and a new glove used as promptly as safety permits. Disposable gloves must not be washed or disinfected for reuse. Washing with surfactants may enhance penetration of liquids through undetected holes in the glove. Disinfecting agents may cause deterioration of the glove material.
- Masks and protective eyewear or face shields should be worn during procedures that are likely to generate droplets of blood or other body fluids to prevent exposure of mucous membranes of the mouth, nose, and eyes.
- Gowns or aprons should be worn during procedures that are likely to generate splashes of blood or other body fluids. Protective clothing should be removed before leaving the area.
- Hands and other skin surfaces must be washed immediately and thoroughly if contaminated with blood or other body fluids. Hands should be washed immediately after gloves are removed since no barrier is 100% effective.
- Workers should take precautions to prevent injuries caused by needles, scalpels, and other sharp instruments or devices during procedures, when cleaning used instruments, during disposal of used needles, and when handling sharp instruments after procedures. Needles and syringes should be used only in those situations when there is no alternative. To prevent needlestick injuries, needles must not be recapped, purposely bent or broken by hand, removed from disposable syringes, or otherwise manipulated by hand. After they are used, disposable syringes and needles, scalpel blades, and other sharp items should be placed in puncture-resistant containers for disposal. The puncture-resistant container should be located as close to the use area as practical.
- Workers who have exudative lesions, weeping dermatitis, cuts, open wounds or other breaks in the skin must either refrain from all direct contact with blood and other body fluids until the condition resolves, or utilise protective barriers to reduce the risk of exposure.

- Pregnant workers should be aware that some BBPs may be particularly harmful to a developing foetus.

4.5 BIOSAFETY SIGNS AND LABELS

The Public Health Agency of Canada requires that warning signs and/or symbols be used to inform personnel and visitors of the potential of hazards in the workplace. Specifically, with regard to biohazards, the universal biohazard warning symbol, see Figure 1, must be used to "signify the actual or potential presence of a biohazard and to identify equipment, containers, rooms, materials, experimental animals or combinations thereof, which contain and/or are contaminated with, viable hazardous agents."

- The universal biohazard symbol must be used to designate the presence of agents/substances that are believed to be biohazardous.
- All laboratories and work areas utilizing and/or storing biohazardous substances must have the appropriate biohazardous caution sign posted prominently. If RG2 agents are used, a biohazard sign must be located outside the laboratory door to indicate the nature of the hazard, the biohazard level, special provisions for entry and contact information for the Principal Investigator and/or other responsible person(s).
- Principal Investigators/Supervisors are responsible for ensuring that all hazard signs are current and accurate. Notify the Biosafety Officer if changes are necessary in laboratory door signage and/or equipment labeling.



Figure 1: Universal Biohazard Symbol

4.6 ACCESS/SECURITY CONTROLS

Doors must be locked when laboratories are unoccupied and only authorized persons are permitted to enter laboratory working areas. Children under the age of 14 years must not be permitted to enter laboratory working areas.

4.7 CELL CULTURE

All new cell lines introduced into Laurier must be registered with the Biosafety Officer.

Storage and retrieval of frozen cell cultures from liquid nitrogen require appropriate personal protective equipment. There are three major risks associated with liquid nitrogen (-196 °C): frostbite, asphyxiation and exposure. Gloves should be worn that are thick enough to provide insulation, but flexible enough to allow manipulation of ampoules.

When ampoules are submerged in liquid nitrogen, a high-pressure differential results between the outside and the inside of the ampoule. If the ampoule is not perfectly sealed, the pressure differential may result in inspiration of liquid nitrogen, which may cause the ampoule to explode violently when thawed. Wear eye protection, a face shield and earplugs.

Biological Safety Cabinets (BSCs) should be kept clean and free of unnecessary equipment and material to ensure proper functioning of the cabinet.

Liquid waste should be decontaminated by chemical disinfectant (e.g., 10% sodium hypochlorite). Vacuum collection flasks for liquid waste should be kept outside the cabinet in a secure place and should contain an appropriate disinfectant (e.g., Wescodyne). The collection flask should also have a back-up trap to protect the central vacuum line.

All flasks should be properly labelled.

Decontamination of the biological safety cabinet should be done with a liberal spray or wipe with 70% ethanol at the end of the shift.

Solid waste should be placed in biological waste bags and the bags then sealed for autoclaving. Biohazard disposal containers with lids should be used for primary disposal.

Glass pipettes should be placed in a pipette container with an appropriate disinfectant. Plastic disposable pipettes must be disposed of in an appropriate container.

4.8 TRAINING REQUIREMENTS

Biosafety training is mandatory for all new Principal Investigators, Laboratory Supervisors, research staff and students who work with microorganisms, cell cultures and human blood and body fluids. The Biosafety Officer provides general biosafety training to all individuals handling biohazardous materials. Principal Investigators are responsible for ensuring new employees have received training appropriate to the specific biological materials and/or processes in the lab. This training is to be provided prior to initiation of work and should be documented by the Principal Investigator.

On completion of Biosafety training, the participant will understand:

- the process of risk assessment for work with microorganisms and cell lines
- the concept of containment level as it applies to biohazard laboratories
- how a biological safety cabinet works and its role in a biohazard laboratory
- the procedures for accidental exposure or spills of biohazardous materials
- the risks associated with human blood and body fluids
- how to apply precautions when working with human blood and body fluids

4.9 PERSONAL PROTECTIVE EQUIPMENT

The type and extent of clothing and equipment to be selected for any particular procedure depend on the research operations and levels of risk associated. At a minimum, a lab coat, closed-toe shoes, and gloves must be worn in any microbiology laboratory. Lab coats, closed-toe shoes, and gloves prevent biohazardous materials from contact with the skin, including areas where there might be cuts, abrasions, or dermatitis. The legs are a vulnerable area if uncovered, so it is inappropriate to wear skirts or shorts. Closed-toe shoes protect the feet from spills as well as injuries from dropped sharps.

4.9.1 Gloves

Appropriate gloves must be worn for all procedures that might involve direct or accidental skin contact with biohazardous materials. Latex or vinyl gloves offer a high level of dexterity and a higher level of sensitivity; however, they don't offer a great deal of protection from needle sticks, animal bites or sharps. All gloves will eventually permeate and should therefore be changed periodically. If gloves become contaminated or torn, remove immediately and wash hands with soap.

When there is risk of gloves ripping, tearing or being cut, procedures may require double gloving.

When there is risk of splashing, gloves should overwrap the cuff and lower sleeve of the lab coat.

Gloves must be removed prior to leaving the laboratory. Gloves that have come into contact with biohazardous materials must be decontaminated before disposal.

4.9.2 Lab Coats

The lab coat protects street clothing from contamination and prevents possible cross-contamination from any normal flora present on the skin.

Lab coats must be worn by all personnel, including visitors, trainees and others entering or working in the laboratory. Coats must be properly fastened. If contaminated, lab coats should be decontaminated by autoclaving before being placed in the laundry. If decontamination is not possible, any contaminated coat should be placed in the biohazard waste container.

When work is taking place in CL2 laboratories, anyone entering the laboratory, including visitors, must wear a lab coat.

Lab coats from CL2 laboratories should be autoclaved prior to laundering. Ensure lab coats entering the autoclave do not have components such as plastic buttons that may melt during the autoclave process.

5. Biological Safety Cabinets

A biological safety cabinet is a ventilated cabinet that uses a combination of HEPA (high efficiency particulate air) filtration, laminar air flow and containment to provide personnel, product and environmental protection from particulates or aerosols involving biohazardous materials. It is distinguished from a chemical fume hood by the presence of HEPA filtration and the laminar nature of the air flow. BSCs are not designed to prevent ignition of volatile flammable chemicals. In containment level 2 facilities, BSCs are used for procedures with the potential to produce infectious aerosols and for high concentrations or large volumes of infectious material.

The provision of natural gas to BSCs is not recommended. When suitable alternatives (e.g., disposal sterile loops, micro-incinerators) are not possible, touch-plate microburners that have a pilot light to provide a flame on demand may be used.

BSCs are verified prior to putting the unit into service and then certified annually, and after any repairs or relocations. SHERM coordinates the annual certification of the BSCs. Any

abnormalities in the functioning of a BSC should be reported to Physical Resources by completing a work order. Immediately discontinue use of a BSC that is not functioning properly. Inform others in the area by posting a sign to indicate the BSC is not functioning properly.

Every individual working in a BSC must be trained in its correct use and have a good understanding of the different types of cabinets and how they work.

There are three classes of BSCs, each with varying capabilities and limitations.

5.1 CLASS I BIOLOGICAL SAFETY CABINET

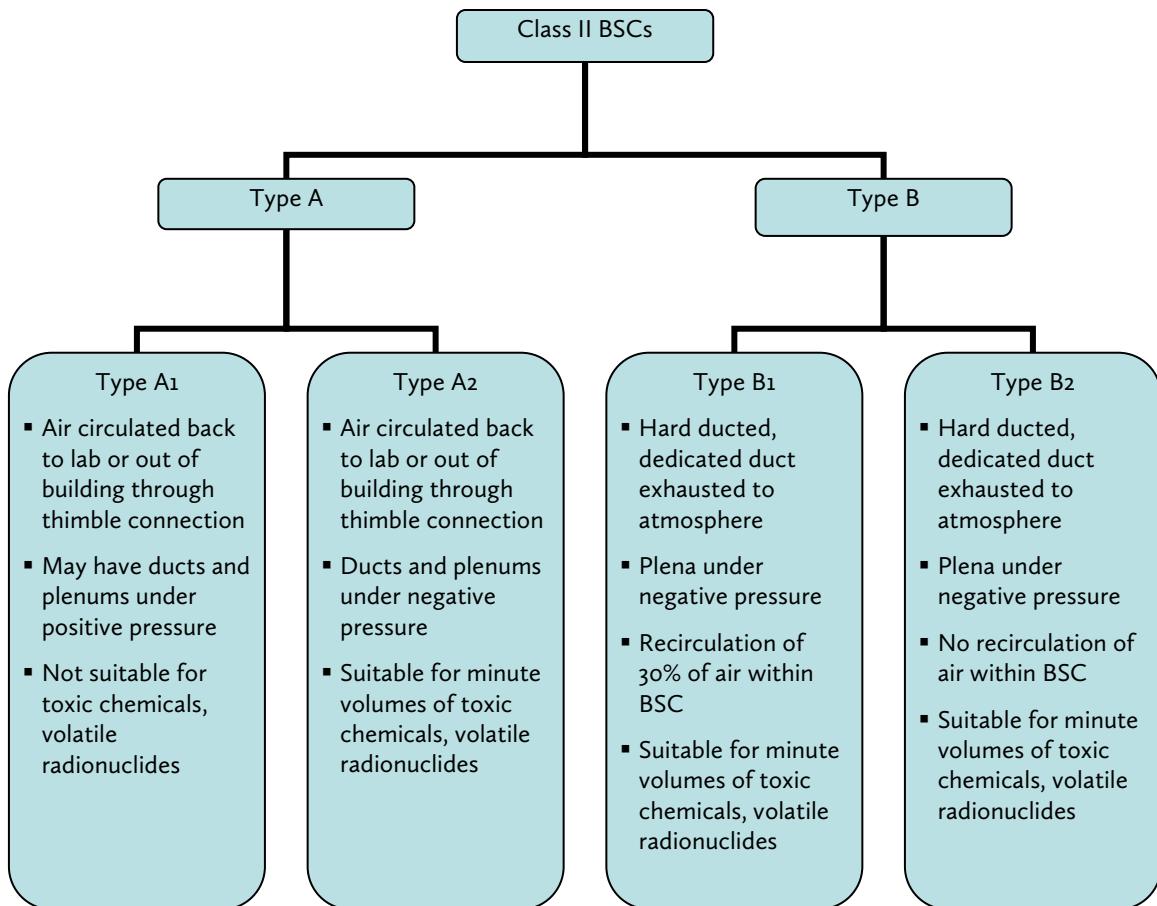
This is a ventilated cabinet which provides good protection to the worker and environment but no protection to the work. These cabinets have unrecirculated airflow away from the operator that is discharged to the atmosphere after filtration through a HEPA filter. Chemical carcinogens and low level of radioactive materials and volatile solvents can be used in a Class I safety cabinet.

5.2 CLASS II BIOLOGICAL SAFETY CABINET

This is a ventilated cabinet that provides personnel, product and environmental protection. These cabinets have an inward airflow and HEPA-filtered supply and exhaust air. Class II cabinets differ from class I in that they allow only HEPA-filtered air to flow over the work surface.

There are two types of class II BSCs, type A and type B. Within each type, there are two subtypes, A₁ and A₂, and B₁ and B₂.

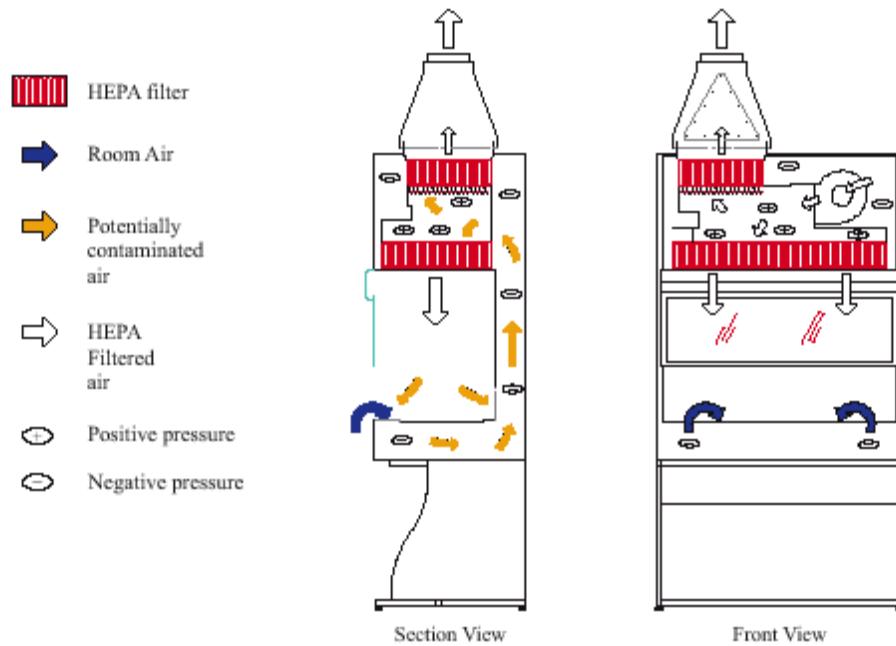
Figure 2: Types of Class II BSCs



A class II biological safety cabinet should be used whenever there is a risk of creating potentially infectious aerosols or droplets. Examples of processes that may create aerosols are: centrifuging, grinding, blending, vigorous shaking or mixing, opening container of infectious materials that are at other than ambient pressure. Use of a centrifuge in the open laboratory may be carried out safely only if the samples have sealed heads or centrifuge safety caps are used. However, it is strongly recommended that centrifuging gets done in a BSC at all times.

Class II Type A2 BSCs are the most commonly used BSC on campus, see Figure A. Only BSCs that have hard ducts to the outside and provide a face velocity of 80 to 125 feet per minute should be used when working with volatile chemicals.

Figure 3: Schematic Diagram of Class II Type A2 Biosafety Cabinet



5.3 CLASS III BIOLOGICAL SAFETY CABINET

Class III BSCs are designed for work with risk group 4 pathogens, and provide an alternative to the positive pressure suit made for maximum containment laboratories. There are no class III BSCs at Laurier.

5.4 WORKING IN A BIOLOGICAL SAFETY CABINET

5.4.1 Start-up Procedures

When preparing for work in the BSC:

- Turn off UV lights if in use and ensure that the sash is in the appropriate position.
- Turn on fluorescent light and cabinet blower.
- Check the air intake and exhaust grilles for obstructions.
- If the cabinet is equipped with an alarm, test the alarm and switch it to the "on" position.
- Confirm inward airflow by holding a tissue at the middle of the edge of the viewing panel and ensuring that it is drawn in.
- Disinfect the interior surfaces with a suitable, noncorrosive disinfectant (e.g., 70% alcohol).
- Assemble all materials required for the procedure and load them into the cabinet; do not obstruct the air grilles; the working surface may be lined with absorbent paper with plastic backing; segregate "clean" items from "contaminated" items.
- Wait 5 minutes to purge airborne contaminants from the work area.

5.4.2 Working in the Cabinet

When working in the BSC:

- Put on protective lab-coat and gloves as appropriate.
- Perform operations as far to the rear of the work area as possible.
- Avoid movement of materials or excessive movement of hands and arms through the front access opening during use; when you do enter or exit the cabinet, do so from straight on; allow the cabinet to stabilize before resuming work.
- Keep discarded, contaminated material to the rear of the cabinet; do not discard materials in containers outside of the cabinet.
- Do not work with open flames inside the cabinet.
- If there is a spill during use, surface decontaminate all objects in the cabinet; disinfect the working area of the cabinet while it is still in operation (do not turn the cabinet off).
- Ensure small items such as KimWipes don't get sucked into the vents, as they can disrupt motor operations.

5.4.3 Shut-down Procedures

Follow these procedures upon completion of the work:

- Allow the cabinet to run for 5 minutes with no activity.
- Close or cover open containers before removing them from the cabinet.
- Surface disinfect by spraying objects with 70% alcohol in contact with contaminated material before removal from the cabinet.
- Remove contaminated gloves and dispose of them as appropriate; wash hands.
- Put on clean gloves, and ensure that all contaminated materials are placed into biohazard bags within the cabinet.
- Using a suitable non-corrosive disinfectant (e.g., 70% ethanol), disinfect interior surfaces of cabinet; periodically remove the work surface and disinfect the area beneath it (including the catch pan) and wipe the surface of the UV light with disinfectant.
- Turn off the fluorescent light and cabinet blower.
- Turn on the UV light if appropriate (do not turn on when people are working close by).

5.5 CERTIFICATION OF BSCs

The certification of the Biological Safety Cabinets is essential to their safe and effective use. All Biological Safety Cabinets must be certified on installation, when the filters are changed, before and after a move or transfer and annually. Cabinets must not be moved without first undergoing a decontamination process. The Biosafety Officer must approve any modifications to any Biological Safety Cabinets. Cabinets must undergo certification following modification.

The certification process is the responsibility of SHERM.

If problems are encountered in operating a biological safety cabinet, do not continue to use it; contact Physical Resources immediately at extension 6280.

6. Laboratory Equipment

6.1 SONICATORS

Sonicators are devices commonly used for disrupting cells and mixing samples. Vortexers and stomachers are also used for mixing samples. The following safety measures should be used with a sonicator to reduce the chance of aerosol formation.

- Follow your Supervisor's direction on how to use a sonicator.
- Loosely cap all samples.
- Make sure there is enough water in the sonicator.
- Avoid prolonged sonication.
- Inspect all glassware to be used in the sonicator. Do not use chipped or cracked glassware.
- Routinely replace the sonicator liquid.
- Avoid sonicating volatile compounds.
- When possible, use secondary containment (container within container within sonicator).
- Perform sonicating in isolated rooms and areas.
- Make sure you have adequate ear protection.

6.2 CENTRIFUGES

Centrifuges are a source of potential biological contamination due to the rapid speeds and relatively high pressure exerted by such devices. The following safety measures should be used when using any centrifuge:

- Follow your Supervisor's direction regarding use of a centrifuge.
- Prior to starting, make sure the centrifuge is clean. Do not operate with any material spills in either the body or the rotor.
- Make sure the centrifuge is level. If a portable model, make sure it is secure on the bench top before starting.
- Inspect all equipment to be placed in centrifuge for cracks or weak areas.
- Use the lowest speed and time setting that will accomplish the job.
- Balance all loads.
- Do not open the lid until it comes to a complete stop.
- Wait for at least one minute before opening the lid to remove your sample.
- Should a spill occur, disinfect immediately and dry completely before the next run.
- Periodically inspect centrifuge. Check seal around top, baskets, rotors and wiring.
- Avoid use of volatile materials when possible.

- Plastic centrifuge tubes with seal-forming screw tops should be used whenever possible.
- Centrifuges should not be placed into a biological safety cabinet if the motor produces strong air current because the air turbulence generated may disrupt the laminar airflow.

6.3 LYOPHILIZERS

Lyophilizers are used to remove liquid by a process commonly referred to as freeze-drying. Because the removal of liquid is complete, the chance of generating aerosol contamination can be quite high if the appropriate safety procedures are not followed.

The following are guidelines for using biological or potential biological materials in a lyophilizer:

- Follow your Supervisor's direction regarding use of a lyophilizer.
- Ensure equipment is clean and sanitized before using.
- Ensure appropriate filters are attached to vacuum and exhaust lines.
- Do not remove samples before the cycle is complete. Do not attempt to break the vacuum.
- Periodically inspect the equipment.
- Where possible cap all material before removal from the unit.

6.4 VACUUM

If there is a vacuum system serving multiple areas, care should be taken that there are filters in the system, and that there is an overflow trap containing an appropriate disinfectant to prevent entry of contaminated material into the piping system and pumps. It is often best to use either a stand-alone pump-type vacuum system, or to use a water siphon vacuum system that is attached to a faucet (provided that measures are taken to prevent back-siphonage).

7. Decontamination

This section provides an overview of cleaning work surfaces and the treatment of equipment and biological wastes. The information provided in the following is intended to assist the investigator in ensuring that a safe environment is afforded to laboratory personnel, as well as custodial and trades staff. The initial risk assessment for any project should include an evaluation of the processes and/or disinfectants to be used to ensure that the biohazardous agents/substances involved in the research are inactivated during spill cleanup, before cleaning equipment for re-use, and before final disposal. Microorganisms vary in their resistance to destruction by physical and chemical means.

Decontamination includes both sterilization and disinfection. Sterilization is the complete destruction of all microorganisms, including bacterial spores. Disinfection is the destruction and

removal of specific types of microorganisms. It is important to have a thorough understanding of the effectiveness of various types of decontaminants and their effectiveness against different microbial groups, and appropriate applications.

7.1 STEAM STERILIZATION/AUTOCLAVING

Autoclaving, or steam sterilization is the most effective way of decontaminating infectious laboratory wastes.

Individuals using the autoclaves at Laurier must complete the training program offered by the Research Instrumentation Technician. Procedures listed in the autoclave SOP must be followed in order to ensure safe and effective sterilization by the autoclave.

7.1.1 Effective Use of the Autoclave

The effectiveness of decontamination by steam autoclaving is influenced by the way in which the waste is loaded into the autoclave chamber. Containers of waste must allow steam penetration and must be arranged in the autoclave in a manner that permits free circulation of steam. Piling containers above one another and overloading can result in decontamination failure.

The following elements all contribute to autoclave effectiveness.

- Temperature: Adequate chamber temperature is at least 121°C (250°F).
- Time: Adequate autoclaving time is a minimum of 30 minutes, measured after the temperature of the material being sterilized reaches 121°C and 15 psi pressure. The more densely arranged the autoclave load, the longer it will take to reach 121°C in the center of the load.
- Contact: Steam saturation of the load is essential for effective decontamination. Air pockets or insufficient steam supply will prevent adequate contact. To ensure adequate steam contact, leave autoclave bags partially open during autoclaving to allow steam to penetrate into the bag. Tight fitting containers do not permit steam penetration.
- Containers: Use leak-proof containers for items to be autoclaved. Place plastic bags inside a secondary container in the autoclave in case liquids leak out. Plastic or stainless steel containers are appropriate secondary containers. Make sure plastic bags and pans are autoclavable.
- Indicators: Tape indicators can only verify that the autoclave has reached normal operating temperatures for decontamination. Most chemical indicators change color after being exposed to 121°C, but cannot measure the length of time spent at 121°C. Biological indicators (such as *Bacillus stearothermophilus* spore strips) and certain chemical indicators (such as Sterigage) verify that the autoclave reached adequate temperature for a long enough time to kill microorganisms.
 - Use a chemical indicator in every load to monitor the effectiveness of individual autoclave runs (temperature only).
 - Performance of the autoclaves is verified weekly using spore strips, and records are kept by the Research Instrumentation Technician in the Faculty of Science.

7.2 CHEMICAL DISINFECTION

Disinfection is the removal of specific types of microorganisms. Chemical disinfectants are used for the decontamination of surfaces and equipment that cannot be autoclaved. In spill or accident cleanups, chemicals disinfectants are typically employed. The type of chemical disinfectant chosen for a decontamination task depends on the resistance of the microorganisms of concern.

7.2.1 Choosing a Chemical Disinfectant

When employed with discretion, and knowledge of its limitations, a chemical disinfectant might be used for any of the following purposes.

- Cleaning and decontamination of work surfaces.
- Cleaning and decontamination of equipment.
- Spill or accident clean-ups.
- Decontamination of containers and transfer equipment suitable for recycling.
- Decontamination of experimental wastes.

The selection of a chemical disinfectant for routine or special use is likely to be determined by a number of factors. The following is a list of properties that should be considered:

- Efficiency
- Toxicity to humans
- Combustibility
- Corrosiveness
- Formation of residues and precipitates
- Shelf life
- Cost

The efficacy of a chemical disinfectant will depend on concentration, temperature and time of exposure. The manufacturer's instructions regarding dilution and storage of the diluted disinfectant should be consulted, as some disinfectants may lose their effectiveness with time. Chemical disinfectants should not be mixed. Cold equipment such as refrigerated centrifuges and cold room equipment may need to be warmed to room temperature. When the biohazardous material under investigation is a known virus or microorganism that can be assayed, an effective concentration of the disinfectant against the agent should be determined in tests conducted under the same conditions in which the disinfectant will be used. An effective concentration should be one that is sufficient to kill or inactivate any hazardous agent, but because of the toxic and /or corrosive nature of some of the decontaminants, excessive concentrations should be avoided.

The efficacy of a disinfectant is limited by the following factors:

- The nature and concentration of the material to be decontaminated

One must keep in mind that the chemical decontaminants listed in Table 1 are not equally effective against all microorganisms. It is important to realize that a compound that is a good germicide may have little virucidal activity. Furthermore, different viruses may not be equally sensitive to inactivation by the same decontaminant.

- **Effective contact**

To be effective, the chemical must come into direct contact with the material to be inactivated. Any decontamination procedure that is not carried out with sufficient care to ensure that this requirement is met may fail to accomplish sterilization, irrespective of the concentration used or treatment time allowed.

- **Competing Reactions**

One should be aware that some of the more widely used chemical decontaminants are inactivated by organic material.

7.2.2 Commonly Used Chemical Decontaminants

Because many chemical disinfectants are at least a skin irritant and others are fairly toxic, care must be taken to avoid skin exposure and/or ingestion. Personal protective equipment appropriate when using these agents includes lab coats, gloves and eye or face shields if there is a likelihood of splashes to the face.

The chemical agents most commonly used in the laboratory, and some of their characteristics and possible applications for decontamination purposes, are listed in Table 1.

Table 1: Summary of Decontamination of Biohazardous Materials

RISK GROUP ^a	CULTURES	PIPETs (Excluding Pasteur Pipets)	WASTE (SPILLS)	BROKEN GLASS	SHARPS (Syringes, Needles, Blades, Pasteur Pipets)	METAL SURFACES (Incubators, BSCs)
1	Autoclave	Place in pipet trays and Autoclave	Autoclave Or 1% Sodium Hypochlorite	Autoclave	Autoclave	70 % Ethanol or other approved

			for 15 min ^b .			disinfectant
2	Autoclave	Place in pipet trays and Autoclave	Autoclave or 1% Sodium Hypochlorite for 15 min ^b .	Autoclave	Autoclave	Wescodyne in 50% Ethanol ^c . Then Rinse with 70% Ethanol until residue disappears

Comments:

- a. Risk Groups are described in Section 2.1.
- b. Do not autoclave 1% sodium hypochlorite. It must be collected as a liquid waste be decontaminated and disposed to the sewer.
- c. Do not autoclave Wescodyne in 50% ethanol. It must be collected as a liquid waste be decontaminated and disposed to the sewer.

8. Disposal of Biohazardous Waste

Biohazardous waste is a commonly used term that includes infectious, pathological, microbiological and pharmaceutical actives of unknown toxicity. For the purposes of this manual, biohazardous waste is defined as waste containing material of sufficient quantity that exposure to the waste by a susceptible host could result in an infectious disease. For specific questions regarding the classification of waste, contact SHERM. Laboratory waste contaminated with or containing biological agents must be autoclaved or disinfected to inactivate the biological agents prior to disposal or cleaning for reuse.

All biohazardous waste leaving Laurier must be transported in accordance with federal, provincial and local transportation regulations, and incinerated in accordance with all environmental regulations. Biohazardous waste leaving Laurier is coordinated by the BSO. Contact the BSO to arrange for a pickup.

Biohazardous waste from laboratories includes the following:

- Human blood and body fluids, including plasma, serum, other blood products, emulsified human tissue, spinal fluids, pleural and peritoneal fluids
- Cultures and stock of infectious agents (CL₂ and CL₁ cultures)
- Items contaminated with infectious agents, such as: disposable culture dishes, devices used to transfer, inoculate and mix cultures, (e.g., pipettes), and disposable bench top covers
- Animal blood and materials contaminated with blood from animals animal carcasses

Animal blood and materials contaminated with blood from animals are considered biological waste, and although not biohazardous in nature, are to be handled and disposed of in the same

manner as biohazardous waste, by being placed in the laboratory's biohazardous waste container. In the case of liquid, waste should be decontaminated with an appropriate disinfectant.

Animal carcasses must be placed in a designated freezer for storage until pickup by a qualified waste contractor.

Sharps that are contaminated with biohazardous materials must be collected in a leak and puncture-proof sharps container. Disposable needles and syringes must not be replaced in their sheath or guard prior to being deposited into the sharps container. Sharps containers with contents exposed to biological materials must be disposed of by placing the container in the facility's biohazardous waste container.

Biohazardous waste generated from work in Biosafety Levels 1 and 2 must be collected within the laboratory in doubled-bagged biohazardous waste bags. These bags must be securely closed and placed in the biohazardous waste disposal container in the laboratory. This container will be closed prior to being removed from the laboratory.

Liquid waste must be collected in the laboratory at the point of generation. If possible, all liquid waste should be put in appropriate leak proof autoclavable containers and transported for autoclaving. If it is not possible to autoclave, the liquid waste must be decontaminated and disposed to the sewer to reduce the risk of spillage during handling and transporting out of the laboratory.

9. Emergency Procedures

9.1 SPILLS

Spills of biohazardous substances may constitute a significant and ongoing health hazard if not handled in an appropriate manner. Effective disinfectants must be available in the laboratory at all times and for immediate use. As part of the laboratory safety regimen, each laboratory should have a spill cleanup plan detailing specific disinfectants and procedures for that area. Clean-up of any spill requires the use of appropriate personal protective equipment.

Since the capacity of most commonly used laboratory culture containers is small, it is anticipated that most spills within the laboratory will be limited in size and therefore minor in nature.

Although the specific response will depend on the type and nature of the incident, decontamination and clean-up procedures incorporating the steps outlined below are recommended. If a spill is large or of a nature that cannot be handled by laboratory personnel, call Special Constable Service or emergency services at 9-911 from any campus phone.

Effective disinfectants must be available in the laboratory at all times and for immediate use.

9.1.1 Biohazardous Spill Inside a Biological Safety Cabinet

Spills confined to the interior of a biological safety cabinet should present little hazard provided: a) clean-up is initiated at once, and b) the cabinet ventilation system continues to operate to prevent the escape of contaminants.

Recommended spill cleanup procedure:

- Pour a strong disinfectant (sodium hypochlorite or Wescodyne) around but not on the spill, and mix the disinfectant with the spilled material cautiously
- Pour or wipe walls, work surfaces and equipment with a solution of appropriate disinfectant
- Allow to stand for the required contact time for the particular hazard (usually 20-30 min)
- Remove excess decontaminant solution with paper towel
- Used disinfectant, gloves, clothes, paper towels and contaminated lab coats should be placed in a biohazard bag and autoclaved
- Inform the Lab Supervisor and Biosafety Officer of the spill
- Decontaminate all surfaces exposed to the spill with a suitable disinfectant

Note that this procedure **will not** disinfect the cabinet filters, blower etc. The interior of the cabinet should be completely cleaned with formaldehyde (if necessary) by a qualified and trained individual.

9.1.2 Biohazardous Spill Outside a Biological Safety Cabinet

A spill of biohazardous materials outside the containment of a biological safety cabinet could represent significant health risks due to the difficulty in containment.

In the event of a spill or container breakage resulting in the unintentional release of a biological agent, evacuate the laboratory for a time sufficient for most aerosols to settle or be dispersed and removed by the ventilation system, usually 20 to 30 minutes. Respiratory protection should be considered for re-entry.

Upon re-entry of the lab:

- Pour a strong disinfectant solution (sodium hypochlorite or Wescodyne) around, but not on the spill, and mix the disinfectant with the spilled material cautiously
- Evacuate the laboratory for a time expected to be sufficient for decontamination of the mixed material, normally 20 to 30 minutes
- Carefully absorb the liquid with absorbent paper and place into an autoclavable bag or other container suitable for autoclaving
- Decontaminate all surfaces exposed to the spill with a suitable disinfectant

Alternatively, if using a spill kit:

- Absorb the spilled liquid with a spill control pillow or other absorbent material
- Place the used pillow or absorbent material into an autoclavable bag or autoclavable container and autoclave it
- Decontaminate all surfaces exposed to the spill with a suitable disinfectant

9.2 ACCIDENTS/INCIDENTS

Rapid and accurate reporting of accidents and incidents involving exposure to biohazardous agents is important in identifying potentially hazardous operations and procedures.

All spills, accidents and overt or possible exposures must be reported in writing to the Principal Investigator/Laboratory Supervisor or acting alternate as soon as circumstances permit. The PI/Lab Supervisor must file the report with SHERM within 24 hours describing the incident in detail, including the route of exposure, the emergency actions taken, a description of the worker's duties as they relate to the exposure incident, as well as any other information that may be pertinent to the accident. Actions taken to prevent future occurrences should be included in the report.

Accidents/incidents occurring during transportation of infectious substances are to be reported to BSO as soon as circumstances permit. The BSO may be required to report to incident to the Ministry of Environment and Ministry of Transportation.

NOTE: FOR MORE INFORMATION, REFER TO ACCIDENT/INCIDENT SECTION IN THE LABORATORY HEALTH AND SAFETY MANUAL.

9.2.1 First Aid Guidance for Exposures

The exposed site should be washed immediately.

- For a needlestick, cut or puncture wound, wash with soap and water after allowing the wound to bleed freely.
- For a mucous (eyes, nose, mouth) membrane or non-intact skin contact (cuts, rash, eczema or dermatitis), flush with water at the nearest faucet or eye wash station.

If necessary, the worker should seek prompt medical attention at the nearest hospital emergency department or emergency clinic, a medical practitioner of their choosing, or preferably, at Laurier's Health Services.

10. Transportation of Biohazardous Material

Transportation of dangerous goods by water, air, road, or rail, whether domestically or internationally, is governed by the Transportation of Dangerous Goods (TDG) Act and Regulations which are administered by Transport Canada. Contained in these regulations are outlines for specific packaging requirements, labelling, documentation, training, and emergency response plans. TDG also imparts to Transport Canada the authority to inspect, seize, and administer fines in cases of non-compliance.

10.1 DEFINITIONS

10.1.1 Internal Versus External

Laurier defines "Internal" as the transportation of biohazardous materials within the university.

Laurier defines "external" as the transportation of biohazardous materials outside the university either nationally or internationally.

10.1.2 Infectious Substances

Under TDG a biohazardous material is categorized under Class 6.2 - Infectious substances. Infectious substances are defined as substances containing viable microorganisms or their toxins, which are known or suspected to cause disease in animals or humans.

TDG does not use the Risk Group classification when categorizing infectious substances to ship. Infectious materials are divided into two categories; A and B. Part 2 of the TDG regulations provides a listing of viruses, bacteria and fungi and their classification.

Prior to shipping any infectious substance, the BSO should be contacted to ensure proper classification.

10.2 INTERNAL TRANSPORTATION PACKAGING REQUIREMENTS

10.2.1 Transportation Within a Laboratory

The work area and procedure(s) should be arranged so as to minimize the number of required moves from one place to another within the laboratory and to reduce the possibility of breakage or a spill, or, if a spill should occur, to effectively contain the biohazard.

Unbreakable and/or watertight containers or doubling of containers should be used.

The use of absorbent material around or underneath the containers should be also considered.

The degree of protection should depend on the level of risk should the biohazardous contents spill.

10.2.2 Transportation Between Laboratories

The biohazardous material should be packed into a primary container that is leak proof. If necessary, use a basket, tray or other type of secondary container to transport the primary container. Absorbent material should be used between the two containers or as lining for the basket or tray, or the secondary container may also have a cover.

Ensure the outer surfaces of the container being transported have been decontaminated before leaving the laboratory.

Heavier loads should be transported by cart with the material arranged in such a way as to minimize any loss of material should the cart strike an unseen object, wall, door, bump, etc.

Materials to contain a spill should be available close by, or transported on the cart for easy access.

10.3 EXTERNAL TRANSPORTATION PACKAGING REQUIREMENTS

The efficient and safe transfer of infectious substances requires good co-ordination between the sender, carrier, and receiver to ensure safe and prompt transport and arrival in proper condition. It is important that the sender make advance arrangements with the carrier and the receiver to ensure that specimens will be accepted and promptly processed. In addition, the sender must prepare the appropriate dispatch documents according to the Transportation of Dangerous Goods Act and Regulations. The sender should also forward all transportation data to the receiver. No infectious substances shall be dispatched before advance arrangements have been made between the sender, the carrier and the receiver, or before the receiver has confirmed with national authorities that the substance can be imported legally and that no delay will be incurred in the delivery of the consignment to its destination.

For any shipments outside of the University, contact the BSO for guidance on shipping requirements to ensure compliance with the TDG Act and Regulations.

Appendix A: Hazard Classification Method

Include this code on the Biohazardous Materials Permit to show how the Risk Group of the material was determined.

Method	Code	Example
Supplier Information	S	Hela Cells were purchased from ATCC and listed in their catalogue as Risk Group 2 material
Other Researcher	R	A cell line was received from a researcher from Laurier, a risk assessment was done by Laurier and the material was categorized as Risk Group 2
Guides	G	Various guides by the Centre for Disease Control or Public Health Agency of Canada list the agent as a Risk Group 2.
Internal Review	I	The researcher has completed their own internal review process using Public Health Agency of Canada Pathogen Safety Data Sheets as a risk assessment guide.
Needs to be Reviewed	N	The risk group needs to be determined in conjunction with the Institutional Biosafety Committee
Other	O	A method not listed above. Provide an explanation.

Appendix B: Biosafety Resources

Below is a list of Biosafety Resources that can be referenced when completing risk assessment analysis or when looking for further information about biosafety practices and procedures.

Canadian Resources

Laurier's Biosafety Program: http://www.wlu.ca/page.php?grp_id=159&p=12689

Canadian Food Inspection Agency's Containment Standards for Veterinary Facilities:
<http://www.inspection.gc.ca/english/sci/bio/anima/convet/convete.shtml>

Canadian Food Inspection Agency's Containment Standards for Facilities Handling Aquatic Animal Pathogens: <http://www.inspection.gc.ca/english/sci/bio/plaveg/placone.shtml>

Canadian Food Inspection Agency's Containment Standards for Facilities Handling Plant Pests:
<http://www.inspection.gc.ca/english/sci/bio/plaveg/placone.shtml>

Human Pathogens and Toxins Act: <http://lois-laws.justice.gc.ca/eng/acts/H-5.67/index.html>

Public Health Agency of Canada's Laboratory Biosafety and Biosecurity: <http://www.phac-aspc.gc.ca/lab-bio/index-eng.php>

International Resources

Belgian Biosafety Server: <http://www.biosafety.be/>

Centers for Disease Control and Prevention, Biosafety: <http://www.cdc.gov/biosafety/>

Safety, Health, Environment & Risk Management (SHERM)

SHERM is committed to promoting an environmentally responsible, safe and healthy work environment for all community members, while striving to ensure compliance with relevant regulations and support the University's mission of teaching and research.

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