University of Regina

BIOSAFETY PROGRAM

Table of Contents

Acknowledgments **4**

1. Biosafety Administration **5**
- 1.1 Introduction 5
- 1.2 Glossary 5
- 1.3 Biosafety Policy 7
- 1.4 Biosafety Advisory Committee 9
- 1.5 Biosafety Committee 10
- 1.6 Biosafety Officer 11

2. Biological Laboratory Commissioning **12**
- 2.1 General 12
- 2.2 Biological Laboratory Commissioning 12
  - 2.2.1 Biological Risk Group Classification 12
  - 2.2.2 Biological Laboratory Containment Classification 12
  - 2.2.3 Biological Laboratory Commissioning Specifics 13

3. Biological Laboratory Inspections and Audits **16**

4. Biological Laboratory Signage **17**

5. Biosafety Training **18**

6. Worker Authorization **20**

7. Health and Medical Surveillance **21**
- 7.1 Laboratory Acquired or Associated Infections or Diseases 21
- 7.2 Pregnant Worker Notification 21

8. Ordering and Receiving Biological Substances **22**
- 8.1 Ordering Biological Substances (Risk Group 1) 22
- 8.2 Receiving Biological Substances (Risk Group 1) 22
- 8.3 Ordering Biologically Hazardous Substances 22
- 8.4 Receiving Biologically Hazardous Substances 23

9. Biological Importation and Exportation **24**
- 9.1 Importation of Human Pathogens 24
- 9.2 Transfer of Human Pathogens 24
- 9.3 Exportation of Human Pathogens 24
- 9.4 Importation and Transfer of Animal Pathogens 25
- 9.5 Importation of Plants and Plant Pathogens 25

10. Material Safety 26

11. Biosecurity (Biological Labeling, Inventory, and Storage) 27
11.1 Risk Group 1 27
11.2 Risk Group 2 28
11.3 Biosecurity Incident and Emergency Response 29

12. Laboratory Equipment 30
12.1 Personal Protective Equipment 30
12.2 Autoclaves 30
12.3 Biological Safety Cabinets 30
12.4 Centrifuges 31
12.5 Other Equipment 31

13. Biological Waste Disposal 33
13.1 Autoclaves 33
13.2 Incineration 33

14. Biological Spills and Decontamination 34
14.1 Biological Emergencies and Spills 34
14.2 General 34
14.3 Disinfectants 34
14.4 Heat Sterilization 35
14.5 Protective and Personal Clothing Decontamination 35

15. Biological Laboratory Decommissioning 36
15.1 Containment Level 2 Laboratory Decommissioning 36

16. Biological Emergency Response 37
16.1 Emergency Contact Information 37
16.2 Exposures, Suspected Exposures, and Post-Exposures 37
16.2.1 Exposure Procedures 37
16.2.2 Suspected Exposure Procedures 37
16.2.3 Post-Exposure Procedures 37

17. Research and Teaching Animals 39
17.1 President's Committee on Animal Care 39
17.2 Zoonoses 39
17.3 Allergies and Asthma 39
17.4 Health and Medical Surveillance 40
17.5 Laboratory and Wild Animals 41
17.5.1 Wild Animals (Fieldwork) 41
17.6 Animal Facilities 41

Appendix 1: Biological Risk Group Classification 43
Appendix 2: Risk Group Guidance List: Examples of Potential Biologically Hazardous Materials or Organisms 44
Appendix 3: Biological Laboratory Containment Level Classification 49
Appendix 4: Good Laboratory Practices 51
Appendix 5: Public Health Agency of Canada's Containment Level 1 & 2 Requirements 54
Appendix 6: University of Regina Biosafety Questionnaire 56
Appendix 7: Research Involving Recombinant DNA and Genetic Manipulation 62
Appendix 8: Annual Containment Level 2 Laboratory Safety Checklist 63
Appendix 9: Safety Standard Operating Procedure for Containment Level 2 Laboratory 66
Appendix 10: Biologically Hazardous Substances Procurement Form 80
Appendix 11: Transportation of Dangerous Goods Class 6 Guidelines 81
Appendix 12: Personal Protective Equipment 85
Appendix 13: Guidelines for Safe Autoclave Use 87
Appendix 14: Guidelines for Biological Safety Cabinet Use 94
Appendix 15: Guidelines for Safe Centrifuge Use 98
Appendix 16: Biological Waste Disposal Flowchart 100
Appendix 17: Biological Waste Disposal Standard Operating Procedures 101
Appendix 18: Biological Emergencies and Spills 106
Appendix 19: Disinfectants 109
Appendix 20: Emergency Exposure or Suspected Exposure Procedures 113
Appendix 21: Zoonosis Awareness 114
Appendix 22: Human Safety Considerations for Wildlife Use 126
Appendix 23: Animal Facilities 129

Acknowledgments

This Biosafety Program has been created in accordance with the Public Health Agency of Canada's *Laboratory Biosafety Guidelines*, 2004 and *Human Pathogen and Toxin Act*, 2009, Canadian Food Inspection Agency's *Laboratory Safety Manual*, 2006, Canadian Council on Animal Care's numerous guidelines, and World Health Organization's *Laboratory Biosafety Manual*, 2004. In addition, the University of Regina would like to thank the University of Saskatchewan, University of Manitoba, and Arizona State University for the use of their biosafety resources.

1. Biosafety Administration

1.1 Introduction

The University of Regina is committed to providing a safe and healthy work and learning environment for all members of the University community. To meet this commitment the Biosafety Program administrated by Health, Safety & Environment, Human Resources, provides resources and guidance for the compliance, safety, and responsible use of biological materials and/or organisms.

This Program manual consists of eighteen sections. It is intended for use and reference by Academic Staff Members, Staff, Students, and others with responsibility for biosafety. The purpose of this manual is to prescribe procedures and standards to follow to comply with legislated standards and requirements.

There are various Federal, Provincial, and Municipal regulations for controlling the acquisition, use, storage, transfer, and disposal of biological substances. The University is responsible to ensure that these regulations are being enforced to protect the safety of staff, students and the public, while at the same time, the use of the biological substance for the benefit of the public and the furtherance of the aims of the University is encouraged.

The Federal Government recommends establishing a local committee to implement the biological substance requirements. The Biosafety Advisory Committee (BSAC) serves in this capacity. The BSAC oversees the University of Regina's Biosafety Program and a Biosafety Sub-Committee (BSC) will develop and implement policies and procedures. The BSC reports to the BSAC and the BSC policies, procedures, and decisions are subject to review and amendment by the BSAC.

1.2 Glossary

Academic Staff Members are the Faculty, Librarians, Laboratory Instructors, Instructors, and Sessionals at the University of Regina.

Administrator means senior administration of the university, including the Vice-President (Administration), Deans, Directors, etc.

Animals are defined as non-human, living vertebrates and any living invertebrates of the class of *cephalopoda*, including free-living and reproducing larval forms, used for research, education or breeding purposes.

Bacteria (singular: **bacterium**) are a large group of unicellular microorganisms.

Biohazard is an organism or material derived from an organism that poses a threat to human health.

Biological Safety Cabinet is a primary device intended to contain and minimize exposure to potentially biohazardous substances.

Biosafety is the maintenance of safe and healthy conditions in biological research to prevent harm to workers, non-laboratory organisms, and the environment.

Biosafety Advisory Committee (BSAC) is responsible for the oversight and administration of the University's Biosafety Policy, which is designed to ensure the safe use of potentially hazardous or non-hazardous biological materials or organisms in education and research at the University of Regina.

Biosafety Committee (BSC) formulates and ensures implementation of University of Regina policies, regulations, and procedures governing the use of biologically hazardous and non-hazardous materials or organisms, to ensure the safe use of biological substances in education and research at the University of Regina in accordance with the University's Biosafety Policy.

Biosafety Officer (BSO) is the individual designated by the Vice-President (Administration) to oversee the University Biological Safety Program and Procedures.

Biosecurity is defined as the institutional and personal security measures designed and implemented to prevent the loss, theft, misuse, or intentional release of biologically hazardous materials or organisms.

Canadian Council on Animal Care (CCAC)

Contamination is the presence or the reasonably anticipated presence of biologically hazardous materials or organisms on an item or surface.

Decontamination is the process of cleaning, sterilizing, or disinfecting to remove contamination or the possibility of contamination.

Disinfectant is any chemical agent used dominantly on inanimate objects to destroy or inhibit the growth of harmful organisms.

DNA (deoxyribonucleic acid) is an organic molecule that contains the genetic instructions used in the development and functioning of all known living organisms.

Fungi (singular: **fungus**) is a member of a large group of eukaryotic organisms that include microorganisms such as single-celled yeasts and multi-cellular molds.

Genetic Engineering is a term that applies to the direct manipulation of an organism's genes using techniques of molecular cloning and transformation.

Genetically Modified Micro-organisms (GMMOs) are microorganisms whose genetic materials have been altered using genetic engineering techniques such as recombinant DNA.

Hazard is any activity, situation, or substance that can cause illness or injury.

Infectious agent/material/organism refers to a substance or biological entity that may cause disease or illness upon exposure.

Local Safety Committee (LSC) is a committee in the Faculties and/or Departments that have been identified as a higher risk to establish a process where health and safety concerns can be addressed at a local level.

Microorganism is broadly defined as a microscopic entity such as bacteria, viruses, fungi, archaea, protists, green algae, plankton, and the planarian.

Pathogen is a biological material or that may cause disease and illness to its host; also called infectious agent.

President's Committee on Animal Care (PCAC) is responsible for overseeing all animal care and use undertaken by members of the University of Regina, and ensuring compliance with institutional and Canadian Council on Animal Care standards.

Prion is an infectious protein.

Recombinant DNA (rDNA) is a form of DNA that is created by combining DNA sequences that would not normally occur together using genetic engineering techniques.

Responsible Official (R) is responsible for the development, training, and implementation of safety, security, and emergency response plans. This person assists with maintaining detailed records of information necessary to give a complete account of all activities related to pathogens.

Standard Operating Procedures (SOPs) are specific safe operating procedures developed by the Principle Investigator, Laboratory Instructor, or individual responsible for the purchase, use, collection, storage, maintenance, and disposal of a biological substance.

Supervisor means a person who is authorized by the University to oversee or direct the work of employees or students, including, but not limited to, Deans, Directors, Department and Unit Heads, Academic Staff Members, and Managers.

Toxin is a poisonous substance produced by living cells or organisms.

University Community Member is all persons associated with the University of Regina, including, but not limited to, the Board of Governors, President, VP's, AVP's, Deans, Directors, employees, students, contractors, visitors and volunteers.

Virus is a small infectious agent that can replicate only inside the cells of other organisms.

1.3 Biosafety Policy

The following is the University of Regina's ***Biosafety Policy***:

Policy Number:	**20.105.90**
Name:	**Biosafety Policy**
Origin:	**Human Resources**
Approved:	**March 22, 2011**
Approval Process:	**President, University of Regina**
Revision Date(s):	Every three years and whenever there is a change of circumstances that may affect the health and safety of the University community and environment.

Introduction

This Policy pertains to all research and teaching activities on and off campus that may put Academic Staff Members, Staff, Students, and University Community Members at risk of being exposed to biologically hazardous materials or organisms. Exposure to biologically hazardous substances can compromise the health and well-being of an individual and may cause disease or illness. The University of Regina is registered under the Public Health Agency of Canada's *Human Pathogen and Toxin Act* (HPTA) which establishes authority to govern human pathogens and toxins in Canada. The HPTA regulations are currently under development and will be implemented under the authority of this Act.

Policy Statement

The University of Regina is committed to protect the health and safety of all members of the University community and the environment from the effects of biologically hazardous materials or organisms. This will be achieved by:

a) Meeting legislative requirements for all safe use, storage, transfer, and disposal of biologically hazardous and non-hazardous materials or organisms;

b) Ensuring concerned parties are aware of their responsibilities;
c) Developing and implementing written procedures to establish appropriate controls that eliminate or minimize potential exposures to infectious agents; and
d) Ensuring all participants have an informed understanding of the hazards and provide their consent to the means of eliminating or minimizing them.

Scope and Application

This Policy and related Procedures apply to Academic Staff Members, Staff, Students, or University Community Members who are engaged in research or teaching activities involving biologically hazardous and non-hazardous materials or organisms.

Responsibilities

1. Administrators will:

1.1 maintain the Committee responsible for the oversight and administration of this Policy, and ensure the formulation of necessary programs and procedures.

1.2 provide sufficient personnel and resources for the administration and enforcement of requirements and procedures following this Policy.

1.3 require that exposures are reported and investigated and take action to prevent a recurrence where it is within their authority and in accordance with the incident reporting procedure.

2. Supervisors will:

2.1 ensure that individuals in their areas of responsibility have been given adequate direction, training, and instruction in the safe performance of activities concerning biological substances and that the activities are performed without undue risk.

2.2 require the participants to use the appropriate safety equipment and to follow appropriate safety procedures and medical precautions.

2.3 ensure every employee or student who is at risk of exposure to a biologically hazardous substance has access to the University *Health and Safety Policy* and the unit's specific exposure control procedures.

2.4 report substandard conditions or procedures to the Biosafety Officer as necessary and correct such conditions where it is within their authority.

2.5 ensure that all exposure incidents are appropriately treated, if necessary by medical attention, reported to Health, Safety & Environment, investigated, and actions taken to prevent a recurrence in accordance with the incident reporting procedure.

3. Employees & Students will:

3.1 know and follow all applicable procedures in the University Biosafety Program.

3.2 undertake any and all appropriate training as determined by their Supervisor and the Biosafety Officer.

3.3 use appropriate engineering controls and/or personal protective equipment when applicable.

3.4 immediately report all hazards or unsafe conditions, procedures, or behaviours to their Supervisor.

3.5 immediately report any exposures to their Supervisors and the Biosafety Officer and if necessary, obtain medical treatment without delay.

4. University Community Members will:

4.1. follow the directions of all biologically hazardous substance signs or instructions.

4.2. keep out of areas in which they are not authorized to enter.

Non-Compliance

All individual are subject to the requirements outlined in these procedures.

Violations of these policies place the University at significant risk and cases of suspected non-compliance will be investigated by the Biosafety Advisory Committee and/or the Biosafety Committee and appropriate actions will be taken. Appropriate actions may include but are limited to the misconduct procedures as outlined in the Procedures for Reporting and Investigating Scholarly Misconduct.

1.4 Biosafety Advisory Committee

Terms of Reference

The Biosafety Advisory Committee (BSAC) is responsible for the oversight and administration of the University's Biosafety Policy, which is designed to ensure the safe use of potentially hazardous or non-hazardous biological materials or organisms in education and research at the University of Regina. This includes the authority to establish and oversee a Biosafety Committee (BSC) mandated to formulate and implement policies, regulations, and procedures governing the use of all types of biologically hazardous and non-hazardous materials or organisms.

The BSAC is comprised of faculty and staff members who are familiar with the use, release, and storage of biological materials or organisms and who agree with the importance of adhering to all federal, provincial, and institutional regulations and prescribed procedures for the safe use of biological substance. Committee members may represent various areas of expertise but will be concerned with regulations concerning all types of biological substances.

Constitution of BSAC

The BSAC consists of the following members:

a. Academic Staff Members and Staff Members chosen for their expertise in the safe use of biological materials or organisms
b. Representatives from Administration
c. The Biosafety Officer (BSO)
d. The Director, Health, Safety & Environment, Human Resources

Duties of BSAC

BSAC is authorized and responsible for:

a. Establishing a Biosafety Committee (BSC) to formulate and implement University of Regina policies and procedures governing the use of biologically hazardous and non-hazardous materials and organisms, to ensure the safe use of biological substances at the University of Regina in accordance with the University's Biosafety Policy.
b. Monitoring, reviewing and if necessary amending or rescinding the policies, procedures, and decisions made by the BSC and BSO.

Frequency of Meetings

BSAC meets at least once per year.

Chair of BSAC

The Chair and Vice-Chair (Chair elect) of the Committee are selected from Academic Staff Members on the Committee. The Chair serves a two year term and is responsible for calling meetings, for correspondence with the committee members and sitting on the Committee. In the absence of the Chair, the Vice-Chair assumes the duties of the Chair. Additionally, the Vice-Chair will assume the Chair duties after two years of sitting on the Committee.

1.5 Biosafety Committee

Terms of Reference

The Biosafety Committee (BSC) is comprised of the Chair of the BSAC and the Biosafety Officer (BSO). The BSC formulates and ensures implementation of University of Regina policies, regulations, and procedures governing the use of biologically hazardous and non-hazardous materials or organisms, to ensure the safe use of biological substances in education and research at the University of Regina in accordance with the University's Biosafety Policy. Policies, procedures, and decisions made by the BSC or the BSO are subject to review and amendment by BSAC.

Constitution of the Biosafety Committee

The Committee consists of the following members:

a. The Chair of the Biosafety Advisory Committee (BSAC)
b. The Biosafety Officer (BSO)

Duties of the Biosafety Committee

The Committee:

a. Under BSAC direction, formulates and implements University of Regina policies, regulations, and procedures governing the use of biologically hazardous and non-hazardous materials or organisms to ensure the safe use of biological substances at the University of Regina in accordance with the University's Biosafety Policy;
b. Reviews the *Biosafety Questionnaire* forms in consultation with Academic Staff Members to ensure the biological work is conducted at the appropriate containment and biosecurity risk level;
c. Ensures the University of Regina Biosecurity Plan is sufficient for the biologically hazardous research and teaching activities pertaining to the University of Regina;
d. Reports its activities to BSAC at such times and to such extent as BSAC directs;
e. Reviews requests for and authorizes the commissioning of new Containment Level 2 laboratories in consultation with Facilities Management; and
f. Responds to biological substance safety situations which require immediate action.

1.6 Biosafety Officer

The Biosafety Officer (BSO), reporting to the Director, Health, Safety & Environment (HSE), is appointed by the Vice-President (Administration) to give professional advice and assistance in all matters related to biological material and organism safety and to coordinate administration of the Biosafety Program. The BSO is responsible for keeping procedures and practices for the use of biological material up to date, for identifying improvements and opportunities to keep biologically hazardous exposures minimal, and in assisting Academic Staff Members to meet regulatory compliance and University HSE Policies.

The duties of the BSO include:

a. Maintaining contact as necessary with the Public Health Agency of Canada (PHAC) and the Occupational Health and Safety Division of the Government of Saskatchewan Ministry of Labour Relations and Workplace Safety (LRWS) including preparation of annual reports and maintenance of required records.
b. Providing on-going advice and technical assistance to persons using biological substances at the University of Regina.
c. Reviewing biosafety aspects of plans, protocols, and operating procedures for research work involving biologically hazardous substances prior to the implementation of these activities in consultation with the Biosafety Committee (BSC).
d. Serving as the Responsible Official for the University.
e. Assisting with investigations and supervising after accidents or incidents involving biologically hazardous substances.
f. Coordinating with medical persons regarding possible laboratory-acquired infections.
g. Ensuring proper waste management.
h. Performing periodic internal biosafety audits on technical methods, procedures and protocols, biological agents, materials, and equipment.
i. Discussing violations of biosafety protocols and procedures with the appropriate persons.
j. Providing biosafety training for staff and students who wish to use biological materials or organisms, including animals, at the University of Regina.
k. Providing a continuing education in biosafety.
l. Maintaining an inventory of all biological substances on campus.
m. Assisting with establishment of appropriate procedures for import/export of biologically hazardous materials or organisms to/from the laboratory, according to federal regulations.
n. Assisting with coordination of the receipt, shipment and transport of biologically hazardous materials or organisms according to WHMIS and *Transportation of Dangerous Goods Regulations*.
o. Liaising with Academic Staff Members.

2. Biological Laboratory Commissioning

2.1 General

At the University of Regina (U of R), building space design is developed, reviewed, and completed according to the National Building Code of Canada, National Fire Code of Canada, and other applicable codes and standards. Laboratory space can only be assigned by Facilities Management and no laboratory space may be occupied until Facilities Management and Health, Safety & Environment (HSE) have commissioned both the proposed laboratory activities and the laboratory space.

Refer to the U of R ***Chemical and Laboratory Safety Program*** for basic laboratory commissioning processes or contact the Biological Safety Officer (BSO) for more information.

2.2 Biological Laboratory Commissioning

In addition to the basic laboratory assignment and commissioning process for wet laboratories (see above), biological laboratories at the U of R must meet additional engineering, operational, technical, and physical requirements set by the U of R and the Public Health Agency of Canada (PHAC).

2.2.1 Biological Risk Group Classification

Biological risk group classification of the materials and organisms that will be used is required. Classification of organisms according to PHAC's four risk groups has traditionally been used to categorize the relative hazards of infectious materials or organisms. See ***Biological Risk Group Classification*** in the Appendices for risk group classification guidance.

In addition to the above mentioned PHAC's four risk groups, any material or organism mentioned in the following list is considered to be unconventional and the risk group of the biological substance and containment level will need to be determined on a case-by-case basis:

- Prions
- Genetically modified microorganisms
- Cell lines (culture)
- Material derived from animals or humans

2.2.2 Biological Laboratory Containment Classification

Classification of biological materials and organisms according to risk group is not meant to establish the actual handling of biological hazards in the laboratory setting. Containment levels (CL) are selected to provide the end-user with a description of the minimum containment required for handling the organisms safely in a laboratory setting. The containment system includes engineering, operational, technical, and physical requirements for manipulating a particular biological substance.

See ***Biological Containment Level Laboratory Classification*** in the Appendices for CL laboratory classification guidance. Additionally, see ***Public Health Agency of Canada's Containment Level 1 & 2 Requirements*** (Appendices) for CL laboratory design and physical requirements in detail.

Biological Containment Level 2 Laboratory

In addition to U of R Facilities Management and HSE commissioning both the proposed laboratory activities and space, PHAC must approve laboratory activities and space in every Containment Level 2 laboratory. PHAC's Containment Level 2 checklist can be found online at: www.phac-aspc.gc.ca/lab-bio/permits/inspection/index-eng.php or contact the BSO for a paper copy.

2.2.3 Biological Laboratory Commissioning Specifics

Academic Staff Members (ASM) must complete the ***Biosafety Questionnaire*** form (Appendices) before starting their research or teaching programs. The reasons for completing this form are:

- To obtain a comprehensive survey of all biological materials and/or organisms on campus;
- To ensure accurate information for first responders in an emergency situation;
- To identify proper procedures for unconventional biological materials or organisms, which may be biohazardous;
- To comply with Federal, Provincial, Municipal, and Institutional regulations regarding Risk Group 2 biological substances; and
- To comply with Provincial regulations regarding genetically modified microorganisms (GMMOs), recombinant DNA, and transgenic work (*The Occupational Health & Safety Regulations*, section 305).

Water, Soil, and Plant Samples

ASM who use whole samples of water, soil, and plants do not require any extra biosafety or biosecurity procedures than those already in place at the U of R, as these activities are not cultivating, intentionally collecting, or extracting any biological materials or organisms from the samples. ASM who use whole water, soil, or plant samples:

- Follow all ***Good Laboratory Practices*** and ***Public Health Agency of Canada's (PHAC's) Containment Level 1 (CL1) Requirements*** listed in the Appendices.
- Annually confirm with the BSO that no additional biological substances are being used.

Risk Group 1 Biologicals

ASM who use Risk Group 1 biologicals:

- Follow all ***Good Laboratory Practices*** and ***PHAC's CL1 Requirements*** listed in the Appendices.
- Follow Biosecurity Risk Level 1 procedures listed in **Section 11**.
- Ensure that all laboratory personnel have completed appropriate training and receive training on how to work properly with biological substances specific to their research projects.
- Complete the appropriate sections on the ***Biosafety Questionnaire*** form (Appendices) annually.

Risk Group 1 Microorganisms

ASM who use Risk Group 1 microorganisms (e.g. E. coli K12):

- Develop or use the prepared written standard operating procedures (SOPs) for microorganism spill cleanup and waste disposal (Appendices).

Risk Group 1 Recombinant DNA and Genetic Manipulation

Genetically modified microorganism (GMMO), rDNA and transgenic research must be assessed for potential risks on a case-by-case basis. ASM who use Risk Group 1 biologicals for genetic manipulation:

- Develop or use the prepared written SOPs for biological substance spill cleanup and waste disposal (Appendices).

Risk Group 1 Cell Lines (Cultures)

Although cell lines do not inherently pose a risk to individuals manipulating them in the laboratory, because of their potential to contain pathogenic organisms an assessment must be made as to the level of hazard associated with a particular line. Cells or primary cultures from animals and humans known or reasonably suspected to be infected should be in the risk group for the suspected agent. ASM who use Risk Group 1 cell lines:

- Develop or use the prepared written SOPs for cell culture spill cleanup and waste disposal (Appendices).

Risk Group 1 Materials Derived From Animals

Materials derived from animals should be considered as potentially biohazardous. At the U of R, all animal use involving healthy animals or tissues is deemed Risk Group 1/CL 1 whereas working with diseased or intentionally diseased animals is designated Risk Group 2/CL 2. ASM who use Risk Group 1 materials derived from healthy animals (body fluids, tissues, etc.):

- Develop or use the prepared written SOPs for animal material spill cleanup and waste disposal (Appendices).

Risk Group 2 Biologicals

ASM who use Risk Group 2 biologicals:

- Follow all ***Good Laboratory Practices*** and ***PHAC's CL1 and CL2 Requirements*** listed in the Appendices.
- Follow Biosecurity Risk Level 2 procedures listed in **Section 11**.
- Develop a written Safety SOP for each microorganism at CL 2 using the ***Safety SOP for Research/Teaching at Containment Level 2*** template (Appendices), which includes protocols for exposure, waste disposal, and spill cleanup.
- Ensure that all laboratory personnel have completed appropriate training and receive training on how to work properly with biological substances specific to their research projects.
- Complete only the appropriate sections on the ***Biosafety Questionnaire*** form (Appendices) annually.

Risk Group 2 Recombinant DNA and Genetic Manipulation

GMMO, rDNA, and transgenic research must be assessed of the potential risks. Work with rDNA should be placed at the higher risk level of either the Host or Vector. ASM who use Risk Group 2 biologicals for genetic manipulation:

- Complete the **Recombinant DNA Form** (Appendices) and provide to the BSO. The BSO provides the University's notification to the Ministry of Labour Relations and Work Safety.

Risk Group 2 Cell Lines (Cultures)

Although cell lines do not inherently pose a risk to individuals manipulating them in the laboratory, because of their potential to contain pathogenic organisms an assessment must be made as to level of hazard associated with a particular line. Cells or primary cultures from animals and humans known or reasonably suspected to be infected should be in the risk group for the suspected agent.

All mammalian lines are considered infectious due to the possibility that they may contain or transmit infectious agents. These cells should be handled at CL 2 in a biological safety cabinet for aerosol creating procedures until proven to be free of infectious agents. All primate cell lines, all cell lines exposed to or transformed by primate oncogenic virus, and all mycoplasma-containing cell lines should be handled at CL 2.

Risk Group 2 Materials Derived From Animals

Materials derived from animals should be considered as potentially biohazardous and zoonotic diseases must be considered. At the U of R all animal work involving healthy animals or tissues is deemed Risk Group 1/CL 1 whereas working with diseased or intentionally diseased animals is designated Risk Group 2/CL 2.

Risk Group 2 Materials Derived From Humans

At the U of R all material derived from humans should be considered potentially biohazardous (as per Universal Precautions). All work with human blood, tissues, and fluids regardless of source, need to be handled using CL 2 practices and/or in a biological safety cabinet.

3. Biological Laboratory Inspections and Audits

All laboratories in use at the University of Regina must be regularly inspected as follows:

- **Daily Inspection**
  All employees or students working in a laboratory must inspect their work area prior to conducting any work, to identify and correct hazardous conditions, or report them to their Supervisor.

- **Monthly Inspection**
  Each Academic Staff Member (ASM) or his/her designate must conduct an inspection to identify hazardous conditions, using the ***Monthly Laboratory Checklist*** located in the U of R ***Chemical and Laboratory Safety Program***. The completed inspection checklists must be posted in the laboratory.

- **Annual Inspection**
  The **Local Safety Committee (LSC)** or designated members of that committee must conduct an annual inspection of each laboratory in their area. This committee must use the ***Annual Laboratory Checklist*** located in the U of R ***Chemical and Laboratory Safety Program*** and post it in the laboratory. A copy of the LSC's report must be provided to the ASM, the Unit Head/Dean, and Health, Safety & Environment (HSE). The LSC reports to the University Occupational Health and Safety Committee annually.

  The **Biosafety Committee (BSC)** must conduct an annual inspection of each Containment Level 2 Biological Laboratory. The BSC must use the ***Annual Containment Level 2 Laboratory Safety Checklist*** (Appendices). A copy of the BSC's report must be provided to the ASM, the Unit Head/Dean, and HSE (Biosafety Officer). The BSC reports to the Biosafety Advisory Committee annually.

- **Special Inspections**
  The ASM, or his/her designate, must conduct an inspection to identify hazardous conditions arising from changes in laboratory operations or facilities, introduction of new equipment or materials, after an incident, or before re-start of laboratory operations after a shut down. Special inspections may also be conducted by the LSC, HSE, or external government inspectorate.

Inspection Follow-up

The ASM must ensure that all deficiencies noted in an inspection report are rectified as soon as reasonably possible. In the case of a deficiency noted in a monthly inspection, the ASM is required to record the action taken to correct the deficiency and the date of the action. In the case of a deficiency noted by an inspection report prepared by the LSC, BSC or HSE, the ASM must report the corrective action taken to HSE within fourteen days of the date of the inspection report or within such other date as required.

4. Biological Laboratory Signage

Containment Level 1 Laboratory

Containment Level 1 (CL1) Laboratories handling and storing Risk Group 1 biological substances do not require specific biological signage.

Containment Level 2 Laboratory

Containment Level 2 (CL2) Laboratories and Animal Facilities Biosafety Level 2 Laboratories handling and storing Risk Group 2 biological substances are identified with the universal Biohazard Symbol (see symbol below) and signage indicating that entry is restricted. Permission of the Academic Staff Member is required before entry into restricted laboratories at ***all*** times.

5. Biosafety Training

All Academic Staff Members (ASM) who direct the work of others are responsible to ensure their staff and students receive the instruction, training, and information needed to protect themselves and others while at work. To provide assistance in meeting regulatory responsibilities, Health, Safety & Environment (HSE) coordinates the development and delivery of a number of biosafety related courses.

Animal Care Training

Purpose:
The Animal Care Training program consists of twelve web-based modules covering the general core topics for all animal users and specific core topics for the Laboratory Animal/Teaching Stream of the Canadian Council on Animal Care *Recommended Syllabus*. The UR Courses site requires a login user ID and password which can be obtained from Office of Research Services or call 337-3238.

Who should attend:
Researchers, instructors, students, and technicians prior to using animals on or off campus.

Autoclave Training

Purpose:
Autoclave Training will help minimize personal risk, ensure successful decontamination or sterilization of the material, and promote optimal use and care of equipment. Please contact the Science Technician at 585-4892.

Who should attend:
Researchers, instructors, students, and technicians who require the use of an autoclave.

Biosafety Level 1 Training

Purpose:
Biosafety Training Level 1 is a specialized course for personnel working with and storing Risk Group 1 biological substances in Containment Level 1 laboratories on campus.

This training course covers material not covered in the ***Chemical and Laboratory Safety Training*** course, including:

- proper waste disposal (e.g. non-pathogenic microorganisms, materials derived from animals, etc.);
- autoclave and specialized equipment training; and
- biological emergency and spill response.

Who should attend:
Researchers, instructors, students, and technicians working with Risk Group 1 biological substances in Containment Level 1 laboratories.

Biosafety Level 2 Training

Purpose:
Biosafety Level 2 Training is an additional course for personnel working with and storing Risk Group 2 biological substances in Containment Level 2 laboratories on campus.

This training course covers additional material not covered in the ***Biosafety Level 1 Training*** course including:

- Federal and Provincial legislation and reporting requirements
- proper hazardous waste disposal
- biological safety cabinet and autoclave training
- biological emergency exposure and spill response
- biosecurity

Individuals taking this course are not required to take Level 1 Training.

Who should attend: Researchers, instructors, students, and technicians working with Risk Group 2 biological substances in Containment Level 2 laboratories.

Animal and Zoonotic Disease Awareness

Purpose:
Animal and Zoonotic Disease Awareness is a training course for personnel working with, caring for, and storing animals and/or materials derived from animals on and off campus.

Who should attend:
Researchers, instructors, students, and technicians working with and storing animals.

6. Worker Authorization

Only authorized personnel are allowed to enter Containment Level 2 (CL2) laboratory working areas. Visitors, maintenance staff, custodial staff and others, as deemed appropriate, must be provided with training and/or supervision commensurate with their anticipated activities in the containment area. All such individuals must have the permission of the Academic Staff Member (ASM) to enter the containment area. Unauthorized entry can jeopardize the University of Regina's Public Health Agency of Canada's (PHAC) CL2 laboratory certification.

CL2 laboratories are identified with the universal Biohazard Symbol and signage indicating that entry is restricted. Permission of the Academic Staff Member is required before entry into restricted laboratories at all times. If entry into a CL2 Laboratory is essential to maintain the building, HSE is available to provide the necessary orientation for staff or contractors required to enter these restricted laboratories.

7. Health and Medical Surveillance

The objective of a health and medical surveillance program is to monitor laboratory personnel for occupationally acquired infections or diseases.

At the University of Regina, health and medical pre-screening is decided on a case-by-case basis under the discretion of the Academic Staff Members (ASM) in consultation with the Biosafety Committee (BSC). All research personnel must understand the hazards and risks of their specific work projects and immuno-compromised and pregnant women must have the option of taking extra care and/or not working with certain biologically hazardous materials or organisms.

ASM in charge of Containment Level 2 laboratories must prepare an exposure control plan, using the ***Safety Standard Operating Procedure (SOP) for Research at Containment Level 2*** form (see Appendices), specific to each biologically hazardous substance used or stored in their laboratory/facility.

ASM in charge of any laboratory are responsible for ensuring personnel under their guidance are familiar with Universal Precautions, appropriate sections in the PHAC's *Laboratory Biosafety Guidelines* (2004), and this Biosafety Program before research and teaching commences.

The plan for post-exposure (and post-suspected exposure) investigation and follow-up is outlined in **Section 16 – *Biological Emergency Response*** and detailed procedures are found in the Appendices (***Emergency Exposure or Suspected Exposure Procedures***).

7.1 Laboratory Acquired or Associated Infections or Diseases

The spread of infection and disease requires a source of an infectious agent, a susceptible host, and a means of transmission. Infectious agents can be transmitted by various routes thus this University of Regina Biosafety Program must be followed and understood to reduce the risk of exposure and illness at the University.

There are a number of ways in which biologically hazardous substances can enter the body and cause infection and disease, including ingestion, inhalation, puncture, or absorption. The types of laboratory events that can lead to an infection or disease include exposure to infectious aerosols, spills and splashes, accidental needle stick injuries, cuts from sharps, bites and scratches from animals, centrifuge accidents, and secondary spread of biologically hazardous substances to non-laboratory areas.

Details of the incident must be documented using the ***Incident Report Form*** and forwarded to Health, Safety & Environment within 24 hours. See www.uregina.ca/hr/hse/incidents.html

7.2 Pregnant Worker Notification

Workers who are pregnant should take steps to reduce their exposure to harmful biological substances by notifying their Supervisor immediately. Academic Staff Members who have been notified that a laboratory user is pregnant must take steps to minimize the worker's exposure or assign the worker to less hazardous work if available.

8. Ordering and Receiving Biological Substances

Academic Staff Members (ASM) may order any permitted biological substance from any supplier and/or institution, if the requirements for ordering biological substances and receiving biological substances are followed, as outlined below. Biologically hazardous substances (Risk Group 2 and above) may only be ordered by ASM through Science Stores, unless written approval from the Biosafety Committee (BSC) has been provided.

8.1 Ordering Biological Substances (Risk Group 1)

Biological substances can only be ordered by ASM and research personnel, through the University purchasing departments (Science Stores, Facilities Management Stores, and Supply Management Services).

The delivery address on the Purchase Order/Requisition Order must be:

[Academic Staff Member Name]
c/o Science Stores, Research and Innovation Centre 110
University of Regina
3737 Wascana Parkway
Regina SK S4S 0A2

8.2 Receiving Biological Substances (Risk Group 1)

Biological substances can only be received through the University purchasing departments (Science Stores, Facilities Management Stores and Supply Management Services).

8.3 Ordering Biologically Hazardous Substances

Prior to any order being placed, the ***Biologically Hazardous Substances Procurement Form*** (Appendices) must be submitted to the Biosafety Officer. Biologically hazardous substances can only be ordered by ASM, through Science Stores.

The delivery address on the Purchase Order/Requisition Order/Importation must be:

[Academic Staff Member Name]
c/o Science Stores, Research and Innovation Centre 110
University of Regina
3737 Wascana Parkway
Regina SK S4S 0A2

See ***Transportation of Dangerous Goods (TDG) Class 6 Guidelines*** in the Appendices to ensure all receiving procedures are in place.

Human pathogens (Risk Group 2 and above) imported into Canada fall under the authority of Public Health Agency of Canada's *Human Pathogen Importation Regulations*, animal pathogens fall under the authority of Canadian Food Inspection Agency's (CFIA's) *Health of Animals Act* and *Regulations* and importation of plants and plant pathogens falls under the authority of CFIA's *Plant Protection Act* and *Regulations*. See **Section 9 – *Biological Importation and Exportation*** for more details.

8.4 Receiving Biologically Hazardous Substances

Biologically hazardous substances can only be received through Science Stores by a TDG certified-receiver. See ***Transportation of Dangerous Goods Class 6 Guidelines*** in the Appendices to ensure all receiving procedures are in place.

Packages must only be opened and verified by the ASM, or designate, in a PHAC- and/or CFIA- certified Containment Level 2 Laboratory after being received by Science Stores.

The BSO will, after ensuring the purchase order is closed out, keep the packing slip with other receipt documents and update the University's Biological Inventory.

9. Biological Importation and Exportation

The importation into and transfer within Canada of biologically hazardous materials or organisms fall under various authorities to ensure that laboratories/facilities have appropriate containment for the biologically hazardous substances to be used and handled. The Biosafety Officer (BSO) will provide assistance to all Academic Staff Members (ASM) to ensure that their laboratory meets all the requirements and will provide assistance with the application process.

9.1 Importation of Human Pathogens

*Importation Permit*s are required from the PHAC's Office of Laboratory Security, Biosafety Division for the importation of all human pathogens (Risk Group 2-4; see Appendices) requiring Containment Level (CL) 2 or higher (see Appendices) into Canada. Biological agents requiring CL 1 facilities are not regulated by *HPIR* thus a permit is not required for importation into Canada.

The PHAC will only issue an *Importation Permit* after appropriate evaluation and approval of the University of Regina (U of R) laboratory that will use and store the pathogen. This laboratory must comply with the operational practices and physical requirements for CL 2 laboratories listed in the Appendices. The laboratory containment level requirements are subject to verification by PHAC and Saskatchewan's Ministry of Labour Relations and Work Safety inspectors at any time.

Many human pathogens are pathogens of animals as well, so additional permits regulated by the Canadian Food Inspection Agency (CFIA) may be required (see below sections).

9.2 Transfer of Human Pathogens

The transportation of human pathogens (Risk Group 2-4) within Canada falls under the authority of Transport Canada's *Transportation of Dangerous Goods Regulations*. These regulations outline the required labeling, packaging, documentation, and training necessary for transporting biologically hazardous materials or organisms within Canada. See ***Transportation of Dangerous Goods Class 6 Guidelines*** in the Appendices.

The air transportation of human pathogens nationally and internationally is regulated by the International Civil Aviation Organization (ICAO). The ICAO regulations outline the required labeling, packaging, documentation, and training necessary for air transport of biologically hazardous materials or organisms within and outside Canada. The air transportation of human pathogens also falls under the *Dangerous Goods Regulations* of the International Air Transport Association. These regulations outline the airline industry's universal rules regarding how to safely package and transport infectious substances.

9.3 Exportation of Human Pathogens

The exportation of human pathogens outside Canada may require a permit. The Department of Foreign Affairs and International Trade Canada is currently controlling permit issuance.

9.4 Importation and Transfer of Animal Pathogens

The importation and transfer of animal pathogens (Risk Group 2-4) into and within Canada, respectively, falls under the authority of CFIA's *Health of Animals Act* and *Regulations*. The CFIA created these regulations to control the use of imported animal pathogens and pathogens associated with reportable animal diseases.

Before the CFIA will issue a *Permit to Import*, ASM need to demonstrate that their laboratories meet the established conditions for which the animal pathogens will be maintained and work will be carried out, in addition to meeting the CFIA's *Containment Standards for Veterinary Facilities* laboratory design and physical and operational requirements.

If an animal pathogen is brought into Canada under an importation permit that restricts its distribution throughout Canada, further transportation approval is required from the CFIA before transportation within Canada.

9.5 Importation of Plants and Plant Pathogens

The importation of plants and plant pathogens (Risk Group 2-4) into Canada falls under the authority of CFIA's *Plant Protection Act* and *Regulations*. The CFIA needs to issue an *Importation Permit* to the ASM before the University can import plants and plant pathogens into Canada.

10. Material Safety

Academic Staff Members in charge of Containment Level 2 laboratories must prepare an exposure control plan, using the ***Safety Standard Operating Procedure (SOP) for Research at Containment Level 2*** form template (see Appendices), specific to each biologically hazardous substance used or stored in their laboratory/facility.

Additionally, the Public Health Agency of Canada has created a series of Pathogen Safety Data Sheets (PSDS) for personnel working in the life sciences as quick safety reference material relating to infectious microorganisms. Please see www.phac-aspc.gc.ca/msds-ftss/index-eng.php for a list of biological PSDS available for use.

11. Biosecurity (Biological Labeling, Inventory, and Storage)

Laboratory biosecurity is defined as the University and personal security measures designed and implemented to prevent the loss, theft, misuse, or intentional release of biologically hazardous materials or organisms. The University Biosecurity Plan has been divided into two basic levels to ensure the security of laboratories containing biological materials and organisms; **Biosecurity Risk Level 1** and **Biosecurity Risk Level 2** corresponding to the two levels of biological substance containment at the University.

Academic Staff Members (ASM) are responsible for ensuring their laboratory and personnel under their guidance follow the level of biosecurity appropriate for the biological substances in use and programs in place for each individual laboratory.

11.1 Risk Group 1

11.1.1 Identification of Biological Materials with a Biosecurity Risk

All ASM complete the ***Biosafety Questionnaire*** form (see Appendices) annually to assist with compiling a University-wide biological inventory.

11.1.2 Physical Protection (Storage)

Biosecurity Risk Level 1 requires very minimal, if any, addition protocols and procedures than what currently exists at the University of Regina (U of R).

- The U of R Campus Security regularly patrols and maintains the appropriate level of security throughout the University campus. They investigate suspicious behaviour.
- Entry into laboratory working areas and access to locations which house biological materials or organisms are limited to authorized personnel.
- All outside doors leading to laboratories where biological materials or organisms are housed should be kept closed. All doors must be locked when laboratories are unoccupied.
- Windows that open are provided with fly screens.
- Biological substance-specific procedures are in place if the substances are deemed to be a potential biosecurity risk.

11.1.3 Personnel Suitability & Reliability

Access to all research and teaching laboratories on campus is restricted to laboratory occupants including faculty, staff, and students under the direct supervision of the ASM responsible for the laboratory. Maintenance/Custodial staff and escorted visitors must be provided with training and/or supervision commensurate with their anticipated activities in the containment area.

- ASM are responsible for creating procedures for approving and granting visitors access to their areas. A log book should be maintained of all visitors to the laboratory if deemed appropriate by the ASM.

- All personnel working within the controlled areas must have appropriate level of training. Research personnel at this level are required to have Biosafety Level 1 Training in addition to the specific duty/project training received from their supervisors.

11.1.4 Pathogen Accountability (Labeling & Inventory)

An up-to-date biological material and organism inventory is required for each laboratory.

The biological materials and organisms inventory includes:

- Identification of biological material or organism (e.g. environmental water samples, *E. coli* K12 and derivatives, crane tissue);
- Person responsible; and
- Storage location (e.g. -20C Freezer LB 523).

11.2 Risk Group 2

11.2.1 Identification of Biological Materials with a Biosecurity Risk

All ASM complete the ***Biosafety Questionnaire*** form (see Appendices) annually to assist with compiling a University-wide biological inventory.

Any ***Biosafety Questionnaires*** that indicate the use of Risk Group 2 and/or Unconventional Biological Materials or Organisms may be reviewed for biosecurity risk by the ASM in consultation with the Biosafety Committee (BSC). Factors such as weaponized risk, consequence of release, and level of threat will be considered when assessing the biosecurity risk of a biological material or organism. For those ASM working with biologically hazardous materials and organisms that have been identified as having a biosecurity risk, Risk Level 2 Biosecurity and additional procedures may be required.

11.2.2 Physical Protection (Storage)

Biosecurity Risk Level 2 requires:

- The U of R Campus Security regularly patrols and maintains the appropriate level of security throughout the University campus. They investigate suspicious behaviour.
- All outside doors leading to laboratories where biologically hazardous materials or organisms are housed must be kept closed and locked at all times. All doors must be locked when laboratories are unoccupied.
- Only authorized personnel are allowed to enter the laboratory working areas.
- Maintenance Staff, Custodial Staff, escorted visitors, and others, as deemed appropriate, must be provided with training and/or supervision commensurate with their anticipated activities in the containment area. All such individuals must have the permission of the ASM to enter the containment area.
- Windows that open are provided with fly screens.
- Fridges and freezers which are located in shared rooms must be locked or stored in a locked room if they contain biologically hazardous materials or organisms (Risk Group 2).
- Biological substance-specific procedures are in place if the substances are deemed to be a biosecurity risk.

11.2.3 Personnel Suitability & Reliability

Access to all research and teaching laboratories on campus is restricted to laboratory occupants including faculty, staff, and students under the direct supervision of the ASM responsible for the laboratory. Maintenance and custodial staff and escorted visitors must be provided with training and/or supervision commensurate with their anticipated activities in the containment area.

- ASM are responsible for creating procedures for approving and granting visitors access to their controlled areas. All visitors working within the Risk Level 2 area must have appropriate training and orientation. A log book should be maintained of all visitors to the laboratory.
- All personnel working within the controlled areas must have appropriate level of biosafety and biosecurity training. Research personnel at this level are required to have Biosafety Level 2 Training course in addition to specific duty/project training received from their supervisors.

11.2.4 Pathogen Accountability (Labeling & Inventory)

An up-to-date biological material and organism inventory is required for each laboratory.

The biologically hazardous materials and organisms inventory includes:

- Identification of biological material or organism (e.g. sewage water, Staphylococcus aureus);
- Person responsible;
- Storage location (e.g. -20C Freezer LB 523);
- Identification of personnel with access;
- Identification of personnel with access to areas stored; and
- Documentation of internal and external transfers within and between facilities (laboratories and buildings).

11.3 Biosecurity Incident and Emergency Response

All personnel working with biological materials and/or organisms must report all security incidents to Campus Security and the BSO as soon as possible. Biosecurity incident and emergency response procedures are covered in the Biosafety Training courses.
Security incidents include, but are not limited to:

- Breach of containment (e.g. major spills that need cleanup assistance);
- Loss, theft, or unauthorized removal of biologically hazardous materials or organisms; and
- Unauthorized personnel in restricted areas.

Additional biosecurity emergency response protocols and procedures for intentional (e.g. bomb threats), unintentional (e.g. accidental release), and natural events (e.g. power outages, severe weather) are forthcoming; however, the U of R has an already established ***Emergency Management Policy*** **and** ***Procedures*** covering these situations.

See the ***Emergency Response Procedures Manual*** for more detail:
www.uregina.ca/hr/hse/assets/docs/pdf/Emergency%20Management/Emergency%20Response%20Procedures%20Manual.pdf

12. Laboratory Equipment

12.1 Personal Protective Equipment

Personal protective equipment (PPE) also known as barrier equipment, is used to prevent blood, body fluids, and other biologically hazardous substances from making direct contact with an individual. In accordance with Universal Precautions, blood, body fluids, and tissues of all persons are considered potentially infectious.

The type and amount of PPE depends upon the task or activity performed. Remember PPE is the least effective type of hazard control and the last resource on which to rely. Administrative and engineering controls are the most effective means of hazard control.

See ***Personal Protective Equipment*** in the Appendices for more information regarding types and amount of PPE available for use.

12.2 Autoclaves

The purpose of the ***Guidelines for Safe Autoclave Use*** outlined in the Appendices, is to inform potential users and their supervisors of the issues that must be considered to ensure the autoclave process is undertaken in a safe, effective, and efficient fashion. It is important to recognize that specific departments may have more stringent operational requirements in place to meet their own needs.

In addition, many autoclave facilities have dedicated individuals who are delegated the task of ensuring the autoclave is used properly, maintained regularly, quality assurance standards are met, and users are trained. These individuals authorize autoclave use.

12.3 Biological Safety Cabinets

Biological safety cabinets are vented cabinets which use a variety of combinations of high efficiency particulate air (HEPA) filtration, laminar air flow, and containment to provide protection to personnel, laboratory materials, or the environment. Refer to ***Guidelines for Biological Safety Cabinet Use*** in the Appendices.

Biological safety cabinets are not chemical fume hoods and must not be used as such.

A variety of types of cabinets exist, and the cabinet chosen must be suited to the work proposed:

- **Clean Air Bench** – These benches are used for product protection only, and do not protect the worker from aerosols or particulates from the work. HEPA-filtered air flows towards the worker. This is not a biological safety cabinet and should not be used as such.
- **Class I** – Laminar air flow is directed away from the user and through a HEPA filter. These cabinets provide partial protection to the user and protection of the environment, but do not protect the product. Class I cabinets are suitable for some work procedures at Containment Level 1 and 2.
- **Class II** – These cabinets provide protection to the worker, the work and the environment.
- **Class III** – These cabinets are typically used in containment Level 4 facilities.

The following table summarizes the selection of a biological safety cabinet by type of protection needed:

Type of Protection	Biological Safety Cabinet Selection
Personnel protection, biological substances in Risk Groups 1-3	Class I, Class II, Class III
Personnel protection, biological substances in Risk Group 4, glove-box laboratory	Class III
Personnel protection, biological substances in Risk Group 4, suit laboratory	Class I, Class II
Product protection	Class II, Class III only if laminar flow included
Volatile radionuclide/chemical protection, small amounts	Class IIB1, Class IIA2 vented to the outside
Volatile radionuclide/chemical protection	Class I, Class IIB2, Class III

12.4 Centrifuges

Centrifuges are common pieces of laboratory equipment that are driven by a motor putting an object, such as a tube, in rotation around a fixed axis. The material in the tube is subject to centripetal acceleration causing dense substances to move towards the bottom of the tube while lighter substances move to the top.

Like other pieces of laboratory equipment, the use of centrifuges safely in the laboratory requires orientation and training prior to use. Refer to ***Guidelines for Safe Centrifuge Use*** in the Appendices.

12.5 Other Equipment

The following table provides a list of safety equipment designed to eliminate or reduce certain hazards you may encounter in a laboratory that uses biological substances.

Equipment	Hazard Corrected	Safety Features
Spatter Shield	Spatter of chemicals	- Forms screen between operator and work
Leak-proof vessels for collection and transport of biologically hazardous substances within a facility	Aerosols, spillages and leakage	- Leak-proof construction with lid or cover - Durable - Autoclavable
Sharps disposal containers	Puncture wounds	- Autoclavable - Robust, puncture-proof
Transport containers between laboratories, buildings, institutions	Release of microorganisms	- Robust - Watertight primary and secondary containers to contain spills - Absorbent material to contain spills

Equipment	Hazard Corrected	Safety Features
Screw cap bottles	Aerosols and spillage	- Effective containment
Vacuum line protection	Contamination of laboratory vacuum system with aerosols and overflow fluids	- Cartridge type filter prevents passage of aerosols (particle size 0.45 micrometer) - Overflow flask contains appropriate disinfectant. Rubber bulb may be used to close off vacuum automatically when storage flask is full - Entire unit is autoclavable

13. Biological Waste Disposal

All human, animal, and microorganism material that has been produced, used, or handled at the University of Regina (U of R) must be disposed of properly. Biological material must never be poured down the drain or put into the regular garbage before inactivation and/or decontamination; this excludes whole water, soil, and plant samples that have not been manipulated.

See the ***Biological Waste Disposal Flowchart*** in the Appendices of this document for a quick reference guide, and ***Biological Waste Standard Operating Procedures*** in the Appendices of this document for detailed step-by-step procedures on how to dispose of biological waste at the U of R.

13.1 Autoclaves

Refer to **Section 12.2 – Autoclaves**

13.2 Incineration

Incineration is a useful method for disposing of laboratory waste, animal carcasses and tissues, and anatomical biomedical waste. Effective incineration depends on proper equipment design; modern incinerators have two chambers with an ideal temperature in the primary chamber of at least 800°C and in the secondary chamber a temperature of at least 1,000°C.

The University has a contract with a waste disposal company to transport and incinerate all animal waste produced on and off campus. Before waste may be disposed of the ***Sharps and Animal Waste Disposal Form*** must be fully completed and forwarded to the BSO. Contact health.safety@uregina.ca for a copy of the form.

See ***Biological Waste Disposal Flowchart*** and ***Biological Waste Disposal Standard Operating Procedures*** in Appendices for animal waste packaging and storing procedures.

14. Biological Spills and Decontamination

14.1 Biological Emergencies and Spills

The most immediate concern following a spill of biologically hazardous materials or organisms is to contain the spill and treat any exposed persons. After this occurs, a properly trained employee can begin the clean up and decontamination process. Use the detailed step-by-step biological emergency and spill procedures outlined in ***Biological Emergencies*** (Appendices).

Every Containment Level 2 laboratory must have a basic biological spill kit to assist with biologically hazardous spill cleanup. The kit must contain:

- Forceps
- Rubber gloves
- Concentrated disinfectant (effective against organism of use)
- Paper towels
- Autoclave/biohazard bags
- Plastic container to hold the kit contents together and for waste collection

14.2 General

Decontamination includes both the complete destruction of all microorganisms and any bacterial spores by sterilization and the chemical destruction and removal of specific types of microorganisms by chemical disinfection.

All contaminated materials including, but not limited to, laboratory cultures, stocks, animal tissues, laboratory equipment, tools, sharps, and personal and protective clothing that has been in contact with biologically hazardous substances must be decontaminated before disposal or reuse. A basic knowledge of how to properly decontaminate using chemical disinfectant and sterilization methods is important for biosafety in the laboratory.

Laboratory bench tops, biological safety cabinets, tools, and surfaces are to be decontaminated after all spills of biologically hazardous substances *and* at the end of the working day. Laboratory rooms and large pieces of equipment may also require decontamination prior to servicing, maintenance, transfer and reassignment.

14.3 Disinfectants

Dirt, soil and organic material can shield microorganisms and interfere with the killing action of disinfectants; thus, pre-cleaning is required before properly decontaminating heavily soiled items with disinfectants. Cleaning is the removal of dirt, organic matter and stains by brushing, vacuuming, dry dusting, washing or damp mopping with water containing a soap or detergent.

Many types of chemicals can be used as disinfectants; therefore, the proper type of disinfectant must be carefully selected for each laboratory's specific needs. Refer to ***Disinfectants*** in the Appendices for a comprehensive list of disinfectant types and against which biological agents the disinfectant is effective.

14.4 Heat Sterilization

Dry heat sterilization is a non-corrosive process used to sterilize laboratory glassware, laboratory waste, some plastics, metals, tools, etc. which can withstand temperatures of 160°C (320°F) or higher for 2-4 hours.

Moist heat sterilization is a process used to sterilize laboratory wares and wastes, and is most effective when used in the form of autoclaving [see ***Guidelines for Safe Autoclave Use*** (Appendices)]. The process of boiling does not necessarily kill all biologically hazardous materials or organisms but it may be used as the minimum processing for decontamination where other methods such as chemical disinfection and autoclaving are not feasible.

14.5 Protective and Personal Clothing Decontamination

All soiled personal clothing items and non-disposable gowns, coveralls and coats should be properly decontaminated to reduce risk of transmission and exposure. The risk of disease transmission from soiled linen is low, but soiled linens may carry organisms that may contaminate the air and immediate environment. It is recommended that decontamination be performed every 6 months, but this will vary with the type and intensity of research activity.

1. Do not walk into public areas with contaminated clothing.
2. Promptly don the appropriate PPE for removing contaminated clothing (i.e. gloves).
3. If soiled clothing cleaning and disinfecting procedures cannot be completed in the room that the clothing was soiled, the items must be removed and transported in strong biohazard/plastic bags.
4. Soiled clothing should be handled as little as possible and with minimum agitation.
5. Hold the soiled clothing away from your unsoiled clothing.
6. Wash soiled clothing and laundry separately in hot soapy water and dry in a hot dryer or have items dry-cleaned.
7. Wash hands very well: wet hands, add soap, lather for 20 seconds, rinse, and dry.

15. Biological Laboratory Decommissioning

All Academic Staff Members and/or Laboratory Users and Laboratory Managers who terminate or relocate their laboratory activities at the University of Regina must follow the outlined procedures and forward the appropriate documentation to Health, Safety & Environment (HSE).

When researchers conclude their work in a lab in which the research activity continues on (for example, when honours students complete their laboratory work), the ***Departing Laboratory Researcher Checklist*** (please see the U of R ***Chemical and Laboratory Safety Program***) must be completed and submitted.

When Laboratory Managers close down their laboratory activities, the Laboratory Deactivation process must be followed.

When a laboratory is completely shut down and turned over for another unrelated activity, the Laboratory Decommissioning process is followed.

The University's policy and procedures on concluding laboratory use can be found in the ***Hazardous Materials Management Policy*** at: www.uregina.ca/presoff/vpadmin/policymanual/hr/2010505.pdf

15.1 Containment Level 2 Laboratory Decommissioning

All Academic Staff Members, Laboratory Managers and/or Laboratory Users who terminate or relocate their Containment Level 2 laboratory activities at the U of R must contact the BSO for assistance before starting the decommissioning process.

16. Biological Emergency Response

16.1 Emergency Contact Information

24 Hour Emergency (Fire, Police, Medical):	911
24 Hour Saskatchewan Health Hotline:	1-877-800-0002
Allied Health Centre:	337-2640
Campus Security:	585-4999

Biosafety Officer (BSO):	585-5198
Emergency Preparedness:	337-3115
Health, Safety & Environment, Human Resources:	585-4776 /585-5487

16.2 Exposures, Suspected Exposures, and Post-Exposures

Medical Emergency

1. Phone 911 – Direct them to the scene of the occurrence.
2. Call Campus Security: 585-4999
3. Give First Aid, if you are qualified to do so, or get help from trained Emergency Wardens and/or Campus Security.
4. Stay with victim.

16.2.1 Exposure Procedures

See ***Emergency Exposure or Suspected Exposure Procedures*** in the Appendices for detailed step-by-step emergency exposure or suspected exposure procedures. An ***Incident Report Form*** must be completed and forwarded to Health, Safety, and Environment (HSE) within 24 hours. The ***Incident Report Form*** can be found online at www.uregina.ca/hr/hse/incidents.html

16.2.2 Suspected Exposure Procedures

If exposure to any biologically hazardous substance is suspected, please follow the corresponding health procedures listed in ***Emergency Exposure or Suspected Exposure Procedures*** in the Appendices (i.e. needle stick puncture, mucous membrane exposure, etc.).

16.2.3 Post-Exposure Procedures

If a student or employee has been exposed to biologically hazardous substances at the University of Regina (U of R), the University will, with the consent of the student/employee, during the student/employee's normal working hours, arrange for immediate medical evaluation, medical intervention, and confidential post-exposure counselling.

If a student/employee cannot receive medical evaluation, medical intervention, or post-exposure counselling during the student/employee's normal working hours, the U of R will credit the student/employee's attendance for evaluation, intervention, or counselling as time at work and shall ensure that the student/employee does not lose any pay or other benefits.

The U of R HSE Unit investigates and documents any occurrence of an occupationally transmitted infection and any occupational exposures to an infectious agent to identify the route of exposure and implement measures to prevent infection.

All investigations and documentation concerning personal information of any work-related exposure incident, including the route of exposure and the circumstances in which the exposure occurred, are held in complete confidentiality.

17. Research and Teaching Animals

17.1 President's Committee on Animal Care

At the University of Regina (U of R), all animal use and care in research and teaching must be authorized by the President's Committee on Animal Care (PCAC) prior to use. Canadian law requires that an Animal Utilization Protocol be approved by the PCAC before research or teaching projects involving live animals are initiated. Those who use animals for research and teaching purposes must ensure ethical and humane use and responsible care of animals. Contact the Office of Research Services or refer to the PCAC website at www.uregina.ca/research/Animal_Care/main.shtml for more information.

No animals may be housed at the University without the written authorization of the PCAC.
This requirement includes pets, such as fish on your desk.

Once the PCAC has reviewed and approved the use of animals for research and/or teaching at the University, the Academic Staff Member (ASM), in consultation with the Biosafety Committee (BSC), will determine what physical, operational and training requirements the ASM must meet prior to animal use.

17.2 Zoonoses

A zoonosis is an animal disease or infection that can be transmitted to humans. Specific animal parasites, bacteria, fungi, viruses, and pria have been found to cause zoonoses (see ***Zoonoses Guide*** in the Appendices) and animal users and handlers must be made aware of the hazards and risks of working with animals before research or teaching begins. Furthermore, not only can personnel acquire infections or diseases directly from animals, but they can also be exposed to infectious agents from other contaminated personnel and equipment.

Transmission of infections from animals to humans can generally be avoided through proper veterinary care and adherence to standard operating procedures (SOPs) for control of transmission. Special attention is required anytime animals capable of carrying zoonoses are handled.

17.3 Allergies and Asthma

Personnel working with animals may encounter the development of allergies, sensitivities, asthma, and/or skin irritations. Allergies to laboratory and fieldwork animals are a significant occupational health concern which may require affected workers to change jobs or careers.

Animal-related asthma and allergies are exaggerated reactions of the body's immune system to animal proteins. Source of allergens include animal fur, dander, urine, saliva, serum or other body tissues.

Typical symptoms range from:

- mild (e.g. upper respiratory signs such as sneezing, itchy and/or runny nose and eyes, and skin reactions such as red, raised and itchy welts after contact with animals, their tissues or their excreta); to
- severe (e.g. wheezing, shortness of breath and a feeling of chest tightness (asthma).

Persons experiencing such symptoms should be advised to contact their physician for diagnosis and treatment.

Common sources of exposure, as reported by the National Institute of Occupational Health and Safety, are:

- urine of rats
- saliva and pelts of guinea pigs
- rabbit pelts
- cat saliva and dander
- dog dander
- horse serum and dander

Exposure to rats, mice and rabbits have frequently been associated with the development of occupational asthma. Species of other mammals have also been reported to cause respiratory symptoms. Exposures to birds have been associated with other respiratory diseases, including hypersensitivity pneumonitis.

Methods to reduce the degree of exposure to laboratory and fieldwork animal allergens include:

- use of protective gear such as gloves, face masks, gowns, shoe covers, etc. worn only in animal rooms;
- regular hand-washing, and showering after work;
- use of improved filtration in animal room ventilation systems, and the use of special filtered caging systems;
- perform animal manipulations within ventilated hoods and biological safety cabinets;
- when possible, use an animal species or sex that is known to be less allergenic than others; and
- educational programs for employees identifying high risk (e.g. high allergen load) areas and tasks, and strict use of preventive measures, as set out by the University of Regina or research-specific SOPs.

17.4 Health and Medical Surveillance

Personnel working with animals may encounter a variety of unique biological hazards, including allergies, asthma, skin irritations and zoonoses. The Canadian Council on Animal Care's (CCAC) *Guide to the Care and Use of Experimental Animals* (1993) indicates that zoonotic hazards may sporadically affect susceptible persons or animals. Persons potentially at higher risk are those who suffer from defective immune systems and those who are under severe stress or who have non-overt clinical disease. Caution should be exercised in assigning women of childbearing status to animal care duties that might expose them to potential or known teratogens.

It is also suggested that work involving exposure to hazardous microorganisms may require prior immunization of the staff, if a vaccine is available. It is recommended, for example, that all personnel handling random-source dogs and cats, including dealers and handlers, should receive routine rabies vaccination.

In addition, procedures for monitoring exposure, health-monitoring of staff at risk, and for dealing with staff who become allergic to laboratory or fieldwork animals should also be considered. The health and medical surveillance of personnel using and caring for animals will be determined on a case-by-case basis by the ASM in consultation with the BSC.

17.5 Laboratory and Wild Animals

When research and teaching activities involve animals, these activities must comply with the policies and procedures of the PCAC, as mentioned in the above section. All animal work, including field studies done by research personnel of the U of R, must be in compliance with the national guidelines for animal care and use as established by the CCAC.

The CCAC has a series of online guides to assist implementation of animal use and care best practices. See: www.ccac.ca/en/CCAC_Programs/Guidelines_Policies/GDLINES/Guidelis.htm.

Personal cleanliness is an important barrier to infection, and washing of hands after handling any animal will reduce the risk of disease spread and self-infection. All employees working with animals, as well as visitors to the facility, must wear appropriate protective clothing.

Physical injuries related to the handling of animals may be kept to a minimum by ensuring that:

- all staff are trained and experienced in handling the species with which they work, and that they know the particular hazards associated with each species;
- all staff are familiar with the hazards of the experiment, and are provided with (and use) a proper working area, protective clothing and equipment;
- a mechanism is in place in every unit to deal with animal-inflicted injury, and for referral for any further medical treatment if this is required.

All personnel using and caring for animals must complete the required training courses in addition to duty/project specific training provided by their Supervisors, which is documented by the Office of Research Services. See **Section 5 - Biosafety Training** for a list of required training.

17.5.1 Wild Animals (Fieldwork)

The approved CCAC guidelines on the care and use of wildlife provide detailed information for all personnel working with wildlife in the field. Please see the CCAC website and become familiar with the entire document prior to initiation of activities: www.ccac.ca/en_/standards/guidelines

Personnel working in the field may encounter a variety of unique hazards and risks, which have been identified in the CCAC guidelines on the care and use of wildlife. Please see ***Human Safety Considerations for Wildlife Use*** in the Appendices for the list of concerns that CCAC has identified.

In addition, the U of R ***Travel and Fieldwork Safety Policy*** and ***Procedures*** pertain to all work activities carried out for the purpose of research, study or teaching undertaken by employees or students of the University at a locality beyond the geographic boundary of University property. See the ***Travel and Fieldwork Safety Policy*** and ***Procedures*** www.uregina.ca/presoff/vpadmin/policymanual/hr/2010570.shtml for more information.

17.6 Animal Facilities

Once approval has been received from PCAC, the ASM must design the animal housing facility appropriately. The Canadian Food Inspection Agency's (CFIA) C*ontainment Standards for Veterinary Facilities* and the CCAC's *Guide to the Care and Use of Experimental Animals* resources should be followed when designing and operating animal facilities for work with animals. At the U of R, animal facilities will be designated Containment Level 1 or 2 according to a risk assessment done by the ASM in consultation with the BSC using the World Health Organization (WHO) guidelines (2004).

For facilities that use biologically hazardous materials or organisms in the animal laboratory, things to be considered are:

- The normal route of transmission of the biologically hazardous agent.
- The volumes and concentrations to be used.
- The route of inoculation.
- Whether and by what route these agents may be excreted.

For facilities that use animals in the animal laboratory, things to be considered are:

- The nature of the animals (i.e. their aggressiveness and tendency to bite and scratch).
- Their natural ecto- and endoparasites.
- The zoonotic disease to which they are susceptible.
- The possible dissemination of allergens.

17.6.1 Animal Facility Containment Level 1 (AFCL-1)

Animal Facility Containment Level 1 (AFCL-1) is ideal for the maintenance and care of most stock animals after quarantine and for animals that are deliberately inoculated with Risk Group 1 biological materials or organisms.

See ***Animal Facilities*** in the Appendices for AFCL-1 operational and physical guidelines and safety precautions developed by the WHO and Public Health Agency of Canada (PHAC).

17.6.2 Animal Facility Containment Level 2 (AFCL-2)

Animal Facility Containment Level 2 (AFCL-2) is ideal for animals that are deliberately inoculated with Risk Group 2 biological materials or organisms.

See ***Animal Facilities*** in the Appendices for AFCL-2 operational and physical guidelines and safety precautions developed by the WHO and PHAC.

Appendix 1: Biological Risk Group Classification

Classification of organisms according to risk groups has traditionally been used to categorize the relative hazards of infectious materials or organisms [Public Health Agency of Canada (PHAC)]. In addition, the following characteristics of a biologically hazardous material or organism are used to determine into which risk group the agent falls:

- Pathogenicity
- Infectious dose
- Mode of transmission (e.g. inhalation, ingestion, absorption)
- Host range (e.g. human, animal, plant)
- Availability of effective preventive measures (e.g. vaccinations)
- Availability of effective treatment (e.g. antibiotics)

PHAC's *Laboratory Biosafety Guidelines* define the four levels of risk, when assuming ordinary circumstances in the research laboratory or for diagnostic and experimental purposes, as follows:

Risk Group 1 (low individual and community risk)

- Any biological substance (microorganism, bacteria, fungi, virus, parasite, etc.) that is unlikely to cause disease in healthy workers or animals.
- This group includes most of the work using non-pathogenic strains of *Escherichia coli* for recombinant DNA and work with healthy animal tissue.

Risk Group 2 (moderate individual risk and low community risk)

- Any pathogen or toxin that can cause human 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 preventive measures are available and the risk of spread is limited.

See the ***Risk Group Guidance List*** (Appendix 2) for a sample list of some of the more common Risk Group 2 biological substances.

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

- Any pathogen or toxin that usually causes serious human disease or can result in serious economic consequences, but does not ordinarily spread by casual contact from one individual to another.
- The disease may be treated by antimicrobial or antiparasitic agents.

See the ***Risk Group Guidance List*** (Appendix 2) for a sample list of some of the more common Risk Group 3 biological substances; however, as of the date on this document, Risk Group 3 work is not being conducted at the University of Regina.

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

- Any pathogen that usually causes very serious human disease, often untreatable, and may be readily transmitted from one individual to another, directly or indirectly, including human-to-human and/or animal-to-human and/or vice-versa.

See the ***Risk Group Guidance List*** (Appendix 2) for a sample list of some of the more common Risk Group 4 biological substances. Risk Group 4 work is not permitted at the University of Regina.

Appendix 2: Risk Group Guidance List: Examples of Potential Biologically Hazardous Materials or Organisms

Compiled from the Public Health Agency of Canada's (PHAC) *Human Pathogens and Toxins Act*, 2009 and the Saskatchewan Ministry of Advanced Education, Employment and Labour (AEEL).

Risk Group 1 (Schedule 1 - Human Pathogens and Toxins Act)

Aerolysin
Alpha toxin
Anthrax toxins:
- Lethal Toxin and Oedema Toxin

Bordetella pertussis Adenylate cyclase toxin
Botulinum neurotoxin
Cholera toxin
Clostridium botulinum C2 and C3 toxins
Clostridium difficile toxins A and B
Clostridium perfringens Epsilon toxin
Dermonecrotic toxin
Diphtheria toxin
***Escherichia coli* toxins:**
- *E. coli* Cytotoxic Necrotizing Factor (CNF)
- Heat-labile *E. coli* enterotoxin (LT)
- Heat-stable *E. coli* enterotoxin (ST)
- Cytolethal distending toxin (CLDT)

Enteroaggregative Shiga-like toxin 1 (EAST)
Exfoliative toxin (also called Exfoliatin)
Exotoxin A
Hemolysin
Listeriolysin O
Pasteurella multocida toxin
Perfringolysin O
Pertussis toxin
Pneumolysin
Pyrogenic exotoxin
Shiga-like toxin (verotoxin)
Shigatoxin
Staphylococcal enterotoxins
Staphylococcus aureus Toxic shock syndrome toxin
Streptolysin O
Tetanolysin
Tetanospasmin (Tetanus toxin)

Risk Group 2 (Schedule 2 - Human Pathogens and Toxins Act)

Bacteria

Actinobacillus pleuropneumoniae
Actinobacillus ureae
Actinomyces israelii
Aerococcus ureinae
Aeromonas hydrophila
Aggregatibacter actinomycetemcomitans
Arcanobacterium bernardiae
Bordetella bronchiseptica
Bordetella parapertussis
Bordetella pertussis
Borrelia burgdorferi
Campylobacter jejuni
Chlamydia trachomatis
Chlamydophila pneumoniae
Citrobacter freundii
Clostridium botulinum
Clostridium difficile
Mycoplasma genitalium
Clostridium perfringens
Clostridium tetani
Corynebacterium diphtheriae
Enterococcus faecium
Escherichia coli
Francisella novicida
Haemophilus influenzae
Haemophilus parainfluenzae
Helicobacter pylori
Klebsiella pneumoniae
Legionella pneumophila
Leptospira interrogans
Listeria monocytogenes
Moraxella catarrhalis
Mycobacterium avium
Mycobacterium leprae
Mycobacterium smegmatis
Shigella flexneri

Bacteria (continued)

Mycoplasma pneumoniae
Neisseria gonorrhoeae
Neisseria meningitidis
Pasteurella multocida
Porphyromonas gingivalis
Proteus mirabilis
Proteus vulgaris
Pseudomonas aeruginosa
Salmonella
Serratia marcescens
Shigella dysenteriae
Shigella sonnei
Sphingobacterium faecium
Staphylococcus aureus
Staphylococcus saprophyticus
Streptococcus agalactiae
Streptococcus pyogenes
Streptococcus salivarius
Treponema pallidum
Ureaplasma urealyticum
Vibrio cholerae
Yersinia pseudotuberculosis

Viruses

Adenovirus
Avian influenza virus
(excluding highly pathogenic strains)
Colorado tick fever viruses
Cowpox virus
Coxsackievirus
Epstein Barr virus
Hepatitis A virus
Hepatitis B virus
Hepatitis C virus
Hepatitis D virus
Hepatitis E virus
Herpes simplex viruses
Human coronavirus (excluding SARS-CoV)
Human herpesvirus 5 (cytomegalovirus)
Human herpesvirus 6 (roseolovirus)
Human herpesvirus 8
(Kaposi's sarcoma-associated herpesvirus)
Human parvovirus
Human rotavirus
Influenza virus, types A-C
(excluding Type A 1918 Spanish Flu and H2N2 strains)
Measles virus
Molluscum contagiosum virus
Mumps virus
Newcastle disease virus
Norwalk virus
Papillomaviruses
Parainfluenza virus (types 1-4)
Reoviruses
Respiratory syncytial virus
Rhinovirus
Semliki Forest virus
Sendai virus
Simian virus 40
Vaccinia virus

Fungi

Aspergillus fumigates
Aspergillus niger
Aspergillus oryzae
Candida albicans
Cryptococcus neoformans
Microsporum audouinii
Microsporum ferrugineum
Sporothrix schenkii
Trichophyton concentricum
Trichophyton rubrum
Trichophyton schoenleinii
Trichophyton tonsurans

Protozoa

Acanthamoeba castellanii
Giardia lamblia **(AEEL)**
Leishmania aethiopica
Leishmania braziliensis
Leishmania chagasi
Leishmania donovani
Leishmania guyanensis
Leishmania infantum
Leishmania panamensis
Plasmodium falciparum
Toxoplasma gondii
(**AEEL** - where work involves routine handling of or exposure to the excreta or materials contaminated with the excreta, of carrier animal species)
Trypanosoma brucei gambiense
Trypanosoma brucei rhodiense
Trypanosoma cruzi

Prions

Chronic wasting disease agent

Parasites

Echinococcus (**AEEL**- gravid segments)

Risk Group 3 (Schedule 3- Human Pathogens and Toxins Act)

Bacteria

Bacillus anthracis
Brucella abortus
Brucella canis
Brucella melitensis
Brucella ovis
Brucella suis
Burkholderia mallei
Burkholderia pseudomallei
Chlamydia psittaci
Coxiella burnetii
Francisella tularensis
Mycobacterium africanum
Mycobacterium avium **(AEEL)**
Mycobacterium bovis
Mycobacterium canettii
Mycobacterium microti
Mycobacterium tuberculosis
Neorickettsia sennetsu
Pasteurella multocida **(AEEL)**
Pseudomonas mallei **(AEEL)**
Rickettsia akari
Rickettsia australis
Rickettsia conorii
Rickettsia japonicum
Rickettsia prowazekii
Rickettsia rickettsii
Rickettsia siberica
Rickettsia typhi
Yersinia pseudotuberculosis **(AEEL)**
Yersinia pestis

Viruses

African Horse Sickness virus
Água Preta virus
Akabane virus
Allpahuayo virus
Andes virus
Araguari virus
Batken virus
Bayou virus
Bear Canyon virus
Bermejo virus
Bhanja virus
Bijou Bridge virus
Black Creek Canal virus
Cabassou virus
Cano Delgadito virus
Chikungunya virus
Dhori virus
Dobrava-Belgrade virus
Douglas virus
Dugbe virus
Duvenhage virus
Eastern equine encephalitis virus
Enseada virus
Everglades virus
Flexal virus
Garissa virus
Germiston virus
Hantaan virus
Herpesvirus ateles
Herpesvirus saimiri
Highly pathogenic avian influenza virus
Human immunodeficiency virus
Human T-cell lymphotrophic virus
Influenza A H2N2
Israel Turkey meningoencephalitis virus
Issyk-Kul virus
Japanese encephalitis virus
Juquitiba virus
Khabarovsk virus
Koutango virus
Kunjin virus
Laguna Negra virus
Lechiguanas virus
Louping ill virus
Lymphocytic choriomeningitis virus
Maporal virus
Mapuera virus
Mayaro virus
Mobala virus
Monkeypox virus
Monongahela virus
Mopeia virus
Mucambo virus
Murray Valley encephalitis virus
Negishi virus
New York virus
Ngari virus
Oliveros virus
O'Nyong-nyong virus
Oran virus
Oropouche virus
Pergamino virus
Pirital virus
Piry virus
Powassan virus
Puumala virus
Rabies virus
Rift Valley fever virus
Rocio virus
Saaremaa virus
Sakpa virus
SARS coronavirus (SARS-CoV)
Seoul virus
Sin nombre virus
Slovakia virus
Somone virus
Sripur virus
St. Louis encephalitis virus
Thogoto virus
Tonate virus
Topografov virus
Venezuelan equine encephalitis virus
Vesicular stomatitis virus
Wesselsbron virus
Western equine encephalitis virus
West Nile fever virus
Whitewater Arroyo virus
Xingu virus
Yellow fever virus

Fungi

Blastomyces dermatitidis
Cladophialophora bantiana
Coccidioides immitis
Coccidioides posadasii
Histoplasma capsulatum
Paracoccidioides brasiliensis
Penicillium marneffei

Prions

Bovine spongiform encephalopathy agent and other related animal transmissible spongiform encephalopathies agents
Creutzfeldt-Jakob disease agent
Fatal Familial Insomnia agent
Gerstmann-Sträussler-Scheinker syndrome agent
Kuru agent
Variant Creutzfeldt-Jakob disease agent

Risk Group 4 (Schedule 4- Human Pathogens and Toxins Act)

Viruses

Absettarov virus
Alkhumra virus
Crimean Congo haemorrhagic fever virus
Ebola virus
Guanarito virus
Hanzalova virus
Hendra virus
Herpes B virus
Hypr virus
Junin virus
Kumlinge virus
Kyasanur Forest virus
Lassa fever virus
Machupo virus
Marburg virus
Nipah virus
Omsk haemorrhagic fever virus
Russian spring-summer encephalitis virus

Prohibited Human Pathogens and Toxins (Schedule 5 - Human Pathogens and Toxins Act)

Variola virus

Appendix 3: Biological Laboratory Containment Level Classification

Classification of organisms according to risk group is not meant to establish the actual handling of biological hazards in the laboratory setting. Containment levels (CL) are selected to provide the end-user with a description of the minimum containment required for handling the organisms safely in a laboratory setting.

The containment system includes engineering, operational, technical, and physical requirements for manipulating a particular biological substance. The following containment level descriptions are provided by the Public Health Agency of Canada's (PHAC) *Laboratory Biosafey Guidelines* (2004) manual.

Containment Level 1

- Containment Level 1 (CL1) requires no special design features beyond those suitable for a well-designed and functional laboratory.
- Biological safety cabinets are not required. Work may be done on an open bench top and containment is achieved through the use of practice normally employed in a basic microbiology laboratory.

See ***Good Laboratory Practices*** (Appendices) which all laboratories/facilities using or storing biological substances must follow. Additionally, see ***Public Health Agency of Canada's Containment Level 1 & 2 Requirements*** (Appendices) for CL 1 laboratory design and physical requirements in detail.

Containment Level 2

- The primary exposure hazards associated with organisms requiring Containment Level 2 (CL2) are through the ingestion, inoculation, and mucous membrane route. Agents requiring CL2 laboratories 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 biological safety cabinets and centrifuges with sealed rotors or safety cups as well as personal protective equipment (i.e. gloves, laboratory coats, and protective eyewear) are to be used as appropriate.
- Environmental contamination must be minimized by the use of hand-washing sinks and decontamination facilities (autoclaves).

Please see ***Good Laboratory Practices***, in the Appendices of this document, which all laboratories/facilities using or storing biological substances must follow. Additionally, see ***Public Health Agency of Canada's Containment Level 1 & 2 Requirements*** (Appendices) for CL 2 laboratory design and physical requirements in detail. PHAC's Containment Level 2 checklist can be found online at: www.phac-aspc.gc.ca/lab-bio/permits/inspection/index-eng.php or contact the Biosafety Officer (BSO) for a copy.

Containment Level 3

- Containment Level 3 (CL3) agents may be transmitted by the airborne route, often have a low infectious dose to produce effects and can cause serious or life-threatening disease.
- CL3 emphasizes additional primary and secondary barriers to minimize the release of infectious organisms into the immediate laboratory and the environment.
- Additional features to prevent transmission of CL3 organisms are appropriate respiratory protection, HEPA filtration of exhausted laboratory air, and strictly controlled laboratory access.

Presently, the University of Regina does not have any CL3-certified laboratories. If you require the use of CL3 laboratories, contact the BSO.

Containment Level 4

- Containment Level 4 (CL4) agents have the potential for aerosol transmission, often have a low infectious dose and produce very serious and often fatal disease; there is generally no treatment or vaccine available.
- This level of containment represents an isolated unit, functionally and, when necessary, structurally independent of other areas.
- CL4 emphasizes maximum containment of the infectious agent by:
    - complete sealing of the facility perimeter within confirmation by pressure decay testing;
    - isolation of the researcher from the pathogen by his or her containment in a positive pressure suit or containment of the pathogen in a Class III biological safety cabinet line; and
    - decontamination of air and other effluents produced in the facility.

This containment level is not permitted at the University of Regina.

Appendix 4: Good Laboratory Practices

The following table, which has been modified from the World Health Organization's *Laboratory Biosafety Manual*, 2004, relates biological risk groups to laboratory containment levels, practices and equipment.

Risk Group	Containment Level	Laboratory Type	Laboratory Practices	Safety Equipment
1	Basic - Containment Level 1	Basic teaching and research	*Good Laboratory Practices* and appropriate personal protective equipment	Open bench work
2	Basic - Containment Level 2	Research, primary health services and diagnostic services	*Good Laboratory Practices*, personal protective equipment and biohazard sign	Open bench plus biological safety cabinet for potential aerosols

Containment Level 1 (Public Health Agency of Canada's Operational Practices)

Research personnel should be trained on the use of the following techniques and equipment to eliminate laboratory injuries and laboratory- acquired infections.

1. Standard Operating Procedures (SOPs) for specific projects must be available for all staff, and its requirements followed; it must be reviewed and updated regularly.
2. Personnel must receive training on the potential hazards associated with the work involved and the necessary precautions to prevent exposure to potentially biohazardous materials and organisms and release of contained material; personnel must show evidence that they understood the training provided; training must be documented and signed by both the employee and supervisor; retraining programs should also be implemented.
3. 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 dangly jewelry is not recommended in the laboratory.
4. Oral pipetting of any substance is prohibited in any laboratory.
5. Long hair is to be tied back or restrained so that it cannot come into contact with hands, specimens, containers or equipment.
6. Access to laboratory and support areas is limited to authorized personnel.
7. Doors to laboratories should not be left open (this does not apply to an open area within a laboratory).
8. Open wounds, cuts, scratches and grazes should be covered with waterproof dressings.
9. Laboratories are to be kept clean and tidy. Storage of materials that are not pertinent to the work and cannot be easily decontaminated (e.g. journals, books, correspondence) should be minimized; paperwork and report writing should be kept separate from such biohazardous materials working areas.

10. 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.

11. 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.

12. Gloves (latex, vinyl, co-polymer) must be used for all procedures that might involved 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.

13. Protective laboratory clothing must not be worn in non-laboratory areas; laboratory clothing must not be stored in contact with street clothing.

14. If a known or suspected exposure occurs, contaminated clothing must be decontaminated before laundering (unless laundering facilities are within the containment laboratory and have proven to be effective in decontamination.)

15. The use of needles, syringes, and other sharp objects should be strictly limited; caution should be used when handling needles and syringes to avoid auto-inoculation and 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 syringe; they should be promptly placed in a puncture-resistant sharps container.

16. Hands must be washed after gloves have been removed, before leaving the laboratory and at any time after handling material known or suspected to be contaminated.

17. Work surfaces must be cleaned and decontaminated with a suitable disinfectant at the end of the day and after any spill of potentially hazardous material; work surfaces that have become permeable (i.e. cracked, chipped, loose) to biohazardous material must be replaced or repaired.

18. Contaminated materials and equipment leaving the laboratory for servicing or disposal must be appropriately decontaminated and labeled or tagged-out as such.

19. Efficacy monitoring of autoclave used for decontamination with biological indicators must be done regularly (i.e. consider weekly, depending on the frequency of use of the autoclave), and the records of these results and cycle loads (i.e. time, temperature, and pressure) must also be kept on file.

20. All contaminated materials, including solid and 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; centralized autoclaving facilities are to follow the applicable Containment Level 2 requirements.

21. Disinfectants effective against the agents in use must be available at all time within the areas where the biohazardous material is handled or stored.

22. Leak-proof containers are to be used for the transport of infectious materials within facilities (e.g. between laboratories in the same facility).

23. Spills, accidents, or exposures to infectious materials and losses of containment must be reported immediately to the laboratory supervisor and the Biosafety Officer; written records of such incidents must be maintained, and the results of incident investigation should be used for continuing education.

24. An effective rodent and control program must be maintained. Occupants should routinely ensure screens are fitted on exterior windows that open into the lab and contact Facilities Management when pest control is needed.

Containment Level 2 (Public Health Agency of Canada's Operational Practices)

In addition to Containment Level 1 requirements outlined above, handling biologically hazardous substances (Risk Group 2) requires the following operational practices:

1. **Good Laboratory Practices** intended to avoid the release of infectious agents are to be employed.
2. Biological safety cabinets 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 Biosafety Committee, should perform a risk assessment to determine which procedures and what concentrations and volumes necessitate the use of a biological safety cabinet.
3. 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 the 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.
4. Entry must be restricted to laboratory staff animal handlers, maintenance staff and other personnel on official business.
5. 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, custodial staff and others, as deemed appropriate, must be provided with training and/or supervision commensurate with their anticipated activities in the containment area.
6. Emergency procedures for spill cleanup, biological safety cabinet failure, fire, animal escape and other emergencies must be written, easily accessible and followed. A record must be made of people entering the facility during an emergency.

Appendix 5: Public Health Agency of Canada's Containment Level 1 & 2 Requirements

Legend: ● Mandatory ○ Recommended

Requirements	Containment Level 1	Containment Level 2
Separated from public areas by a door	●	●
Access limited to authorized personnel	●	●
Laboratory room doors to have appropriate signage (e.g. biohazard sign, containment level, contact information, entry requirements)		●
Size of door openings to allow passage of all anticipated equipment	●	●
Doors to the containment laboratory lockable (this does not apply to areas within the containment laboratory)		●
Office areas to be located outside of containment laboratory. Paperwork stations for data collection can be within containment laboratory provided they are located away from laboratory work areas		○
Doors, frames, casework, and bench tops to be non-absorptive (i.e. the use of organic materials should be avoided)		○
Working surfaces of bench tops to be non-absorptive		●
Surfaces to be scratch, stain, moisture, chemical and heat resistant in accordance with laboratory function	○	●
Surfaces to provide impact resistance in accordance with laboratory function	○	○
Surfaces to be continuous and compatible with adjacent and overlapping materials (i.e. to maintain adhesion and a continuous perimeter)		○
Interior coatings to be gas and chemical resistant in accordance with laboratory function (e.g. will withstand chemical disinfection, fumigation)	○	●
Bench tops have no open seams	○	○
Benches, doors, drawers, door handles, etc. to have rounded rims and corners	○	○
Reagent shelving to be equipped with lip edges	○	○
Drawers to be equipped with catches (i.e. to prevent the drawer from being pulled out of cabinet)	○	○
Cabinet doors not to be self-closing	○	○

Requirements	Containment Level 1	Containment Level 2
100% outside air to be supplied		○
Autoclave or other acceptable means of waste treatment/disposal to be provided	○	●
Windows, if they can be opened, need to be protected by fly screens	●	●
Hooks to be provided for laboratory coats at laboratory exit; street and laboratory clothing areas to be separated	●	●
Hand-washing sinks to be located near the point of exit from the laboratory or in anteroom	●	●
Hand-washing sinks to be provided with “hands-free” capability		○
Biological safety cabinets and other primary containment devices to be provided		○
Emergency eyewash and shower equipment to be provided in accordance with applicable regulations		●

Public Health Agency of Canada’s Containment Level 2 checklist can be found online at:

www.phac-aspc.gc.ca/ols-bsl/containment/index-eng.php

or contact the Biosafety Officer for a paper copy.

Appendix 6: University of Regina Biosafety Questionnaire

Academic Staff Members and supervisors of research and teaching areas that use, store or dispose of biological materials or organisms in University of Regina laboratories/facilities are requested to complete a ***Biosafety Questionnaire*** annually to assist with obtaining a University-wide biological inventory. Once complete, please forward to the Biosafety Officer (Human Resources).

Principal Investigator

Name: _____

Department/Unit: _____

Office Phone: _____

Email: _____

Staff, Students & Volunteers

Please list all your current laboratory staff, students and volunteers.

Name	**Work Phone**

Section 1 Biosafety Questionnaire

1. Does or will your laboratory group use or store whole soil, water or plant samples?

   ☐ YES – **complete Section 2**

   ☐ NO

2. Does or will your laboratory group use microorganisms?
   (e.g. bacteria, toxins, viruses, fungi, protozoa, parasites, or prions)

   ☐ YES – **complete Section 3**

   ☐ NO

3. Does or will your laboratory group use recombinant DNA and genetic manipulation techniques?

   ☐ YES – **complete Section 4**

   ☐ NO

4. Does or will your laboratory group use primary or established cell lines (culture)?

   ☐ YES – **complete Section 5**

   ☐ NO

5. Does or will your laboratory group use animals or material derived from animals?
   (e.g. blood, body fluids, tissues, carcasses)

   ☐ YES – **complete Section 6**

   ☐ NO

6. Does or will your laboratory group use material derived from humans?
   (e.g. blood, body fluids, tissues)

   ☐ YES – **complete Section 7**

   ☐ NO

7. Does or will your laboratory group work with any other type of unfixed biological material or organism in your laboratory?

   ☐ YES – **complete Section 2**

   ☐ NO

Section 2 Whole Water, Soil, and Plant Samples

Please give a brief 1-2 sentence description of the type of material worked with below
(e.g. biological and chemical water quality testing, treated sewage, identification of grass species

Section 3 Biological Materials or Organisms

Please list all biological materials or organisms that your laboratory group uses or stores below.

Biological:	Include all biologicals such as bacteria, toxins, viruses, fungi, protozoa, parasites, prions, etc.
Risk Group 1 or 2:	According to the Public Health Agency of Canada's *Laboratory Biosafety Guidelines*, 2004, Chapter 4. See **Appendices** of the ***Biosafety Program*** for a guidance list. If unknown, indicate "unknown".
Host Ranges:	Is this biological an actual or potential human, animal or plant pathogen?
Activity Used:	Teaching or Research
Person Responsible:	Principle Investigator/Laboratory Instructor name
Location Material is Used/Stored:	Building, room number, freezer, etc.

Biological	Risk Group	Host Ranges	Activity Used	Person Responsible	Location Material is Used/Stored

** Please attach additional pages if necessary*

Section 4 Recombinant DNA and Genetic Manipulation

Please complete the ***Research Involving Recombinant DNA and Genetic Manipulation form*** (**Biosafety Program Appendices**) and forward the completed form with this Questionnaire to the Biosafety Officer.

Section 5 Cell Lines (Culture)

Please list all cell lines that your laboratory group uses or stores below. Cells or primary cultures from animals and humans known or reasonably suspected to be infected should be in the risk group for the suspected agent.

Cell line:	All clones and variants need not be listed unless they would be at a different Risk Level
Origin:	Species and tissue/organ (e.g. mouse mammary gland)
Transformed:	Name chemical, oncogene (if known) (e.g. SV-40 human oncogenic virus)
Risk Group 1 or 2:	According to the Public Health Agency of Canada's *Laboratory Biosafety Guidelines*, 2004, Chapter 4. See **Appendices** of the ***Biosafety Program*** for a guidance list. If unknown, indicate "unknown".
Person Responsible:	Principle Investigator/Laboratory Instructor name
Location Material is Used/Stored:	Building, room number, freezer, etc.

Cell Line	Species & Tissue of Origin	Transformed	Risk Group	Person Responsible	Location Material is Used/Stored

** Please attach additional pages if necessary*

Section 6 Animals

1. Are any agents listed in Sections 2-5 being used in any animals, even if just to carry a cell line?

   ☐ YES

   ☐ NO

Please list all materials derived from animals that your laboratory group uses or stores below. Materials derived from animals should be considered as potentially infectious and zoonotic diseases must be considered. At the University of Regina all animal work involving healthy animals or tissues is deemed Containment Level 1, whereas working with diseased or intentionally diseased animals is designated Containment Level 2.

Material:	Description of tissue or body fluid
Species of Origin:	Species of animal
Specimen Source:	e.g. clinical sample, Red Cross, commercial animal breeding facility, fieldwork
Risk Group 1 or 2:	According to the Public Health Agency of Canada's *Laboratory Biosafety Guidelines*, 2004, Chapter 4. See **Appendices** of the ***Biosafety Program*** for a guidance list. If unknown, indicate "unknown".
Person Responsible:	Principle Investigator/Laboratory Instructor name
Location Material is Used/Stored:	Building, room number, freezer, etc.

Material	Species of Origin	Specimen Source	Risk Group	Person Responsible	Location Material is Used/Stored

** Please attach additional pages if necessary*

Section 7 Humans

Please list all materials derived from humans that your laboratory group uses or stores below. At the University of Regina all material derived from humans should be considered potentially infectious (as per Universal Precautions). All work with human blood, tissues and fluids, regardless of source, needs to be handled at Containment Level 2.

Material:	Description of tissue or body fluid
Species of Origin:	Species name
Specimen Source:	e.g. clinical sample, Red Cross, commercial animal breeding facility, fieldwork
Risk Group 1 or 2:	According to the Public Health Agency of Canada's *Laboratory Biosafety Guidelines*, 2004, Chapter 4. See **Appendices** of the ***Biosafety Program*** for a guidance list. If unknown, indicate "unknown".
Person Responsible:	Principle Investigator/Laboratory Instructor name
Location Material is Used/Stored:	Building, room number, freezer, etc.

Material	Species of Origin	Specimen Source	Risk Group	Person Responsible	Location Material is Used/Stored

** Please attach additional pages if necessary*

Appendix 7: Research Involving Recombinant DNA and Genetic Manipulation

Principal Investigator

Name: _____

Department/Unit: _____

Office Phone: _____

Email: _____

1. Vector used (plasmid/phage/virus):

2. a) Prokaryotes (e.g. *E. coli* K12):

   b) Eukaryotes (e.g. mammalian cell line):

   c) Higher animals (e.g. mice)

3. Source of cloned DNA
   (host organism/gene name of nature of sequence):

4. Risk Group level of source organism:

   And Host: _____

5. Will experiments involve

a)	DNA transfer to animals?	☐	Yes	☐ No
b)	DNA transfer to plants?	☐	Yes	☐ No
c)	Genetic alteration of animals?	☐	Yes	☐ No
d)	Genetic alteration of plants?	☐	Yes	☐ No
e)	Expression of cloned DNA?	☐	Yes	☐ No
f)	Release of rDNA/genetically altered animals or plants to the environment?	☐	Yes	☐ No

Briefly describe the research (1-2 sentences).

- Include and describe the hazards that may be associated with this research (e.g. the replication competency of the recombinant organisms, the potential pathogenic or non-pathogenic properties of the protein expressed by the recombinant techniques, the process used to identify the hazards and assess the risks of infectivity, allergenicity, toxicity or other hazardous properties [e.g. antibiotic resistance] of the GMO to workers).

Appendix 8: Annual Containment Level 2 Laboratory Safety Checklist

To be completed by the Biosafety Committee

Laboratory Manager Name: _____

Building and Room Number: _____

Inspected by: _____

Date: _____

The following inspection report identifies deficiencies found by the Biosafety Committee. This inspection report is in addition to the annual Local Safety Committee Checklist completed for every University of Regina laboratory.

A. ADMINISTRATION OF BIOSAFETY	**YES**	**NO**	**NA**	**COMMENTS**
1. Detailed ***Biosafety Questionnaire*** completed (containment level/risk assessment)	☐	☐	☐	
2. Health and medical surveillance program in place	☐	☐	☐	
3. Risk assessment completed to determine which procedures what concentrations and volumes necessitate the use of a BSC	☐	☐	☐	
4. Documentation of site- and project-specific training kept on file	☐	☐	☐	

B. BIOSECURITY	**YES**	**NO**	**NA**	**COMMENTS**
5. Laboratory follows the appropriate level of biosecurity as outlined in the ***UR Biosecurity Plan***, including training	☐	☐	☐	
6. Biological inventory current (<1 year)	☐	☐	☐	

C. MANAGEMENT OF BIOSAFETY	**YES**	**NO**	**NA**	**COMMENTS**
7. Emergency procedures posted and legible (fire, spills, injuries, SOPs, BSC failure)	☐	☐	☐	
8. PSDS information posted	☐	☐	☐	
9. Biosafety Program Manual available	☐	☐	☐	
10. ***CL2 Standard Operating Procedures*** available	☐	☐	☐	
11. ***Biological Safety Cabinet Procedures*** available	☐	☐	☐	
12. Hands-free washing sinks located near the laboratory exit (soap and paper towel accessible)	☐	☐	☐	
13. Shower available and accessible	☐	☐	☐	
14. Eyewash available and accessible	☐	☐	☐	
15. CL2 spill kit available and stocked	☐	☐	☐	

D. AUTHORIZED ENTRY	YES	NO	NA	COMMENTS
16. Personnel (visitors, trainees, and others) are required to wear protective laboratory clothing when entering/working in the laboratory	☐	☐	☐	
17. Access to laboratory limited to authorized personnel	☐	☐	☐	
18. Appropriate CL2 Biohazard Sign on laboratory door	☐	☐	☐	
19. Laboratory doors kept closed and locked	☐	☐	☐	
20. Record made of other people (emergency responders) entering facility during an emergency	☐	☐	☐	
21. Visitors, maintenance staff, custodial staff and others provided with training and/or supervision with regards to anticipated activites in laboratory	☐	☐	☐	

E. PERSONAL PROTECTION	YES	NO	NA	COMMENTS
22. Procedures in place to ensure that substantial footwear is worn and that legs are covered	☐	☐	☐	
23. Procedures in place outling protective laboratory clothing requirements and decontamination procedures	☐	☐	☐	
24. Laboratory coats and gloves available	☐	☐	☐	
25. Face shield and eye protection available and in good condition	☐	☐	☐	
26. Respirator(s) available	☐	☐	☐	
27. Respirator user(s) trained & fit-tested	☐	☐	☐	

F. HOUSEKEEPING	YES	NO	NA	COMMENTS
28. Bench tops and sink areas tidy	☐	☐	☐	
29. Food and drink absent	☐	☐	☐	
30. “No Eating/Drinking/Smoking” signs posted	☐	☐	☐	

G. DECONTAMINATION	YES	NO	NA	COMMENTS
31. Procedures in place for decontamination of bench tops and surfaces at end of working day	☐	☐	☐	
32. Procedures in place for decontamination of laboratory rooms and large pieces of equipment	☐	☐	☐	
33. Procedures in place for contaminated materials and equipment to be decontaminated before disposal or removal from laboratory	☐	☐	☐	
34. Disinfectants are effective against agents in use and stored in all areas where agents are used	☐	☐	☐	

H. WASTE	YES	NO	NA	COMMENTS
35. Biological waste containers labelled and secure	☐	☐	☐	
36. "Biohazardous waste" segregated from general refuse	☐	☐	☐	
37. Needles and sharps in "Sharps" container	☐	☐	☐	
38. Procedures in place for effective decontamination (autoclave, disinfectant)	☐	☐	☐	

I. BIOLOGICAL SAFETY CABINETS	YES	NO	NA	COMMENTS
39. BSC certified in accordance with NSF/ANSI 49-2004s: NSF 49 Class II (Laminar Flow) Biosafety Cabinetry requirements	☐	☐	☐	
40. Laboratory Managers have current BSC certification report on file	☐	☐	☐	

Please ensure that a written response and corrections are made by: _____

(Date)

Principal Investigator Signature:	**Date:**
Biosafety Officer Signature:	**Date:**

(*Please sign after violations have been acted upon*)

UPON CORRECTION OF VIOLATIONS, PLEASE RETURN TO BIOSAFETY OFFICER

Appendix 9: Safety Standard Operating Procedure for Containment Level 2 Laboratory

Safety Standard Operating Procedure for _____
at Containment Level 2

Principle Investigator _____

Laboratory Location _____

Issue Date _____

Revision Date _____

Prepared By _____

Approval Signature _____

Introduction and Purpose of Work:

Applicable Regulatory Statues/Guidelines:

Saskatchewan's *Occupational Health and Safety Regulations*, 1996, Section 85, Exposure Control Plan

Saskatchewan's *Occupational Health and Safety Regulations*, 1996, Section 305, Notifiable Biological Substances

Public Health Agency of Canada's *Human Pathogen and Toxin Act*, 2009

Risk Assessment

Hazard Identification and Risk of Exposure to the Hazards:

Routes of Transmission:

Health and Medical Surveillance (in necessary):

Biosecurity Risk:

Precautions & Procedures

All laboratory work shall fully comply with Risk Group 2/Containment Level 2 requirements as described in the current edition of Public Health Agency of Canada's *Laboratory Biosafety Guidelines*: **Error! Hyperlink reference not valid.**www.phac-aspc.gc.ca/publicat/lbg-ldmbl-04/index-eng.php

Personal Protective Equipment:

Protective Equipment:

Specimen transport and removal of material(s) from the laboratory:

Cleaning and Disinfection:

Waste Generation and Disposal Methods:

Emergency Exposures

Exposures or Suspected Exposures

Medical Emergency

1. Phone 911 – Direct them to the scene of the occurrence.
2. Call Campus Security: 585-4999
3. Give First Aid, if you are qualified to do so, or get help from trained Emergency Wardens and/or Campus Security.
4. Stay with victim.

Needle stick Poke, Puncture Wound, or Percutaneous Injury

1. Remove gloves and allow the wound to bleed.
2. Immediately wash the affected area for 15 minutes with soap and warm water.
3. Notify Supervisor (if available) to obtain assistance.
4. Seek **medical assistance immediately** (within **1-2 hours**) from a health care professional. The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday - Friday: (306) 337-2643. The cause of the wound and organisms involved should be reported.
5. Details of the incident must be documented using the **Incident Report Form** and forwarded to Health, Safety & Environment within 24 hours. Please include the following details:
   - What was the method of contact (e.g. needle stick, splash)?
   - How did the exposure occur?
   - What known biological agents or body fluids were you in contact with?
   - What action was taken in response to the exposure to remove the contamination (e.g. hand washing)?
   - What personal protective equipment was being used at the time of exposure?
   - What is your immune status (e.g. tetanus, Hepatitis A or B Virus)?

Eyes or Mucous Membrane Exposure (e.g. Splash)

1. Immediately flush the affected area for 15 minutes using an eyewash or shower.
2. Notify Supervisor (if available) to obtain assistance.
3. Seek **medical assistance immediately** (within **1-2 hours**) from a health care professional. The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday - Friday: (306) 337-2643. The organisms involved should be reported.
4. Details of the incident must be documented using the **Incident Report Form** and forwarded to Health, Safety & Environment within 24 hours. Please include details as listed above.

Ingestion

1. Protective clothing should be removed.
2. Notify Supervisor (if available) to obtain assistance.
3. Seek **medical assistance immediately** (within **1-2 hours**) from a health care professional. The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday - Friday: (306) 337-2643.
4. Identification of the material ingested and circumstances of the incident should be reported.
5. Details of the incident must be documented using the **Incident Report Form** and forwarded to Health, Safety & Environment within 24 hours. Please include details as listed above.

Spill Procedures

Training

Personnel conducting research using the above mentioned Containment Level 2 biological substance must comply with the following training requirements:

- Complete **Chemical and Laboratory Safety Training**
- Complete **Biosafety Level 2 Training**

All personnel shall read and fully adhere to this safety SOP; documentation of personnel reading and understanding this laboratory-specific safety SOP will be kept below.

Documentation

I have read and understood all sections of this Safety SOP and understand that I have the right to know hazards and refuse unsafe acts in the workplace under Saskatchewan's *Occupational Health and Safety Act* and Regulations:

Signature of Authorized Worker	Date
Signature of Authorized Worker	Date
Signature of Authorized Worker	Date
Signature of Authorized Worker	Date
Signature of Authorized Worker	Date
Signature of Authorized Worker	Date
Signature of Authorized Worker	Date
Signature of Authorized Worker	Date

☑ MSDS attached to the back of this document. See www.phac-aspc.gc.ca/msds-ftss/index-eng.php

SAMPLE: Safety Standard Operating Procedure for Containment Level 2 Laboratory

Safety Standard Operating Procedure for at Containment Level 2 Candida albicans

Red font = Questions to think about
Black font = Example

Principle Investigator	Dr. John Doe
Laboratory Location	Research & Innovation Centre 613
Issue Date	January 2, 2009
Revision Date	February 25, 2010
Prepared By	Jane Jones
Approval Signature	PI's signature only allowed

Introduction and Purpose of Work:

Please provide a brief generic description of work.
For example: Investigating ultrastructural consequences of antifungal drugs on Candida spp.

Applicable Regulatory Statues/Guidelines: *List only the appropriate. The Biosafety Officer can assist you with this.*

For example:
Saskatchewan's Occupational Health and Safety Regulations, 1996, Section 85, Exposure Control Plan

Public Health Agency of Canada's Human Pathogen and Toxin Act, 2009

Saskatchewan's Occupational Health and Safety Regulations, 1996, Section 305, Notifiable Biological Substances

Risk Assessment

Hazard Identification and Risk of Exposure to the Hazards:
Describe the risk of the agents being handled in the laboratory. If applicable, describe the signs and symptoms of illness and/or disease.

Routes of Transmission:
Prior to assigning containment requirements, it is imperative to understand the routes of transmission.
Some issues to address:

1. *What are the exposure routes/risks of most concern? (**Examples:** Sharps exposures, splash exposures, non-intact skin exposures, other exposures such as food, drink, inanimate objects).*
2. *If applicable, are there any off target effects (insertional mutagenesis, etc.) from exposure to the biohazardous and/or recombinant material?*
3. *What are the consequences of exposure to the biohazardous and/or recombinant material?*

For example: Accidental inoculation/puncture, exposure of mucous membranes (eyes, nose and mouth) to droplets and aerosols, absorption through non-intact skin, and ingestion could cause illness (thrush). The creation of infectious aerosols is low but research personnel will use caution when pipetting, opening tubes, and after centrifuging. No food or drink allowed in research areas. Monitor for symptoms, go to a health professional if unsure. Antibiotic therapy is available.

Health and Medical Surveillance (in necessary):
If deemed appropriate, pre-screening may be required, in addition to vaccinations or special counseling. The personnel must understand the risks of using the specific biologically hazardous agents. Determine if immunization is needed.

For example: Through consultation, it has been deemed that here are no health and medical surveillance pre-screening requirements for this project (including immuno-compromised or pregnant women). No immunization is required for this project. As mentioned above, the consequence of potential exposure could be illness/disease so any personnel splashed and in contact with samples will seek immediate medical care.

Biosecurity Risk:
For example: No additional biosecurity risks have been identified; therefore the laboratory will follow **Biosecurity Risk Level 2** requirements outlined in the UR Biosafety Program.

Precautions & Procedures

All laboratory work shall fully comply with Risk Group 2/Containment Level 2 requirements as described in the current edition of Public Health Agency of Canada's *Laboratory Biosafety Guidelines*: **Error! Hyperlink reference not valid.**

Personal Protective Equipment:

List all required personal protective equipment (e.g. gloves, eye protection).

For example: Laboratory coats and disposable latex/nitrile gloves must be worn at all times while working with the *Candida albicans* culture samples. When working with concentrated culture samples eye/face protection must be worn.

Protective Equipment:

List all required protective equipment needed for procedure (e.g. biological safety cabinet), specific work practice guidelines (e.g. use of conveniently located sharps containers, safer needles and sharps, absorbent material placed on countertops), methods to prevent the release of infectious agents/protect workers from aerosols, splashes, splatters: (e.g. equipment/engineering controls: ex., Class II Biological Safety Cabinets,, covered centrifuge cups).

For example: After mixing and/or centrifugation the samples will sit for 5 minutes before opening of the tubes. Filter-plugged pipette tips are to be used for all procedure steps. Bench coat will be placed on laboratory benches. Biological Safety Cabinets will be used for procedures that create aerosols.

Specimen transport and removal of material(s) from the laboratory:

List details here if applicable (e.g. leak-proof transport containers, decontaminate outside containers).

For example:

Liquid Waste

1. Wear gloves, a laboratory coat, and other appropriate personal protective equipment (face and eye protection).
2. Samples or waste must be stored in a tightly closed tube, jug, pail, etc. If it is unrealistic to cap every tube, then samples must be stored in a tightly closed plastic container (e.g. Rubbermaid bin, Ziploc container, etc.) as the primary container.
3. Samples in primary container (tubes, jugs, containers) must be transported in a secondary container (e.g. autoclave bin, Rubbermaid bin, Ziploc container, etc.).
4. Wipe down storage and transport containers with appropriate disinfectant if containers are contaminated or suspected to be contaminated.
5. Transport liquid waste using a cart.

Solid Waste

1. Wear gloves, a laboratory coat, and other appropriate personal protective equipment (face and eye protection).
2. Samples or waste must be stored in an autoclave/biohazard bag placed inside a tightly closed plastic container (e.g. Rubbermaid bin, Ziploc container, etc.).
3. Sample/waste in primary container must be transported in a secondary container (e.g. autoclave bin, Rubbermaid bin, Ziploc container, etc.).
4. Wipe down storage and transport containers with appropriate disinfectant if containers are contaminated or suspected to be contaminated.
5. Transport solid waste using a cart.

Cleaning and Disinfection:

*Describe surface decontamination, cleaning procedures and type of disinfectant(s) used. See **Appendix 7** and **8** of the **UR Biosafety Program** for more disinfectant information.*

For example: A 1% sodium hypochlorite dilution, prepared monthly (or as required), will be used to wipe down the benches, equipment (centrifuges, biological safety cabinets, incubators), wares, and tools daily and/or after use. As bleach may corrode metal, a 70% ethanol can be substituted for metal equipment decontamination.

Waste Generation and Disposal Methods:

*Identify the types of waste generated (liquid waste, dry waste, sharps waste, animal carcasses) and procedures for handling/disposing of biological waste including contaminated, non-contaminated waste and use of sharps containers. See **Appendix 9** and **10** for more information.*

For example: Liquid and dry waste will be generated while working with *Candida spp.* cultures. Liquid waste will be collected in a properly labeled glass or plastic waste jugs and dry waste will be collected in plastic biohazard containers or bags.

Liquid Waste

1. Wear gloves, a laboratory coat and eye/face protection.
2. Slowly pour appropriate amount of bleach (see MSDS and Manufacturer's directions) into the container holding the liquid biological waste.
3. Allow appropriate contact time (10-30 minutes).
4. Slowly pour decontaminated waste down the sanitary sewer while being cautious to prevent the formation of aerosols or spills.
5. The Laboratory Supervisor must be informed at once for cleanup and exposure assistance.

Solid Waste

1. Wear gloves, a laboratory coat and eye/face protection.
2. No other types of waste should be mixed or included with contaminated solid wastes.
3. Place contaminated waste in a biohazard/autoclave bag.
4. Inactivate waste by autoclave. Inactivated waste can be treated as decontaminated and can be directly disposed of into a regular garbage bin. Biohazard symbols must be defaced.
5. The Laboratory Supervisor must be informed at once for cleanup and exposure assistance.

Emergency Exposures

Exposures or Suspected Exposures

Medical Emergency

1. Phone 911 – Direct them to the scene of the occurrence.
2. Call Campus Security: 585-4999
3. Give First Aid, if you are qualified to do so, or get help from trained Emergency Wardens and/or Campus Security.
4. Stay with victim.

Needle stick Poke, Puncture Wound, or Percutaneous Injury

1. Remove gloves and allow the wound to bleed.
2. Immediately wash the affected area for 15 minutes with soap and warm water.
3. Notify Supervisor (if available) to obtain assistance.
4. Seek **medical assistance immediately** (within **1-2 hours**) from a health care professional. The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday - Friday: (306) 337-2643. The cause of the wound and organisms involved should be reported.
5. Details of the incident must be documented using the **Incident Report Form** and forwarded to Health, Safety & Environment within 24 hours. Please include the following details:
   - What was the method of contact (e.g. needle stick, splash)?
   - How did the exposure occur?
   - What known biological agents or body fluids were you in contact with?
   - What action was taken in response to the exposure to remove the contamination (e.g. hand washing)?
   - What personal protective equipment was being used at the time of exposure?
   - What is your immune status (e.g. tetanus, Hepatitis A or B Virus)?

Eyes or Mucous Membrane Exposure (e.g. Splash)

1. Immediately flush the affected area for 15 minutes using an eyewash or shower.
2. Notify Supervisor (if available) to obtain assistance.
3. Seek **medical assistance immediately** (within **1-2 hours**) from a health care professional. The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday - Friday: (306) 337-2643. The organisms involved should be reported.
4. Details of the incident must be documented using the **Incident Report Form** and forwarded to Health, Safety & Environment within 24 hours. Please include details as listed above.

Ingestion

1. Protective clothing should be removed.
2. Notify Supervisor (if available) to obtain assistance.
3. Seek **medical assistance immediately** (within **1-2 hours**) from a health care professional. The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday - Friday: (306) 337-2643.
4. Identification of the material ingested and circumstances of the incident should be reported.
5. Details of the incident must be documented using the **Incident Report Form** and forwarded to Health, Safety & Environment within 24 hours. Please include details as listed above.

Spill Procedures

Small Hazardous Biological Spill (can be covered with a few paper towels)

1. All persons should immediately leave the affected area and allow aerosols to settle.
2. Any exposed person should seek **medical assistance immediately** (within **1-2 hours**) from a health care professional. The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday - Friday: (306) 337-2643.
3. The Laboratory Supervisor should be informed for cleanup assistance.
4. Wear gloves, laboratory coast, and eye/face protection.
5. Cover the spill with cloth or paper towels to contain it.
6. Spray or pour an appropriate disinfectant over the paper towels and the immediate surrounding area (generally, 5% bleach solutions are appropriate).
7. Start applying the disinfectant from the outside and move inwards.
8. After the appropriate amount of time (30 minutes; see MSDS), clear away any materials like broken glass using forceps or another mechanical device and place in a sharps container/biohazard container.
9. Clean and disinfect the area of the spillage using paper towels.
10. Place contaminated cleaning materials into a labeled, leak-proof, puncture-resistance waste disposal container and dispose of waste appropriately.
11. Complete an **Incident Report Form** and forward to Health, Safety & Environment within 24 hours.

Large Hazardous Biological Spill

1. All persons should immediately leave the affected area and allow aerosols to settle.
2. Any exposed person should seek **medical assistance immediately** (within **1-2 hours**) from a health care professional. The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday - Friday: (306) 337-2643.
3. The Laboratory Supervisor *and* Biosafety Officer should be informed for cleanup assistance.
4. Wear gloves, a laboratory coat and eye/face protection. Consider disposal foot coverings and appropriate respirators.
5. Cover the spill with cloth or paper towels to contain it.
6. Spray or pour an appropriate disinfectant over the paper towels and the immediate surrounding area (generally, 5% bleach solutions are appropriate).
7. Start applying the disinfectant from the outside and move inwards.
8. After the appropriate amount of time (30 minutes; see MSDS), clear away any materials like broken glass using forceps or another mechanical device and place in a sharps container/biohazard container.
9. Clean and disinfect the area of the spillage using paper towels.
10. Place contaminated cleaning materials into a labeled, leak-proof, puncture-resistance waste disposal container and dispose of waste appropriately.
11. Complete an **Incident Report Form** and forward to Health, Safety & Environment within 24 hours.

Potentially Hazardous Aerosol Release (Outside a Biological Safety Cabinet)

1. All persons should immediately leave the affected area and allow aerosols to settle.
2. Any exposed person should seek **medical assistance immediately** (within **1-2 hours**) from a health care professional. The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday - Friday: (306) 337-2643.
3. The Laboratory Supervisor *and* Biosafety Officer must be informed for cleanup assistance.
4. No one should enter the room for an appropriate amount of time (30 minutes), to allow for aerosols to be carried away and heavier particles to settle. If the laboratory does not have a central air exhaust system, entrance should be delayed (e.g. for 24 hours).

5. Signs should be posted indicating that entry is forbidden; Post a sign stating “DO NOT ENTER, BIOHAZARD SPILL. Contact (name and phone #) for information.”
6. After the appropriate amount of time, decontamination should proceed, supervised by the Biosafety Officer.
7. Appropriate personal protective equipment including respiratory equipment should be worn.
8. Complete an **Incident Report Form** and forward to the Health, Safety & Environment with 24 hours.

Always contact Health, Safety & Environment (585-4776) before wearing a respirator for the first time. You must be Fit Tested.

Spilled Hazardous Substances and Broken Containers

1. All persons should immediately leave the affected area.
2. Any exposed person should seek **medical assistance immediately** (within **1-2 hours**) from a health care professional. The University of Regina Allied Health Center is open from 8:30 a.m.-5:00 p.m. Monday-Friday: (306) 337-2643.
3. The Laboratory Supervisor must be informed at once for cleanup assistance.
4. Wear gloves, a laboratory coat and eye/face protection.
5. Broken containers contaminated with infectious substances and spilled infectious substances should be covered with a cloth or paper towels. Care must be taken to avoid splashing or generating aerosols during the clean up.
6. Spray the site with the freshly prepared disinfectant (5% bleach dilution) and for larger spills make enough dilute disinfectant to pour into the spill puddle to double its size. Start applying the disinfectant from the outside and move inwards.
7. Leave the disinfectant on the surface for appropriate amount of time (30 minutes; see MSDS).
8. The cloth or paper towels and the broken material can then be cleared away; glass fragments should be handled with forceps or another mechanical device and placed in a sharps container/biohazard container.
9. The contaminated area should be cleaned with disinfectant.
10. If dustpans are used to clear away the broken material, they should be autoclaved or placed in an effective disinfectant.
11. Cloths, paper towels, and swabs used for cleaning must be disposed of in a contaminated-waste container and dispose of waste appropriately.
12. If laboratory forms or other printed or written material are contaminated, the information should be copied onto another form and the original discarded into the contaminated waste container.
13. Complete an **Incident Report Form** and forward to Health, Safety & Environment within 24 hours.

Training

Personnel conducting research using the above mentioned Containment Level 2 biological substance must comply with the following training requirements:

- Complete **Chemical and Laboratory Safety Training**
- Complete **Biosafety Level 2 Training**
- All personnel shall read and fully adhere to this safety SOP; documentation of personnel reading and understanding this laboratory specific safety SOP will be kept below
- *Any other training requirements you want completed*

Documentation

I have read and understood all sections of this Safety SOP and understand that I have the right to know hazards and refuse unsafe acts in the workplace under Saskatchewan's Occupational Health and Safety Act and Regulations:

Signature of Authorized Worker	Date
Signature of Authorized Worker	Date
Signature of Authorized Worker	Date
Signature of Authorized Worker	Date
Signature of Authorized Worker	Date
Signature of Authorized Worker	Date
Signature of Authorized Worker	Date
Signature of Authorized Worker	Date

☑ MSDS attached to the back of this document. See www.phac-aspc.gc.ca/msds-ftss/index-eng.php

Appendix 10: Biologically Hazardous Substances Procurement Form

The Biologically Hazardous Substances Procurement Form must be completed and approved by the Biosafety Committee before biologically hazardous (Risk Group 2 and above) will be ordered or received.

Principal Investigator	
Name:	
Department/Unit:	
Office Phone:	
Email:	
FOAPAL:	

Description of Material to be Procured (e.g. species name of origin, cell line, tissue type, etc.):

Risk Group: _____ **Laboratory Containment Level Required:** _____

Location Material is Used and Stored: _____

Material Source (e.g. clinical sample, Red Cross, fieldwork, University college sample, etc.):

Person Responsible: _____

Date Required By: _____

Special Instructions: _____

Principal Investigator Signature:	**Date:**
Biosafety Officer Signature:	**Date:**
Office of Research Services Signature:	**Date:**

Appendix 11: Transportation of Dangerous Goods Class 6 Guidelines

** This document has been modified from the University of Guelph, College of Biological Science - Standard Operating Procedure, Transportation of Dangerous Goods, 2008

The purpose of this document is to provide instruction on the requirements for the transport of Dangerous Goods Class 6- Toxic Substances or Infectious Substances. These guidelines apply to all individuals who will be offering for transport, transporting, or receiving dangerous goods [as defined in the Transportation of Dangerous Goods Regulations (TDGR)].

Reviewing these guidelines do not constitute training; you must successfully complete an approved course and obtain a certification card from Health, Safety & Environment to be certified to ship, carry or receive Dangerous Goods Class 6.

Shipping

The basic requirements for shipments under Transportation of Dangerous Goods (TDG) consist of:

- Classification
- Packaging
- Labeling
- Shipping Documentation

Step 1 - Notify the Biosafety Officer and Classify the Material

Contact the Biosafety Officer (BSO) prior to shipping any dangerous good. The BSO will assist with classification and provide a recommendation of the type of packaging that should be used, in addition to the required shipping documentation and labels.

NOTE: if you do not have current TDG training certification, you cannot send, carry or receive a shipment of regulated dangerous goods. The BSO is available to coordinate shipments for those who do not have the required training.

Step 2 - Package the Material

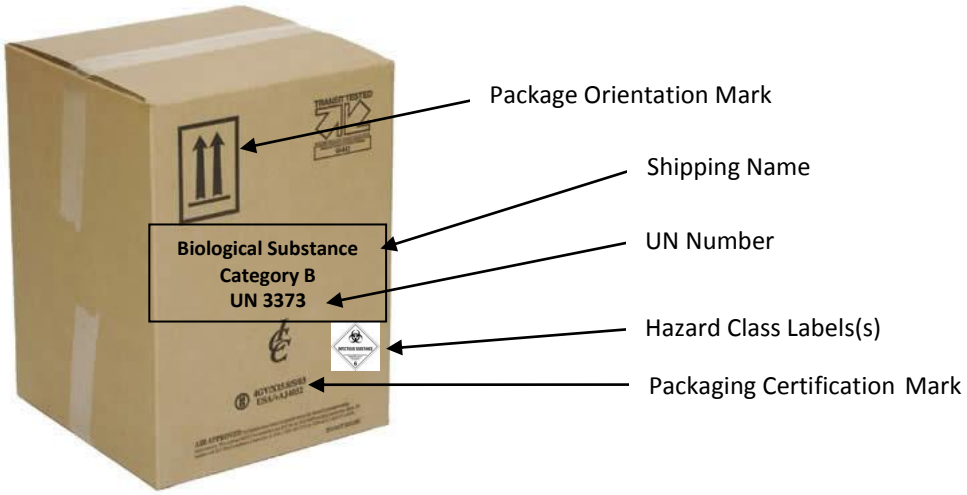
The exact nature of the packaging will depend on the goods being shipped. The packaging must protect the material from damage during shipping. For ground shipping, the packaging must conform to UN requirements (and **must** have the UN safety mark on the outside). For air transport, the packaging must meet the criteria of the International Civil Aviation Organization (ICAO).

In most circumstances, use combination packaging - basically a leak-proof container inside a box. The dangerous good(s) are sealed inside a secure tight container, which is then placed in an outer package that protects it from damage.

Step 3 - Apply Labels

There is a set of requirements for what must appear on the outside of a package of dangerous goods. These include:

- Shipping Name
- UN Identification Number
- Hazard Class Label(s)
- Packaging Certification Mark



The manufacturer of the carton will typically print on the orientation mark and packaging certification – the shipper usually applies the shipping name, UN number and the hazard class label stickers.

Step 4 - Shipping Documents

For ground shipments, the form must include:

- Date prepared
- 24-hour phone number for emergency response (in Canada, use CANUTEC)
- Shipping description for each dangerous good in the shipment, in the following order:
  - Shipping Name (and technical name if required)
  - Hazard Class (and subsidiary class if required)
  - UN Identification Number
  - Packing Group

For the shipment of *Escherichia coli* above, the biological substance is classified by TDGR as a Biological Substance, Category B, so for the name on the shipping document, we would write:

Shipping Name	Primary Class	Subsidiary Class	UN Identification Number	Packing Group	Quantity
Biological Substance, Category B	6.2		UN 3373	Category B, Type 1B	500 µl

Step 5 - Contact Courier Service

Once the material has been classified, packaged, and labeled and you have the shipping documents completed, you are ready to ship. Contact a carrier to arrange the pick up and be sure to let them know the details of what you are shipping.

Receiving

Step 1 - Examine Package

Each package containing dangerous goods must be visually inspected to ensure that the packaging is intact and undamaged, and that no leaks or spills have occurred during transport. University of Regina requires receivers to refuse damaged packages – let the driver know that you can't accept the part of the shipment that has been damaged.

In addition to being free from damage and leaks, packages should have the appropriate safety marks and labels. During the visual inspection of the package, quickly check the exterior of the packages to confirm that labeling is in place. Let the carrier know if you note any deficiencies.

After a shipment has been received, TDG labeling requirements no longer apply and the hazardous materials are subject to Workplace Hazardous Materials Information System (WHMIS) labeling requirements. Once the goods have been removed from the package, deface or remove all labels on the carton to avoid any confusion.

Step 2 - Confirm Contents

After the visual inspection, review the shipping documents and check the contents of the shipment against the contents listed on the shipping paperwork. Any omissions or errors must be reported to the carrier.

Store the packages in a safe and suitable location until they are delivered to their final destinations or used. Ensure that incompatible chemicals (e.g. flammables and oxidizers; acids and bases) are well separated.

Step 3 - Document Retention

The receiver must retain shipping documents for at least **two** years.

TDG Example of Shipping an Infectious Substance

This is an example to demonstrate how a microorganism is classified and the process to determine the packaging, labeling, and documentation requirements. In this example scenario, we have a culture of *Escherichia coli* which we wish to send to a colleague elsewhere in Canada.

1. **Does it qualify as an 'Infectious Substance'?**
   Risk Group 1 materials and organisms are exempt from TDGR and can be shipped by road without documentation or training. Anything in Risk Group 2 qualifies as an 'Infectious Substance'. In the example of *E. coli*, it is an 'infectious substance' because *E. coli* is a Risk Group 2 organism.

2. **Is it 'Category A' or 'Category B'?**
   To determine whether an organism is Category A or B, we have to consult Appendix 3 of the TDGR: (http://legislation.ccohs.ca/legislation/documents/canada/caetod/cartrde1.htm).

   E. coli is listed under Category B.

   Category A materials are those that could cause permanent disability or life threatening disease in animals or humans. All infectious substances that don't meet the Category A (high risk) criteria are captured under Category B.

3. **What is the correct shipping name – UN3373, UN2814 or UN2900?**
   Anything in Category B is shipped under the name UN3373, Biological Substance, Category B. This would be the correct shipping name for our example shipment of an *E. coli* culture.

   Category A materials are assigned to either UN2814 or UN2900, Infectious Substance, depending on the ability of the organisms to cause disease in humans or animals.

4. **What type of packaging is needed?**
   There are two types of packaging: the highest level, Type 1A, is packaging you can buy commercially that has undergone various tests to verify it is durable - it is only required for Category A infectious substances (although it can be used for lower risk, Category B shipments).

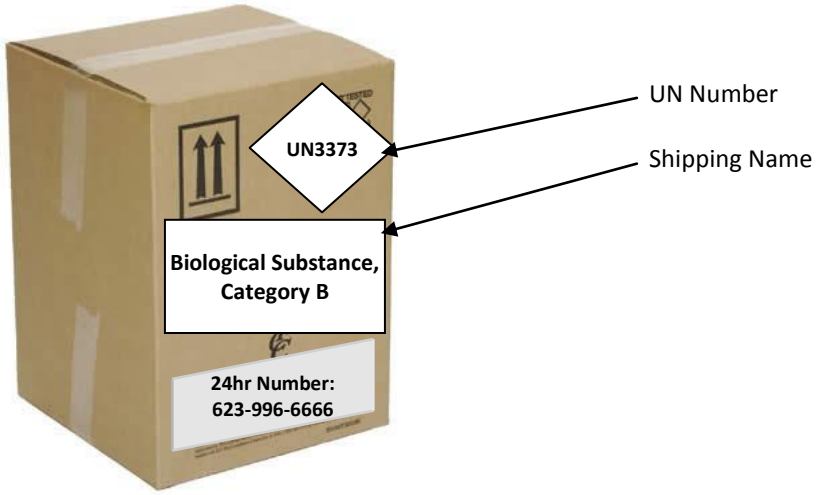
   For the majority of biological shipments at the University of Regina, Type 1B packaging is adequate. In 2008, the requirements for Type 1B packaging became more stringent. Therefore, it is strongly recommended that Type 1B packaging be purchased from a commercial supplier. The marking 'TC-125-1B' indicates a packaging system meets the requirements for Type 1B.

   In our example, E. coli is Category B, so Type 1B packaging is required.

5. **What labels are required?**
   The labeling requirements are dictated by the classification of the contents. Shipments of Category B Infectious Substances must have diamond hazard label shown below on the outer container.

   They must also have the shipping name written at least 6 mm high: Biological Substance, Category B. In the case of Category B materials, a 24-hour emergency response number must also be written.
   For example: '24 Hr Number: CANUTEC 613-996-6666'

   Here is what our package of E. coli culture should look like:



6. **What documentation is needed by the carrier?**
   Shipments of Biological Substance, Category B are exempt from documentation requirements, providing the outer package is at least 10 cm x 10 cm and meets the packaging certification and labeling requirements described above.

7. **Are placards required on the outside of the vehicle?**
   Placards would not typically be required for a shipment of a culture of E. coli. In fact, in general, for the size of shipments the University of Regina would send out, placards are not necessary.

Appendix 12: Personal Protective Equipment

Gloves

- Gloves reduce the possibility that personnel will become exposed to infectious substances and contract infectious diseases.
- Gloves should always be worn when touching blood, body fluids, fecal matter, saliva, contaminated objects, pathogens, toxins, microorganisms, animal droppings and wild animals. When in doubt, wear a pair of gloves.
- When gloves are required, disposable single-use gloves should be worn.
- No glove can provide protection against all hazards, so the gloves selected must be appropriate for the duty/activity they are used for. Gloves available for protection against biologically hazardous materials or organisms are latex, nitrile, vinyl or rubber.

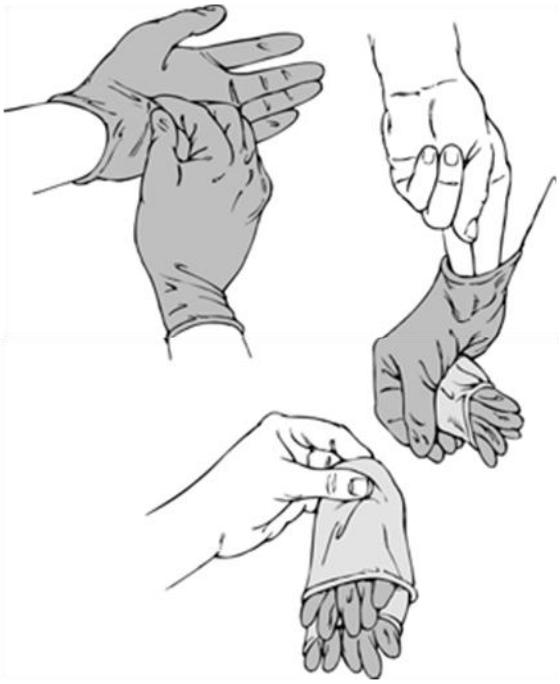
Along with the increasing usage of latex gloves, there have been increasing reports of irritations or allergic reactions to latex, including some severe, immediate reactions. If you detect a reaction to latex, notify your Supervisor immediately.

Steps for Putting on Gloves

1. Place hand through opening of first glove and pull the glove up to the wrist.
2. Repeat with second glove.
3. Adjust gloves to cover wrists or cuffs of gown. Caution: Do not touch any part of your body with gloved hands.
4. Complete duty.

Steps for Removing Gloves

1. Grasp one glove on the inside of wrist at ½ inch below band of dirty side of glove without touching the skin.
2. Pull down glove, turning it inside out, and pull hand out. Hold the glove with the still-gloved hand.
3. Insert fingers of ungloved hand under the cuff of the glove on the other hand (on inside of cuff).
4. Pull down glove until it is inside out, drawing it over the first glove.
5. Discard both gloves by dropping them in appropriate trash container.
6. Wash hands well.



Laboratory Coats, Gowns, Coveralls, and Aprons

- University of Regina employee uniforms/clothing are not considered appropriate PPE.
- Lab coats, gowns, coveralls, and aprons are used to prevent skin and clothing from being splashed or soiled with biologically hazardous substances.
- If the protective clothing is disposable, these must be properly disposed of in a plastic-lined garbage receptacle after use and before leaving area of use. If the protective clothing is non-disposable and soiled, see **Section 14.5 – Protective and Personal Clothing Decontamination**.

Face and Eye Protection

- Face and eye protection must be worn whenever there is potential for the generation of splashes, spray, splatter or droplets of biologically hazardous substances in the face, especially eyes, nose and mouth.
- Eye protection may be provided by safety glasses, goggles or chin length face shields. Nose and mouth protection may be provided by surgical masks and face shields. Some face shields may provide protection against impact injuries.
- Surgical masks may protect the mucous membranes of the mouth and nose against sprays, splashes and droplets, but offer limited protection from infectious aerosols.

Remember that although face shields and surgical masks reduce the risk of splashes and sprays of blood, body fluids, pathogens, etc. from reaching the wearer's mouth and nose, they do not offer mucous membrane protection from infectious aerosols.

Respiratory Protection

- Respirators offer levels of protection against different contaminants by varying their aerosol filter or cartridge efficiency (95, 99, & 99.7%).
- National Institute of Safety and Health (NIOSH)-approved masks and respirators for airborne protection against infectious aerosols are the N95, N99 or N100 rated respirators.
- All respirator wearers must be properly Fit Tested before they can use a respirator! If the respirator does not fit properly on the user's face, it will not offer any protection against infectious aerosols.
- Please see the Health, Safety & Environment ***Respiratory Protection Procedures*** for more information.

If you will require a respirator, please contact Health, Safety & Environment (585-5487) to arrange for an appointment to be Fit Tested.

Appendix 13: Guidelines for Safe Autoclave Use

Thank you to Jackie Rorquist for developing this guide for the University of Regina.

An autoclave is a specialized piece of equipment designed to deliver heat under pressure to a chamber, with the goal of decontaminating or sterilizing the contents of the chamber. Decontamination is the reduction of contamination to a level where it is no longer a hazard to people or the environment, while sterilization is the total destruction of microorganisms present. Sterilization using heat damages the cell's essential structures, including the plasma membrane, rendering the cell non-viable. This will occur only if the material is heated to a specific temperature for a given period of time.

These parameters will vary depending upon the nature of the microorganisms present and the characteristics of the load itself. To facilitate this transfer of heat, moisture in the form of steam is often added, but this does not guarantee success. A number of other factors must be considered. This guideline will outline these in greater detail, as each step in the process is discussed.

Personal Protective Equipment

Since autoclaves use steam, heat and pressure, the risk of personal exposure and potential harm is great; therefore, one must wear the appropriate protective equipment. Often material to be loaded contains potentially infectious material, so standard laboratory protective equipment must be worn. This includes:

- Safety eye and face protection (face shield minimizes the risk of facial steam burns)
- Gloves (latex or nitrile gloves prevent contact with contaminated material, while heat-resistant gloves must be used when loading and unloading the autoclave)
- Lab coats (long sleeves must be used to protect wrists and forearms, while an apron is necessary if a spill hazard exists)

Remember that although the autoclave trays may be cool, the door and walls of the chamber may still be hot enough to cause serious burns!

Training

Training is absolutely required prior to using an autoclave. Not only will this minimize the risk of personnel being harmed, but is essential for ensuring a successful decontamination or sterilization of the material. Training will also help minimize the risk of damage to the equipment. This guideline is one tool to assist in training. In addition, you must receive training specific to the autoclave you will be using.

Training will help promote:

- safety;
- research quality; and
- optimal use and care of equipment.

All Principal Investigators, Laboratory Instructors and Supervisors should ensure that their staff and students receive adequate training.

Items for Autoclaving

Although autoclaving provides an economical way of sterilizing and decontaminating items, not all material can be autoclaved. Some materials present specific hazards when they are autoclaved, generating toxic or noxious gas. To help you identify what may or may not be autoclaved, a general list of items has been included in this guideline.

Items that **CAN** be autoclaved are:

- Cultures and stocks of infectious material
- Culture dishes and related devices
- Discarded live and attenuated vaccines
- Contaminated solid items such as petri dishes, eppendorf tips, pipettes, gloves, paper towel
- Items for sterilization such as glassware, media, aqueous solutions, equipment

Items that **CAN NOT** be autoclaved are:

- Materials containing solvents, volatile compounds, chlorinated compounds (HCl, bleach) or corrosive chemicals (phenol, trichloroacetic acid, ether, chloroform), etc.
- Material contaminated with chemotherapeutic agents
- Radioactive material
- Some plastics

Loading an Autoclave

Packaging Items for Autoclaving

Since the success of the decontamination/sterilization is dependent upon the penetration of heat, material preparation will greatly affect the outcome. Consideration must be given to the primary container (containing the contaminated waste), volume of liquid, amount of material and the secondary container (containing the primary container).

The structural integrity of the container is an important consideration. Not all containers withstand the demands placed on them during the autoclave process. Desirable characteristics are heat resistance, good thermal conductivity, puncture-proof and imperviousness to water.

Good Choices:

- Borosilicate glass (Pyrex) has very low thermal expansion property and is therefore resistant to breaking due to heating
- Polypropylene (PP) and polycarbonate (PC) are heat-resistant plastics
- Stainless steel is a good heat conductor and thus facilitates sterilization

Poor Choices:

- Polystyrene (PS), polyethylene (PE) and high density polyethylene (HDPE) do not resist heat well.
- If there is a risk of materials melting, ensure they are placed in a secondary container that is resistant to heat.

Most containers will identify the type of plastics identified on the base of the container with the appropriate initials imprinted. (PP, PC, PS, PE, HDPE, LDPE...)

Primary Container

The primary container is the container that comes into direct contact with the contaminated material or fluid. This may include such items as: flasks or vials holding liquids (either media or infectious material), wrapping paper or muslin protecting instruments and biohazard bags containing waste.

This packaging must permit heat (steam) penetration, and ensure that pressure differentials are not created as this will result in breakage. This may be accomplished by using techniques such as:

- Loosening screw caps or using self venting caps
- Capping open containers for sterilization with aluminum foil
- Using envelope folds for wrapping kraft paper or muslin (this has the added benefit of protecting contents from contamination during the opening process)
- Opening plastic bags slightly prior to loading them into the autoclave

Do not place sealed containers in an autoclave!!

The classic autoclave bag is made of polypropylene (PP) and is strong and puncture-resistant. These bags come in a variety of sizes, with or without labeling. Although these are excellent qualities, there is a draw back; polypropylene does not have good steam permeability. To facilitate the steam transfer, one may open the bag prior to autoclaving and add water to the contents to generate steam from within.

Volumes/Amounts

Since volume and density impact heat transfer and steam penetration, it is important not to fill the containers beyond the 75% of the holding capacity. Ideally, containers should only be half full, especially in the case of liquid media. This allows for liquid expansion and prevents overflow. Similarly with solid material, the additional available volume will allow the contents to shift during transfer into a secondary container, without spilling out of the bag. Avoid packing or compressing the contents, as this will restrict steam penetration.

Secondary Container (Trays)

The sides of the secondary container must be sufficiently high to contain any spill that may occur. Extreme care must be taken to ensure they are capable of withstanding the demands of the autoclave procedure. Aging of pans can often cause them to become brittle or to soften when heated.

Another advantage to using a secondary container is that it makes loading and unloading the autoclave much easier, as one only needs to lift one tray, rather than several items, out of the autoclave. This prevents burns and will be appreciated by other users who may need to remove the load from the autoclave. Feel free to use the trays in the autoclave room, but please return them clean and in a timely manner.

Use of Temperature Sensitive Tape

Temperature sensitive tape must be affixed to bags or items. When this tape has been exposed to high temperatures, lines will appear. Thus it may be used to indicate that the labeled material has been autoclaved. *It is not proof that the autoclave cycle was successful at decontaminating or sterilizing the contents***.** A biological indicator or other means must be used to act as a quality control validator. These tests are done and documented on a regular basis using a *Bacillus stearothermophilus* biological indicator [***Autoclave Efficacy Testing Template*** (Appendices)].

Loading an Autoclave

As much attention must be applied to loading the autoclave as was given to packaging. Again, the determining factor is ensuring heat/steam penetration. Therefore, care must be given to avoid overloading the chamber, placing bags in the chamber that are too large, or adding too much weight, which will tax the design elements of the autoclave. Consideration must also be given to ergonomic factors.

Conversely, users should do their best to use the autoclave efficiently by running as few loads as possible. For example, autoclave waste in one large batch, rather than in several small batches, or combine the load with those of other users. ***Items that are not required immediately should be put aside until there is a full load to run.***

Simple measures can be taken to ease the flow of heat and steam throughout and into the contents of the containers:

- Avoid crowding or stacking items,
- Ensure that containers do not touch each other; this will ensure all surfaces are sterilized.
- No items should touch the top or sides of the autoclave container as the container is pushed inside.
- Liquids and dry goods are processed separately as they require different cycle selections.
- A load of liquid-filled containers should be of similar size, shape, content and volume because exposure time is based on these characteristics.
- Run material to be sterilized separately from material to be decontaminated.

Operating an Autoclave

There are three cycles to choose from when using the autoclaves in LB 432.1:

Slow exhaust is used for sterilizing non-porous heat and moisture stabilized goods. These include liquids, media and solids such as laboratory waste. Slow exhaust prevents boiling-over of super-heated liquids.

Fast exhaust is used for dry material, such as empty flasks, tubes and tips. Excess moisture can be removed from items by placing them in a low temperature drying oven (30 – 60 °C) for a short period of time.

Fast exhaust and dry is also for dry material, but usually only used for wrapped items.

Factors that will affect autoclave cycle times are:

- If the autoclave will be used for sterilization or decontamination
- Manufacturer's recommendation for media sterilization
- If the material is primarily solid or liquid
- Volume of liquid
- Shape and size of containers used
- Thermal conductivity properties of the container
- Viscosity of the liquid
- Density of the material

To be effective, the autoclave must reach and maintain a temperature of 121-123 °C for at least 20 minutes. This is achieved by using saturated steam under at least 15 psi of pressure. However, if large volumes are being autoclaved, the sterilization time should be increased.

Unloading an Autoclave

The greatest risk of personal injury occurs during the process of unloading the autoclave. Not only is the risk of burns or scalding significant, but one may also be exposed to the vapours and gases generated by the inadvertent autoclaving of volatile chemicals. Super-heated liquids pose risk of exploding if they are shaken or moved during the cooling process. In addition, glassware can break if the autoclave door is opened too quickly, and sufficient time is not provided for them to cool down. *Extreme caution must occur during this final stage*.

Procedures to follow:

1. Wear all necessary personal protective equipment.
2. The chamber pressure gauge of the autoclave should be zero before opening the door.
3. Open door slightly and stand back to allow steam to escape. To minimize the risk of accidents caused by steam escape, the person who opens the autoclave door should stand directly behind it.
4. Slowly open autoclave door. Opening the autoclave door too quickly may result in broken glassware and/or steam burns to the skin.
5. If boiling or bubbling is present, wait until it subsides.
6. Bring the autoclave trolley to the chamber.
7. Using heat-resistant gloves, carefully transfer the containers (pans) to the trolley. Be careful not to jolt the containers as it could result in breakage.
8. After every use, it is advised to close the autoclave door but do not seal the door as this will shorten the life span of the rubber gaskets on the door.
9. Verify that the temperature sensitive tape has changed color, or that diagonal lines or the word “autoclaved” have appeared. If no change appears on the tape, the load is must be re-autoclaved after placing new tape on the material.
10. When the container is contaminated by a liquid splash (due to boil-over) or by direct contact with contents of the waste bag (such as melted agar), it should always be washed. DO NOT POUR MELTED AGAR DOWN THE DRAIN!

Disposing of Autoclaved Waste

Once the waste has been successfully autoclaved, the waste is no longer considered biohazardous. It may now be disposed of in the large covered garbage can in the autoclave room. Sterilized broken glass must be disposed in the Glass Discard container.

Mistakes in Autoclaving

A number of events (operator and mechanical) can cause the autoclave cycle to fail, but most failures tend to be directly related to packaging and loading. Autoclave cycle failure may result in re-autoclaving material, or in modifying the cycle conditions (length of exposure time or temperature). Unfortunately, lack of diligence during the autoclave process can be very costly in terms of:

- Personal injury
- Down time
- Lost experimental data
- Expensive and/or lengthy repairs
- Inappropriate disposal to landfill resulting in regulatory violation and an inquiry/fine

Typical mistakes:

- Not tightening the door completely
- Insufficient personal protective equipment (resulting in injury)
- Rushing (resulting in burns, spills, etc.)
- Inappropriate material selection (resulting in glassware breakage or unexpected or undesired melting of containers)
- Sealing containers (resulting in pressure buildup, explosions and lack of steam penetration)
- Lack of use of secondary containers (resulting in the chamber becoming contaminated)
- Over-filling containers (resulting in liquids boiling over and loss containment of solids)
- Poor loading practices (resulting in lack of steam penetration through the load)

References

"A Guideline for the Safe Use of Autoclaves", University of Ottawa, Environmental Health and Safety Service
www.uottawa.ca/services/ehss/docs/**autoclave**.pdf

Speaker, C. "Autoclave Safety", Penn State University, Environmental Health & Safety.
www.ehs.psu.edu/occhealth/autoclave/

Autoclave Efficacy Testing Template

Autoclave Efficacy Testing

Date	Location & Autoclave	Method Used	Results	Person Responsible

Appendix 14: Guidelines for Biological Safety Cabinet Use

Biological safety cabinets are vented cabinets which use a variety of combinations of high-efficiency particulate air (HEPA) filtration, laminar air flow and containment to provide protection to personnel, laboratory materials or the environment. They differ from chemical fume hoods due to the presence of HEPA filters and the laminar flow of air. Biological Safety Cabinets must not be used as chemical fume hoods.

The World Health Organization's (WHO) *Laboratory Biosafety Manual*, 2004, states that HEPA filters trap 99.97% of particles 0.3 µm in diameter and 99.99% of particles of greater or smaller size, so the use of biological safety ensures that microbe free exhaust air is discharged from the cabinet.

Choice of Cabinets

A variety of types of cabinets exist, and the cabinet chosen must be suited to the work proposed:

Clean Air Bench (Laminar Flow Hood) – These benches are used for product protection only, and do not protect the worker from aerosols or particulates from the work. HEPA-filtered air flows towards the worker. This is not a biological safety cabinet and should not be used as such.

Class I – Laminar air flow is directed away from the user and through a HEPA filter. These cabinets provide partial protection to the user and protection of the environment, but do not protect the product. Class I cabinets are suitable for some work procedures at Containment 1 and 2.

Class II – These cabinets provide protection to the worker, the work and the environment. There are different variations of Class II cabinets allowing for specialized purposes.

e.g. **Class II type A1 –** The air drawn into the cabinet is passed through a HEPA filter before flowing downwards towards the work surface. Additionally, the downward air captures the aerosol particles generated at the work surface, thereby providing the highest level of product protection.

Class III – These cabinets provide the highest level of personal protection and are typically used in containment Level 4 facilities. Supply air is filtered though two HEPA filters and the cabinet interior is kept under negative pressure. Access to the work area is through heavy duty rubber gloves.

The following table provided by the WHO's *Laboratory Biosafety Manual*, 2004, summarizes the selection of a biological safety cabinet by type of protection needed:

Type of Protection	Biological Safety Cabinet Selection
Personnel protection, biological substances in Risk Groups 1-3	Class I, Class II, Class III
Personnel protection, biological substances in Risk Group 4, glove-box laboratory	Class III
Personnel protection, biological substances in Risk Group 4, suit laboratory	Class I, Class II
Product protection	Class II, Class III only if laminar flow included
Volatile radionuclide/chemical protection, small amounts	Class IIB1, Class IIA2 vented to the outside
Volatile radionuclide/chemical protection	Class I, Class IIB2, Class III

Location of Cabinets

The following factors should be taken into account when locating Biological Safety Cabinets:

- The correct location of the cabinet will improve the efficiency of its operation. The cabinet should be located away from doors, windows, air supply registers and main traffic areas in the lab – air currents can disrupt the laminar flow characteristics inside the cabinet.
- Allow at least 30 cm of space on either side and behind the cabinet.
- A minimum of 40 cm should be available between the top exhaust filter and the ceiling to allow access for certification.
- Do not locate a cabinet directly under or adjacent to the room air supply.

Personal Protective Equipment

Personal protective equipment should be worn whenever using a biological safety cabinet:

- Laboratory coats
- Gloves pulled over the wrists of the coat rather than worn inside
- Masks and safety glasses may be required for some procedures

Use of Cabinets

If biological safety cabinets are use not properly, their protective benefits may be greatly reduced. The following rules must be considered and followed when using a biological safety cabinet:

Before Using the Cabinet

- Allow the blower to run at least five minutes.
- Turn off UV lamp; turn on fluorescent lamp.
- The number of movements across the front opening should be minimized by placing all necessary items into the cabinet prior to beginning manipulations.
- Do not block or cover the front intake grille with paper, equipment or other items.
- Disinfect work surfaces.
- Materials to be placed inside cabinet should be disinfected with 70% alcohol (WHO, 2004).
- All materials should be placed as far back in the cabinet as practical without blocking the rear grille.
- Aerosol generating equipment (e.g. mixers, centrifuges) should be placed towards the rear of the cabinet.
- Bulky items such biohazard bags and discard pipette containers should be placed inside and to one side of the interior cabinet.

Using the Cabinet

- Operators' arms should be moved in and out of the cabinet slowly, perpendicular to the front opening.
- Manipulations of materials within the cabinets should be delayed for about 1 minute after placing hands and arms inside.
- Do not use gas burners inside a Class II Biological Safety Cabinet – the flame will disrupt the laminar air flow.
- When a spill of biologically hazardous material occurs with a cabinet, cleanup should begin immediately, while the cabinet continues to operate.

After Completing Work

- Leave blower on at least five minutes.
- All items within the cabinet, including equipment, should be surface-decontaminated and removed.
- Decontaminate the cabinet with a disinfectant that will kill any microorganism that might be found inside the cabinet.
- Turn off the blower and fluorescent lamp; turn on UV lamp.

Ultraviolet Lights Inside of Cabinets

If UV lights are used to decontaminate the work surfaces inside a cabinet, the following points must be taken into consideration:

- The 253.7 wavelength has limited penetrating power, and is only effective against microbes in the air or on the work surface.
- The intensity of the lamp, and therefore, the ability of the lamp to sterilize, decreases with time.
- The intensity of the radiation decreases as the square of the distance of the lamp; therefore, exposure time required is related to the distance from the lamp.
- The lamp must be cleaned regularly.
- The UV light reflects off the cabinet surfaces and is a risk to persons working in or near the hood. Never operate the lamp if a worker is near the hood.

Spill Procedures

A copy of the laboratory's protocol for handling spills should be posted, read and understood by everyone who uses the laboratory.

Spills Inside a Biological Safety Cabinet

When a spill of biologically hazardous material occurs within a cabinet, cleanup should begin immediately, while the cabinet continues to operate. An effective disinfectant should be used and applied in a manner that minimizes the generation of aerosols. All items that come into contact with the spilled agent should be disinfected and/or autoclaved.

Small Hazardous Biological Spill (can be covered with a few paper towels)

1. All persons should immediately leave the affected area and allow aerosols to settle.
2. Any exposed person should seek **medical assistance immediately** (within **1-2 hours**) from a health care professional. The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday to Friday: (306) 337-2643.
3. The Laboratory Supervisor should be informed for cleanup assistance.
4. Wear gloves, a laboratory coat and eye/face protection.
5. Cover the spill with cloth or paper towels to contain it.
6. Spray or pour an appropriate disinfectant over the paper towels and the immediate surrounding area (generally, 5% bleach solutions are appropriate).
7. Start applying the disinfectant from the outside and move inwards.
8. After the appropriate amount of time (30 minutes; see MSDS), clear away any materials like broken glass using forceps or another mechanical device and place in a sharps container/biohazard container.
9. Clean and disinfect the area of the spillage using paper towels.
10. Place contaminated cleaning materials into a labeled, leak-proof, puncture-resistance waste disposal container and dispose of waste appropriately.

Potentially Hazardous Aerosol Release (Outside a Biological Safety Cabinet)

1. All persons should immediately leave the affected area and allow aerosols to settle.
2. Any exposed person should seek **medical assistance immediately** (within **1-2 hours**) from a health care professional. The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday - Friday: (306) 337-2643.
3. The Laboratory Supervisor *and* Biosafety Officer must be informed for cleanup assistance.
4. No one should enter the room for an appropriate amount of time (30 minutes), to allow for aerosols to be carried away and heavier particles to settle. If the laboratory does not have a central air exhaust system, entrance should be delayed (e.g. for 24 hours).
5. Signs should be posted indicating that entry is forbidden; post a sign stating "DO NOT ENTER, BIOHAZARD SPILL. Contact (name and phone #) for information."
6. After the appropriate amount of time, decontamination should proceed, supervised by the Biosafety Officer.
7. Appropriate personal protective equipment including respiratory equipment should be worn.
8. Complete an **Incident Report Form** and forward to Health, Safety & Environment within 24 hours.

Always contact Health, Safety & Environment (585-4776) before wearing a respirator for the first time. You must be Fit Tested.

Operation and Maintenance of Cabinets

- Biological Safety Cabinets must be certified annually to CSA standards by a qualified technician
- All repairs made on biological safety cabinets must be made by a qualified technician
- Any malfunction in the operation of a cabinet should be reported to the Biosafety Officer and repaired before the cabinet is to be used again
- The biological safety cabinet must be decontaminated before filter changes and before being moved
- Biological safety cabinets can be equipped with one of two kinds of alarms:
    - **Sash alarms** are found only on cabinets with sliding sashes. This alarm signifies that the operator has moved the sash to an improper position. Corrective action for this type of alarm is returning the sash to the proper position.
    - **Airflow alarms** indicate a disruption in the cabinet's normal airflow pattern. This alarm represents an immediate danger to the operator or product and when an airflow alarm sounds, work should cease immediately and the Laboratory Supervisor is notified.

Training

Training is absolutely required prior to using a biological safety cabinet. Not only will this minimize the risk of personnel being exposed to biologically hazardous substances, but is also essential for ensuring that the product is not contaminated. Training will also help minimize the risk of damage to the equipment. This guideline is one tool to assist in training. In addition, you must receive training specific to the biological safety cabinet you will be using.

Training will help promote:

- safety,
- research quality, and
- optimal use and care of equipment.

All Principal Investigators, Laboratory Instructors, and Supervisors should ensure that their staff and students receive adequate training. Contact the Biosafety Officer for more information.

Appendix 15: Guidelines for Safe Centrifuge Use

It is the responsibility of the Principle Investigators, Laboratory Instructors, and Supervisors to ensure that all centrifuge users are properly trained in the care and use of centrifuges and rotors.

All centrifuges that have manufacturers' rotor de-rating systems including ultracentrifuges, high speed centrifuges and high speed bench top centrifuges, must have an up-to-date record of the total hours of usage. This is essential to prevent rotor fatigue and other mechanical hazards. Each user log entry must include the User's Name; Date of Use; Sample Description; Number of Runs; Run Time; Run Speed and Rotor Serial Number. The lab manager is responsible to de-rate the rotors according to the manufacturer's specification.

General Safety Measures

When using a centrifuge, follow these safety measures:

- The centrifuge should always be installed according to the manufacturer's specifications.
  - Do not locate the instrument near areas containing flammable reagents or combustible fluids, or where vibration will cause items to fall off nearby shelves.
  - The centrifuge should be securely anchored by strong suction cups (bench top models), wheel brakes (floor models), etc. Movement of the instrument can damage parts and injure users.
- Proper selection, use and maintenance of rotors is critical to safe operation. Lack of care can lead to severe personal injury.
  - Use only rotors designed for the specific centrifuge.
  - Inspect the rotor for signs of corrosion or cracking before using. If found, do not use the rotor, and inform the lab supervisor that the rotor is unusable.
  - Inspect the inter-lock system to ensure the cover cannot be opened while the rotor is spinning.
  - Never operate the rotor unless it is symmetrically loaded and balanced. Care is required to achieve this.
  - Never operate the rotor without the lid or cover closed or locked in place; if the lid cannot be locked, the machine must be removed from service.
  - Clean and disinfect rotors and sample cavities or cups after each use with non-corrosive solutions.
- Lack of proper sample management can result in exposure of the user to harmful materials.
  - Always use sample tubes or bottles designed for the particular rotor being used.
  - In general, samples should be capped to avoid generation of aerosols.
  - Nitrocellulose tubes should only be used when transparent and flexible. They must never be heated because of explosion possibility.
  - Plastic centrifuge tubes should be discarded after one cycle of ultracentrifugation.
  - When using radioactive, toxic or pathogenic materials, be aware of potential hazards associated with them in case of leakage during centrifugation. If leakage does occur, you may be exposed to particles dispersed in the air (aerosol).
- For safe use of the centrifuge:
  - Do not circumvent any of the safety features (such as lid closure override switches).
  - Do not lean or place items on the instrument while it is running.
  - Do not leave the centrifuge until full operating speed is obtained and the instrument appears to be running normally without vibration.
  - If vibration occurs, stop the run immediately; wait until the rotor stops, and check the load balances.
  - In event of a power failure, do not try to open the lid to retrieve samples for a least one hour. After the rotor has stopped, follow the instructions in the manual for recovery of the samples.
- In general:
  - Always leave the drum of the centrifuge clean; wipe up any spills or aerosols. Do not use a bottle brush to clean the cavities of a rotor, as it may scratch the rotor, and allow corrosion to start.

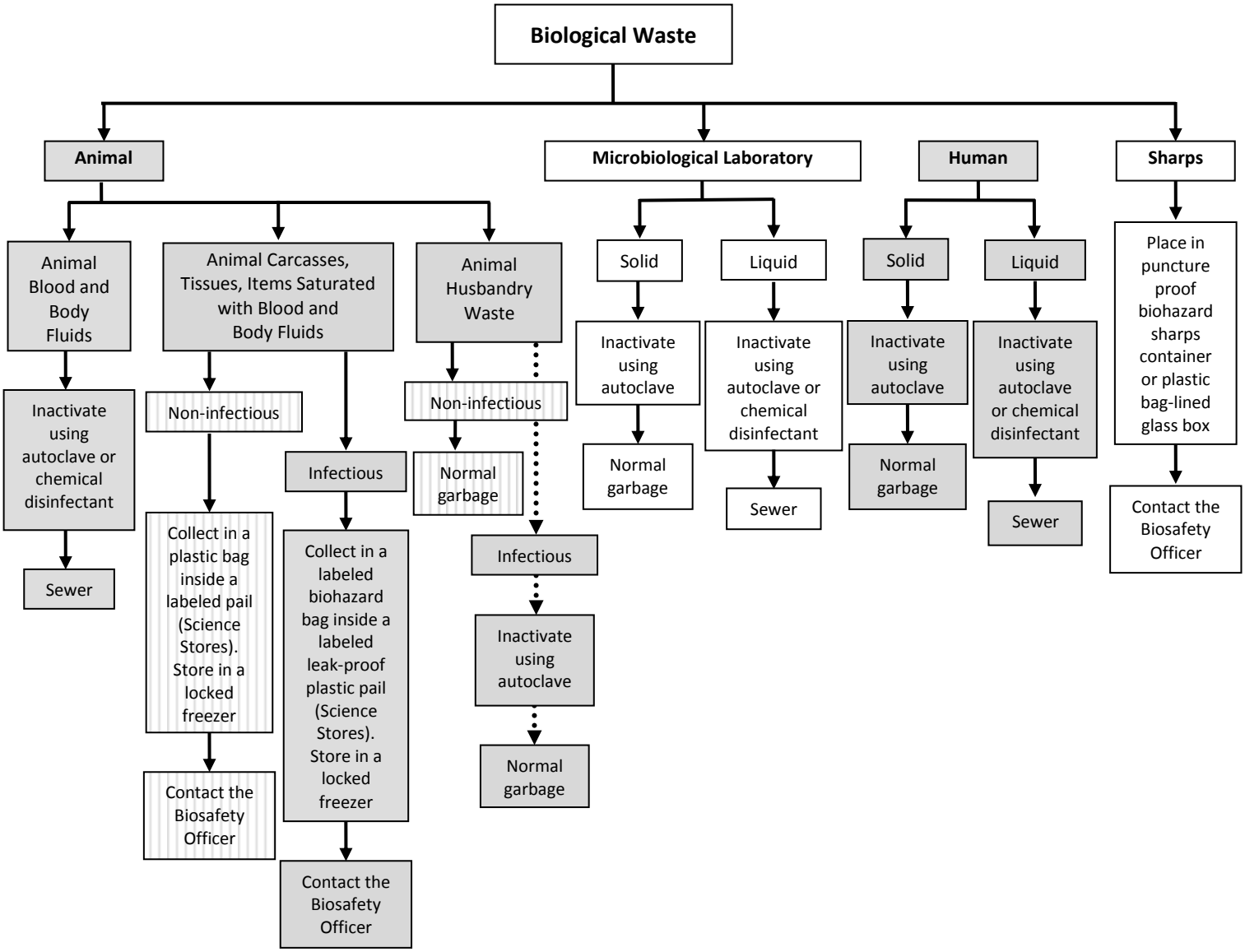
Breakage of Tubes in Centrifuges

1. If breakage occurs or is suspected while the machine is running, the motor should be switched off and machine left closed for about 30 minutes to allow for substance settling.
2. If breakage is discovered after the machine has stopped, immediately close the lid and leave closed for about 30 minutes.
3. The Laboratory Supervisor and Biosafety Officer must be informed at once for cleanup assistance.
4. Appropriate personal protective equipment must be donned; strong, thick rubber gloves covered with disposable gloves should be worn at all times.
5. Forceps or cotton held in forceps should be used to retrieve all glass debris.
6. All broken tubes, glass fragments, buckets, trunnions and the rotor should be placed in a non-corrosive disinfectant known to be active against the biologically hazardous materials or organisms concerned [see ***Disinfectants*** *(Appendices*)].
7. Unbroken, capped tubes may be placed in disinfectant in a separate container and recovered.
8. The centrifuge bowl should be swabbed with the disinfectant twice, washed with water, and dried.
9. Complete an **Incident Report Form** and forward to Health, Safety & Environment within 24 hours.

Appendix 16: Biological Waste Disposal Flowchart

Most laboratory wastes and disposable wares that have not been in contact with biologically hazardous materials or organisms do not have to be treated before disposal in the regular garbage. However, microbiological laboratory, animal, human and sharps waste disposal has additional procedures. Below is a quick reference biological waste disposal flowchart outlining special and additional waste procedures required prior to waste disposal.

*Modified from University of Saskatchewan's Biosafety Manual, 2006



Appendix 17: Biological Waste Disposal Standard Operating Procedures

Animal Waste Disposal

Animal Blood and Body fluids (Non-Infectious)

The *Saskatchewan Biomedical Waste Management Guidelines*, 1998, outlines the following procedures for disposal of animal blood and body fluids:

1. Wear gloves and other appropriate personal protective equipment, including face and eye protection if appropriate.
2. Slowly pour appropriate amount of disinfectant (see MSDS and Manufacturer's directions) into the container holding the liquid biological waste.
3. Allow appropriate contact time (10-30 minutes).
4. Slowly pour decontaminated waste down the sanitary sewer while being cautious to prevent the formation of aerosols or spills.

Animal Blood and Body fluids (Infectious)

The *Saskatchewan Biomedical Waste Management Guidelines*, 1998, outlines the following procedures for disposal of infectious animal blood and body fluids:

1. Wear gloves and other appropriate personal protective equipment, including face and eye protection if appropriate.
2. Slowly pour appropriate amount of disinfectant (see MSDS and Manufacturer's directions) into the container holding the liquid biological waste.
3. Allow appropriate contact time (30 minutes).
4. Slowly pour decontaminated waste down the sanitary sewer while being cautious to prevent the formation of aerosols or spills.
5. The Laboratory Supervisor must be informed at once for cleanup and exposure assistance.

Any exposed person should seek **medical assistance immediately** (within **1-2 hours**)
from a health care professional.
The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday-Friday: (306) 337-2643.

Animal Materials (Non-Infectious)

e.g. carcasses, tissues, organs, items saturated with animal blood and body fluids, etc.

All animal materials *must* be incinerated to abide by Provincial and Municipal regulations.

The *Saskatchewan Biomedical Waste Management Guidelines*, 1998, outlines the following procedures for disposal of non-infectious animal materials:

1. Wear gloves and other appropriate personal protective equipment, including face and eye protection if appropriate.
2. No other types of waste should be mixed or included with animal non-infectious wastes - i.e. no highly combustible materials (e.g. culture plates, gloves, test tubes).
3. Place animal material in plastic bag-lined biohazard waste pail (obtained from Science Stores). Keep weight of the pail below 20 kg. Label pail appropriately!!
4. Once pail is full, tie off bag and tuck inside pail before securing pail lid.

5. This pail should be stored in a freezer/refrigerator until the day of pick-up. Storage areas should be totally enclosed and contain no other materials except for other wastes.
6. Facilities refrigerating or freezing animal waste should use a lockable, closed storage facility or lockable, domestic-type freezer unit.
7. The animal wastes should be packaged and transported to the incinerator in accordance with *Transportation of Dangerous Goods Regulations*, except the containers do not need to be colour-coded. Contact the Biosafety Officer for more information.

Animal Materials (Infectious)

e.g. carcasses, tissues, organs, items saturated with animal blood and body fluids, etc.

All animal materials *must* be incinerated to abide by Provincial and Municipal regulations.

The *Saskatchewan Biomedical Waste Management Guidelines*, 1998, outlines the following procedures for disposal of infectious animal materials:

1. Wear gloves and other appropriate personal protective equipment, including face and eye protection if appropriate.
2. No other types of waste should be mixed or included with infectious animal wastes - i.e. no highly combustible materials (e.g. culture plates, gloves, test tubes).
3. Place animal material in plastic bag-lined biohazard waste pail (obtained from Science Stores). Keep weight of the pail below 20 kg. Label pail appropriately!!
4. Once pail is full, tie off bag and tuck inside pail before securing pail lid.
5. This pail should be stored in a freezer/refrigerator until the day of pick-up. Storage areas should be totally enclosed, contain no other materials except for other wastes, and restricted access to authorized personnel only.
6. Facilities refrigerating or freezing animal waste must use a lockable, closed storage facility or lockable, domestic-type freezer unit identified as containing biohazardous waste with biohazard symbol clearly displayed.
7. The animal wastes should be packaged and transported to the incinerator in accordance with *Transportation of Dangerous Goods Regulations*. Contact the Biosafety Officer for more information.

Any exposed person should seek **medical assistance immediately** (within **1-2 hours**)
from a health care professional.
The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday-Friday: (306) 337-2643.

Animal Husbandry Waste (Non-Infectious)

e.g. bedding, waste feed, litter, etc.

1. Waste that is not contaminated with radioactivity, chemicals or biologically hazardous substances can be directly disposed of into a regular garbage bin.

Animal Husbandry Waste (Infectious)

e.g. bedding, waste feed, litter, etc.

1. Wear gloves and other appropriate personal protective equipment, including face and eye protection if appropriate.
2. No other types of waste should be mixed or included with infectious animal wastes.

3. Place animal waste in a biohazard/autoclave bag.
4. Inactivate waste by autoclave. Inactivated waste can be treated as non-infectious and can be directly disposed of into a regular garbage bin.

Any exposed person should seek **medical assistance immediately** (within **1-2 hours**) from a health care professional.
The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday-Friday: (306) 337-2643.

Microbiological Laboratory Waste Disposal

Non-Contaminated Solid Waste

e.g. laboratory cultures, weigh boats, gloves, paper towels, absorbent pads, bench top covers, plastic products (tubes, flasks, petri dishes), etc.

1. Wear gloves and other appropriate personal protective equipment if appropriate.
2. Must be placed into plastic bags (not in a biohazard bag) and closed/tied.
3. Waste can be disposed of into the regular garbage bins.

Contaminated Solid Waste

e.g. laboratory cultures, weigh boats, gloves, paper towels, absorbent pads, bench top covers, plastic products (tubes, flasks, petri dishes), etc.

The Regina Waste Management Bylaw, 2002, and the *Saskatchewan Biomedical Waste Management Guidelines*, 1998, outline the following procedures for disposal of contaminated laboratory waste:

1. Wear gloves and other appropriate personal protective equipment, including face and eye protection if appropriate.
2. No other types of waste should be mixed or included with contaminated solid wastes.
3. Place contaminated waste in a biohazard/autoclave bag.
4. Inactivate waste by autoclave. Inactivated waste can be treated as decontaminated and can be directly disposed of into a regular garbage bin. Biohazard symbols must be defaced.

Any exposed person should seek **medical assistance immediately** (within **1-2 hours**) from a health care professional.
The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday-Friday: (306) 337-2643.

Non-Contaminated Liquid Waste

e.g. laboratory cultures, stocks or specimens, live or attenuated vaccines, human or animal cell cultures

The Regina Waste Management Bylaw, 2002, and the *Saskatchewan Biomedical Waste Management Guidelines*, 1998, outline the following procedures for disposal of liquid laboratory waste:

1. Wear gloves and other appropriate personal protective equipment, including face and eye protection if appropriate.
2. Slowly pour appropriate amount of disinfectant (see MSDS and Manufacturer's directions) into the container holding the liquid biological waste.

3. Allow appropriate contact time (10-30 minutes).
4. Slowly pour decontaminated waste down the sanitary sewer while being cautious to prevent the formation of aerosols or spills.

Contaminated Liquid Waste

e.g. laboratory cultures, stocks, or specimens, live or attenuated vaccines, human or animal cell cultures

The Regina Waste Management Bylaw, 2002, and the *Saskatchewan Biomedical Waste Management Guidelines*, 1998, outline the following procedures for disposal of liquid laboratory waste:

1. Wear gloves and other appropriate personal protective equipment, including face and eye protection if appropriate.
2. Slowly pour appropriate amount of disinfectant (see MSDS and Manufacturer's directions) into the container holding the liquid biological waste.
3. Allow appropriate contact time (10-30 minutes).
4. Slowly pour decontaminated waste down the sanitary sewer while being cautious to prevent the formation of aerosols or spills.

Any exposed person should seek **medical assistance immediately** (within **1-2 hours**)
from a health care professional.
The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday-Friday: (306) 337-2643.

Human Waste Disposal

Human Blood and Body Fluids

The Regina Waste Management Bylaw, 2002, and the *Saskatchewan Biomedical Waste Management Guidelines*, 1998, outline the following procedures for disposal of human blood and body fluids:

1. Wear gloves and other appropriate personal protective equipment, including face and eye protection if appropriate.
2. Slowly pour appropriate amount of disinfectant (see MSDS and Manufacturer's directions) into the container holding the liquid biological waste.
3. Allow appropriate contact time (10-30 minutes).
4. Slowly pour decontaminated waste down the sanitary sewer while being cautious to prevent the formation of aerosols or spills.
5. The Laboratory Supervisor must be informed at once for cleanup and exposure assistance.

Any exposed person should seek **medical assistance immediately** (within **1-2 hours**)
from a health care professional.
The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday-Friday: (306) 337-2643.

Human Blood and Body Solid Waste

The Regina Waste Management Bylaw, 2002, and the *Saskatchewan Biomedical Waste Management Guidelines*, 1998, outline the following procedures for disposal of human blood and body fluids:

1. Wear gloves and other appropriate personal protective equipment, including face and eye protection if appropriate.
2. No other types of waste should be mixed or included with contaminated solid wastes.

3. Place contaminated waste in a biohazard/autoclave bag.
4. Inactivate waste by autoclave. Inactivated waste can be treated as decontaminated and can be directly disposed of into a regular garbage bin. Biohazard symbols must be defaced.

Any exposed person should seek **medical assistance immediately** (within **1-2 hours**) from a health care professional.
The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday-Friday: (306) 337-2643.

Disposal of Sharps Contaminated With Biological Material

The Regina Waste Management Bylaw, 2002, and the *Saskatchewan Biomedical Waste Management Guidelines*, 1998, outline the following procedures for disposal of sharps:

1. Wear gloves and other appropriate personal protective equipment, including face and eye protection if appropriate.
2. No other types of waste should be mixed or included with contaminated sharps waste.
3. Place contaminated razor blades, needles, etc. in a puncture-proof biohazard sharps container. Only fill container until ¾ full.
4. Place contaminated broken glass in the plastic-lined glass disposal boxes.
5. Dispose of waste by contacting the Biosafety Officer.

Any exposed person should seek **medical assistance immediately** (within **1-2 hours**) from a health care professional.
The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday-Friday: (306) 337-2643.

Appendix 18: Biological Emergencies and Spills

Small Non-Hazardous Biological Spill (Spills that can be covered by a few paper towels)

1. All persons should inform other personnel in the affected area not to enter.
2. Wear gloves, a laboratory coat and other appropriate personal protective equipment, including face and eye protection.
3. Cover the spill with cloth or paper towels to contain it.
4. Spray or pour an appropriate disinfectant over the paper towels and the immediate surrounding area (generally, 1% bleach or 70% ethanol solutions are appropriate; see Appendices).
5. Start applying the disinfectant from the outside and move inwards.
6. After the appropriate amount of time (5-10 minutes), clear away any materials like broken glass using forceps or another mechanical device and place in a sharps container/biohazard container.
7. Clean and disinfect the area of the spillage using paper towels.
8. Place contaminated materials into a labelled, leak-proof, puncture-resistant waste disposal container and dispose of waste appropriately (see Appendices).

Large Non-Hazardous Biological Spill (> 500 ml)

1. All persons should inform other personnel in the affected area not to enter.
2. The Laboratory Supervisor and Biosafety Officer should be informed for cleanup assistance.
3. Wear gloves, a laboratory coat and other appropriate personal protective equipment, including face and eye protection.
4. Cover the spill with cloth, paper towels or other absorbent material to contain it.
5. Pour an appropriate disinfectant over the paper towels and the immediate surrounding area (generally, 1% bleach or 70% ethanol solutions are appropriate; see Appendices).
6. Start applying the disinfectant from the outside and move inwards.
7. After the appropriate amount of time (5-10 minutes), clear away any materials like broken glass using forceps or another mechanical device and place in a sharps container/biohazard container.
8. Clean and disinfect the area of the spillage using paper towels.
9. Place contaminated materials into a labelled, leak-proof, puncture-resistant waste disposal container and dispose of waste appropriately (see Appendices).
10. Complete an **Incident Report Form** and forward to Health, Safety & Environment within 24 hours.

Small Hazardous Biological Spill (Spills that can be covered by a few paper towels)

1. All persons should immediately leave the affected area and allow aerosols to settle.
2. Any exposed person should seek **medical assistance immediately** (within **1-2 hours**) from a health care professional. The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday - Friday: (306) 337-2643.
3. The Laboratory Supervisor should be informed for cleanup assistance.
4. Wear gloves, a laboratory coat and eye/face protection.
5. Cover the spill with cloth or paper towels to contain it.
6. Spray or pour an appropriate disinfectant over the paper towels and the immediate surrounding area (generally, 5% bleach solutions are appropriate).
7. Start applying the disinfectant from the outside and move inwards.
8. After the appropriate amount of time (30 minutes; see MSDS), clear away any materials like broken glass using forceps or another mechanical device and place in a sharps container/biohazard container.
9. Clean and disinfect the area of the spillage using paper towels.

10. Place contaminated cleaning materials into a labelled, leak-proof, puncture-resistant waste disposal container and dispose of waste appropriately.
11. Complete an **Incident Report Form** and forward to Health, Safety & Environment within 24 hours.

Large Hazardous Biological Spill (> 500 ml)

1. All persons should immediately leave the affected area and allow aerosols to settle.
2. Signs should be posted indicating that entry is forbidden; post a sign stating "DO NOT ENTER, BIOHAZARD SPILL. Contact (name and phone #) for information."
3. Any exposed person should seek **medical assistance immediately** (within **1-2 hours**) from a health care professional. The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday - Friday: (306) 337-2643.
4. The Laboratory Supervisor *and* Biosafety Officer should be informed for cleanup assistance.
5. Wear gloves, a laboratory coat and eye/face protection. Consider disposal foot coverings and appropriate respirators.
6. Cover the spill with cloth or paper towels to contain it.
7. Spray or pour an appropriate disinfectant over the paper towels and the immediate surrounding area (generally, 5% bleach solutions are appropriate).
8. Start applying the disinfectant from the outside and move inwards.
9. After the appropriate amount of time (30 minutes; see MSDS), clear away any materials like broken glass using forceps or another mechanical device and place in a sharps container/biohazard container.
10. Clean and disinfect the area of the spillage using paper towels.
11. Place contaminated cleaning materials into a labelled, leak-proof, puncture-resistant waste disposal container and dispose of waste appropriately.
12. Complete an **Incident Report Form** and forward to Health, Safety & Environment within 24 hours.

Potentially Hazardous Aerosol Release (Outside a Biological Safety Cabinet)

1. All persons should immediately leave the affected area and allow aerosols to settle.
2. Any exposed person should seek **medical assistance immediately** (within **1-2 hours**) from a health care professional. The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday - Friday: (306) 337-2643.
3. The Laboratory Supervisor *and* Biosafety Officer must be informed for cleanup assistance.
4. No one should enter the room for an appropriate amount of time (30 minutes), to allow for aerosols to be carried away and heavier particles to settle. If the laboratory does not have a central air exhaust system, entrance should be delayed (e.g. for 24 hours).
5. Signs should be posted indicating that entry is forbidden; post a sign stating "DO NOT ENTER, BIOHAZARD SPILL. Contact (name and phone #) for information."
6. After the appropriate amount of time, decontamination should proceed, supervised by the Biosafety Officer.
7. Appropriate personal protective equipment including respiratory equipment should be worn.
8. Complete an **Incident Report Form** and forward to Health, Safety & Environment with 24 hours.

Always contact Health, Safety & Environment (585-4776) before wearing a respirator for the first time. You must be Fit Tested.

Spills inside a Biological Safety Cabinet

When a spill of biologically hazardous material occurs within a cabinet, cleanup should begin immediately, while the cabinet continues to operate. An effective disinfectant should be used and applied in a manner that minimizes the generation of aerosols. All items that come into contact with the spilled agent should be disinfected and/or autoclaved.

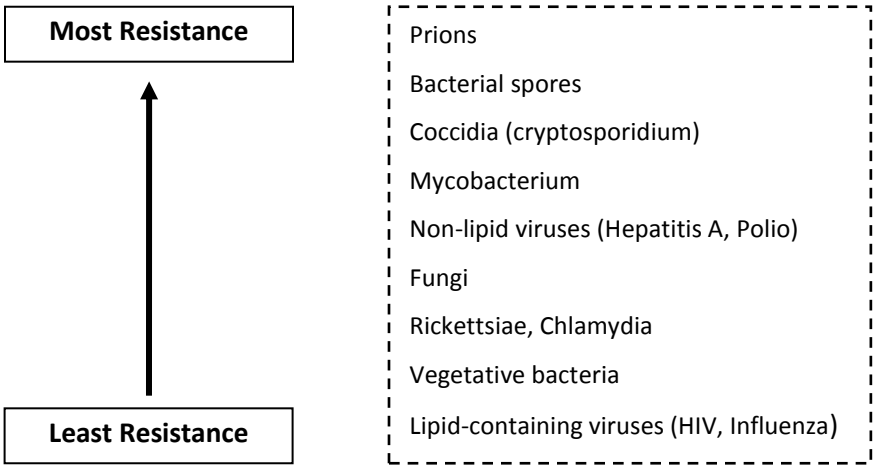
- Follow the above steps for a Hazardous Biological Spill.

Spilled Hazardous Substances and Broken Containers

1. All persons should immediately leave the affected area.
2. Any exposed person should seek **medical assistance immediately** (within **1-2 hours**) from a health care professional. The University of Regina Allied Health Center is open from 8:30 a.m.-5:00 p.m. Monday-Friday: (306) 337-2643.
3. The Laboratory Supervisor must be informed at once for cleanup assistance.
4. Wear gloves, a laboratory coat and eye/face protection.
5. Broken containers contaminated with infectious substances and spilled infectious substances should be covered with a cloth or paper towels. Care must be taken to avoid splashing or generating aerosols during the clean up.
6. Spray the site with the freshly prepared disinfectant (5% bleach dilution) and for larger spills make enough dilute disinfectant to pour into the spill puddle to double its size. Start applying the disinfectant from the outside and move inwards.
7. Leave the disinfectant on the surface for appropriate amount of time (30 minutes; see MSDS).
8. The cloth or paper towels and the broken material can then be cleared away; glass fragments should be handled with forceps or another mechanical device and placed in a sharps container/biohazard container.
9. The contaminated area should be cleaned with disinfectant.
10. If dustpans are used to clear away the broken material, they should be autoclaved or placed in an effective disinfectant.
11. Cloths, paper towels and swabs used for cleaning must be disposed of in a contaminated-waste container and waste disposed of appropriately.
12. If laboratory forms or other printed or written material are contaminated, the information should be copied onto another form and the original discarded into the contaminated-waste container.
13. Complete an **Incident Report Form** and forward to Health, Safety & Environment within 24 hours.

Appendix 19: Disinfectants

Many disinfectants can be harmful to humans or the environment; therefore, they should be selected, stored, handled, used and disposed of with care, following manufacturers' instructions. For personal safety, appropriate personal protective equipment (gloves, aprons and eye protection) is recommended when preparing dilutions of the disinfectant.



* Figure modified from University of Saskatchewan's Biosafety Manual, 2006

Comparison of Common Chemical Disinfectants

Legend: ● Active ⭘ Variable ○ Not Active

Name/Type	General Info	Used For	Effective Against	Directions for Use
Chlorine (sodium hypochlorite; household bleach)	- Fast-acting oxidant - Usually sold as bleach, which can be diluted with water to provide various concentrations - Highly alkaline and can be corrosive to metal	Used as a broad-spectrum disinfectant - General all-purpose laboratory disinfectant should have a concentration of 1 g/l available chlorine (WHO, 2004) - 5 g/l available chlorine concentration is recommended for cleaning biohazardous spillage and in the presence of large amounts of organic matter - Bleach is not recommended by the WHO to be used as an antiseptic, but may be used as a general all-purpose laboratory disinfectant, and for soaking contaminated metal-free materials	Vegetative Bacteria ● Lipid Viruses ● Nonlipid Viruses ● Mycobacteria ● Fungi ● Bacterial Spores ⭘	- Chlorine gas is toxic, so bleach must be stored and used in well-ventilated areas - Bleach must not be mixed with acids or other chemicals to prevent the release of harmful chlorine by-products - Activity is reduced by organic matter and a freshly (daily-weekly) made dilution is required - Household bleach contains approximately 50 g/l available chlorine so should be diluted 1:50 or 1:10 to obtain a working concentration of 1 g/l and 5 g/l, respectively

Name/Type	General Info	Used For	Effective Against	Directions for Use
Alcohol (ethanol, isopropanol)	- Does not leave residue on treated items - Alcohol may harden rubber and some glue types	- 70 % (v/v) of ethanol can be used on skin, laboratory work surfaces (benches, biosafety cabinets), and to soak small pieces of surgical instruments - Alcohol-base hand rubs can be used for the decontamination of lightly soiled hands where hand washing is not possible or inconvenient - Mixtures with other agents (formaldehyde (100 g/l), chlorine (2 g/l)) are more effective than alcohol alone	Vegetative Bacteria ● Lipid Viruses ● Nonlipid Viruses ◘ Mycobacteria ● Fungi ● Bacterial Spores ○	- Highest effectiveness is used at ~70% (v/v) in water - Alcohols are volatile and flammable and must not be used near open flames - Alcohol will evaporate so alcohols need to be properly stored
Phenolic compounds (Triclosan and chloroxylenol)	- Safe for skin and mucous membranes - Safety concerns: In lab studies, bacteria made resistant to low concentrations of triclosan also show resistance to certain types of antibiotics	- Used for the decontamination of environmental surfaces and some are among the more commonly used antiseptics (e.g. triclosan and chloroxylenol) - Triclosan is common in hand-washing products - Not recommended for use of food contact surfaces and in areas with young children	Vegetative Bacteria ● Lipid Viruses ● Nonlipid Viruses ◘ Mycobacteria ◘ Fungi ◘ Bacterial Spores ○	- Some phenolic compounds could be inactivated by water hardness and therefore must be diluted with distilled or deionized water - May be absorbed by rubber
Quaternary ammonium compounds (benzalkonium chloride; Lysol)	- Often used as mixtures in combination with other germicides, such as alcohols - Low biodegradability - may accumulate in the environment	- Benzalkonium chloride is used as an antiseptic	Vegetative Bacteria ● Lipid Viruses ● Nonlipid Viruses ◘ Mycobacteria ○ Fungi ◘ Bacterial Spores ○	- Germicidal activity reduced by organic matter, water hardness, and anionic detergents (soaps) - Potentially harmful bacteria can grow in quaternary ammonium compound solutions

Name/Type	General Info	Used For	Effective Against	Directions for Use
Hydrogen peroxide and peracids	- Like chlorine, hydrogen peroxide and peracids are strong oxidants - Safer to humans and the environment - Hydrogen peroxide can be corrosive to metals such as aluminum, copper, brass and zinc - Can decolourize fabrics, hair, skin, and mucous membranes	- Potent broad-spectrum germicide - 3-6% solutions are relatively slow and limited - Hydrogen peroxide can be used for the decontamination of work surfaces of laboratory benches and biosafety cabinets - Stronger concentrations may be suitable for disinfecting heat-sensitive devices	Vegetative Bacteria ● Lipid Viruses ● Nonlipid Viruses ● Mycobacteria ● Fungi ● Bacterial Spores ●	- Hydrogen peroxide is supplied as a ready-to-use 3% or as an aqueous 30% solution that needs to be diluted 5-10 times its volume with sterilized water - Articles treated must be thoroughly rinsed - Should be stored away from heat and protected from light
Formaldehyde	- A gas which is slow-acting and needs a humidity level of ~70% - A suspected carcinogen and is a dangerous, irritating gas with a strong smell	- Decontamination & disinfection of biological safety cabinets and rooms - May be used as a liquid disinfectant	Vegetative Bacteria ● Lipid Viruses ● Nonlipid Viruses ● Mycobacteria ● Fungi ● Bacterial Spores ●	- Supplied as paraformaldehyde or formalin which is heated to liberate the gas - Must be stored and used in a fume-hood or well-ventilated area - Chemical safety regulations must be followed
Glutaraldehyde	- Non-corrosive - Fast-acting but takes several hours to kill bacterial spores - Supplied as a solution with a concentration of 20 g/l (2%) - Toxic and an irritant so contact must be avoided	- Not recommended as a spray or solution for the decontamination of environmental surfaces	Vegetative Bacteria ● Lipid Viruses ● Nonlipid Viruses ● Mycobacteria ● Fungi ● Bacterial Spores ●	- Activated solution (by addition of a bicarbonate compound supplied with the product) can be reused for 1-4 weeks depending on the type and frequency of use - Should be discarded if it becomes turbid - Must be used in a fume-hood or well-ventilated area - Chemical safety regulations must be followed - Some products may need to be activated before use

Name/Type	General Info	Used For	Effective Against	Directions for Use
Iodine and Iodophors	- Iodine can stain fabrics and environmental surfaces - Iodine can be toxic	- Iodine is generally unsuitable for use for laboratory disinfectant - Iodophors are good antiseptics - Polyvidone-iodine is a reliable and safe surgical scrub and preoperative skin antiseptic	Vegetative Bacteria ● Lipid Viruses ● Nonlipid Viruses ● Mycobacteria ○ Fungi ○ Bacterial Spores ○	- Action similar to chlorine, but slightly less inhibited by organic matter - Iodine should not be used on aluminum or copper - Organic iodine-based products must be stored at 4-10C to avoid the growth of potentially harmful bacteria

* Data compiled from numerous sources including the World Health Organization's *Laboratory biosafety guidelines,* 2004, University of Saskatchewan's *Biosafety Manual*, 2006, and Arizona State's *Biosafety Manual*, 2010.

Appendix 20: Emergency Exposure or Suspected Exposure Procedures

Needle Stick Poke, Puncture Wound, or Percutaneous Injury

1. Remove gloves and allow the wound to bleed.
2. Immediately wash the affected area for 15 minutes with soap and warm water.
3. Notify Supervisor (if available) to obtain assistance.
4. Seek **medical assistance immediately** (within **1-2 hours**) from a health care professional. The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday - Friday: (306) 337-2643. The cause of the wound and organisms involved should be reported.
5. Details of the incident must be documented using the ***Incident Report Form*** and forwarded to Health, Safety & Environment within 24 hours. Please include the following details:
   a) What was the method of contact (e.g. needle stick, splash)?
   b) How did the exposure occur?
   c) What known biological agents or body fluids were you in contact with?
   d) What action was taken in response to the exposure to remove the contamination (e.g. hand washing)?
   e) What personal protective equipment was being used at the time of exposure?
   f) What is your immune status (e.g. Tetanus, Hepatitis A or B Virus)?

Eyes or Mucous Membrane Exposure (e.g. Splash)

1. Immediately flush the affected area for 15 minutes using an eyewash or shower.
2. Notify Supervisor (if available) to obtain assistance.
3. Seek **medical assistance immediately** (within **1-2 hours**) from a health care professional. The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday - Friday: (306) 337-2643. The organisms involved should be reported.
4. Details of the incident must be documented using the ***Incident Report Form*** and forwarded to Health, Safety & Environment within 24 hours. Please include details as listed above.

Ingestion

1. Protective clothing should be removed.
2. Notify Supervisor (if available) to obtain assistance.
3. Seek **medical assistance immediately** (within **1-2 hours**) from a health care professional. The University of Regina Allied Health Center is open from 8:30 a.m. - 5:00 p.m. Monday - Friday: (306) 337-2643.
4. Identification of the material ingested and circumstances of the incident should be reported.
5. Details of the incident must be documented using the ***Incident Report Form*** and forwarded to Health, Safety & Environment within 24 hours. Please include details as listed above.

Appendix 21: Zoonosis Awareness

Personnel working with animals may encounter a variety of unique biological hazards, including allergies, asthma, skin irritations, and zoonoses. A zoonosis is an animal disease or an infection that can be transmitted to humans. Specific animal parasites, bacteria, fungi, viruses and pria, outlined below, have been found to cause zoonoses. Furthermore, not only can personnel acquire infections or diseases directly from animals but they can be exposed to infectious agents from other contaminated personnel and equipment.

Introduction

The spread of zoonoses requires a source of an infectious agent (from an animal), a susceptible host (human), and a means of transmission. Zoonoses can be transmitted by various routes; thus, the University of Regina's *Biosafety Program* and duty/procedure specific President's Committee on Animal Care (PCAC) standard operating procedures must be followed to reduce the risk of exposure and illness.

There are a number of ways in which biologically hazardous substances can enter the body and cause infection and disease, including ingestion, inhalation, injection or absorption. The types of events that can lead to an infection or disease include, but are not limited to, exposure to infectious aerosols, spills and splashes, accidental needle stick injuries, cuts from sharps, bites and scratches from animals, oral pipetting, equipment accidents and secondary spread of biologically hazardous substances to non-laboratory areas. According to PHAC's *Laboratory Biosafety Guidelines* (2004), exposure to aerosols may be the greatest biohazard facing laboratory workers.

The Canadian Council on Animal Care's (CCAC) *Guide to the Care and Use of Experimental Animals*, 1993, indicates that zoonotic hazards may sporadically affect susceptible persons or animals. Persons potentially at higher risk are those who suffer from defective immune systems and those who are under severe stress or who have non-overt clinical disease. Caution should be exercised in assigning women of childbearing status to animal care duties that might expose them to potential or known teratogens.

Zoonoses

The following information has been adapted from the CCAC's *Guide to Care and Use of Experimental Animals,* 1993, Appendix VII, *Zoonoses - Experimental Animals to Man* and supplemented using the Public Health Agency of Canada's online Pathogen Safety Data Sheets.

1. Bacterial Diseases

Disease/Infection in Human	Infectious Agent	Animal Hosts (Common) & Vectors	Mode of Transmission	Early Signs and Symptoms
Anthrax (Woolsorter's disease)	*Bacillus anthracis*	Wild and zoo animals (cattle, sheep, goats, horses, pigs). Vultures have been reported to spread the organism from one area to another. **Vectors:** Biting flies which had fed on infected animals.	Contact with infected animal tissues, contaminated hair, wool, hides or products made from them. By biting flies feeding on such animals. Inhalation of spores in contaminated soil areas, dried or processed skins, and hides of infected animals. Spores are resistant and remain viable for years in soil, dried or processed hides. Ingestion of contaminated undercooked meat.	Skin lesions becoming papular, then vesiculated and developing into a depressed eschar; respiratory distress, fever and shock with death shortly thereafter; abdominal distress followed by fever, septicemia.

Disease/Infection in Human	Infectious Agent	Animal Hosts (Common) & Vectors	Mode of Transmission	Early Signs and Symptoms
Brucellosis (Undulant fever, Malta fever, Bang's disease)	*Brucellosis suis, B. abortus, B. melitensis, B. ovis, B. canis*	Cattle, swine, goats, sheep, deer, caribou, elk, dogs and coyotes	Ingestion of raw milk or cheese from infected animals. Direct contact via skin abrasions and mucous membranes and in abattoirs. Inhalation. Risk factors: contact with infected animal tissues, blood, urine, vaginal discharge, aborted fetuses.	Systemic bacterial disease with acute or insidious onset. Intermittent fever, headache, weakness, sweating, chills, arthralgia; localized suppurative infections.
Campylobacteriosis	*Campylobacter fetus*	Cattle	Ingestion of organisms in food. Contact with infected animals.	Systemic infection in immunocompromised hosts; bacteremic illness, high fever; endocarditis, pericarditis, thrombophlebitis, meningoencephalitis.
Campylobacteriosis *(Campylobacter* enteritis, Vibrionic enteritis, Traveler's diarrhea)	*Campylobacter jejuni*	Swine, cattle, sheep, cats, dogs, other pets, rodents and birds, including poultry	Ingestion of organisms in undercooked food or in unpasteurized milk or water. Contact with infected pets (puppies and kittens), farm animals or infected infants. Cross-contamination from these sources to foods eaten uncooked or poorly refrigerated.	Acute enteric disease; diarrhea, abdominal pain, malaise, fever, nausea and vomiting; blood in association with mucus and WCBs present in liquid of foul-smelling stools; typhoidal-like syndrome, reactive arthritis; rare cases of febrile convulsions, Guillain-Barré syndrome and meningitis.
Chlamydiosis (Psittacosis, Parrot's Fever)	*Chlamydia psittaci*	Cattle, swine, parakeets, parrots, pigeons, turkeys, ducks, other birds and other misc. animals. Infections have occurred through contact with infected domestic mammals, but this is relatively uncommon.	Inhalation of the agent from desiccated droppings and secretions of infected birds. Direct contact with infected birds; relatively uncommon infections have occurred through contact with infected domestic mammals. Bite from an infected bird.	Fever, headache, myalgia, chills, upper or lower respiratory tract disease, pneumonia, lethargy, anorexia, encephalitis.
Colibacillosis	*Escherichia coli*	Cattle, swine, poultry and other misc. animals	Ingestion	Systemic infections; bacteremia progresses to septicemia and death, or the infection extends to serosal surfaces, pericardium, joints and other organs.

Disease/Infection in Human	Infectious Agent	Animal Hosts (Common) & Vectors	Mode of Transmission	Early Signs and Symptoms
Leptospirosis (Weil's disease)	*Leptospira* spp.	Farm and pet animals, including cattle, dogs, horses, swine, rats and other rodents. Wild animals, including deer, squirrels, foxes, skunks, reptiles and amphibians. In Europe: field mice, voles, shrews and hedgehogs.	Indirect contact of the skin or mucous membranes with contaminated water, soil, or vegetation. Direct contact with urine or tissues of infected animals. Ingestion of contaminated food. Inhalation of droplet aerosols of contaminated fluids.	Fever, headache, chills, severe malaise, vomiting, myalgia and conjunctival suffusion; meningitis, rash and uveitis; jaundice, renal insufficiency, anemia and hemorrhage of the skin.
Pasturellosis (Shipping fever)	*Pasteurella multocida*, *P. hemolytica* and *P. pneumotropica*	Cats, dogs, rabbits, misc. mammals, and birds **Vectors:** Fleas, flies, cockroaches, mosquitoes	Animal bite or scratch (especially from cats and dogs). Inhalation of aerosols. Indirect wound contamination from infected tissues. Vector transmission by fleas, flies and cockroaches.	Localized infection such as cellulitis and abscess, osteomyelitis, arthritis, chronic pulmonary infections, bacteremia, meningitis, septicemia, otitis media, hepatic cirrhosis and peritonitis.
Plague	*Yersinia pestis*	> 200 mammalian species including: wild rodents (rats), lagomorphs (rabbits, hares) and carnivores **Vectors:** Wild rodent fleas, especially the oriental rat flea (*Xenopsylla cheopis*), and occasionally by human fleas (*Pulex irritans*)	Contact of rats, flea bites and domestic pets can carry plague-infected fleas. Handling of infected tissues. Airborne droplets from humans or pets. Careless manipulation of laboratory cultures. Person-to-person transmission by human fleas.	Bubonic plague with lymphadenitis occurring in lymph nodes and inguinal areas, fever, may progress to septicemic plague with dissemination by blood to meninges. Secondary pneumonic plague with pneumonia, mediastinitis, and pleural effusion.
Pseudotuberculosis	*Yersinia pseudotuberculosis*	Rodents, lagomorphs (rabbits and hares), pigeons, turkeys, canaries and other wild and domesticated birds and mammals (puppies, kittens, pigs)	Fecal-oral transmission by contact with infected persons or animals. Ingestion of food or drink fecally contaminated. Transmission by infected blood products has been reported.	Acute watery diarrhea, enterocolitis, acute mesenteric lymphadenitis mimicking appendicitis, fever, headache, pharyngitis, anorexia, vomiting, erythema nodosum, arthritis, iritis, cutaneous ulceration, hepatosplenic abscesses, osteomyelitis and septicemia.
Rat Bite Fever	*Spirillum moniliformis* and *Spirillum minus*	Rodents	Rodent bites and ingestion	Fever, headaches
Salmonellosis	*Salmonella* spp.	Farm animals, rodents, reptiles, amphibians, and other zoo and wild animals	Ingestion of food contaminated directly from infected animals or indirectly by infected animal or person. Contact by animal feeds and fertilizers prepared from contaminated meat scraps. Fecal-oral transmission from person to person. Inhalation.	Acute gastroenteritis with sudden onset of headache, abdominal pain, diarrhea, nausea and sometimes vomiting and septicemia, intravascular lesions, osteomyelitis, and meningitis

Disease/Infection in Human	Infectious Agent	Animal Hosts (Common) & Vectors	Mode of Transmission	Early Signs and Symptoms
Shigellosis (Bacillary dysentery)	*Shigella* spp.	Non-human primates	Direct or indirect fecal-oral transmission: poor hygiene practices spread infection to others by direct physical contact or indirectly by contaminating food and water, milk, cockroach, and fly-borne transmission may occur as the result of direct fecal contamination.	Acute disease of large and small intestine; diarrhea, fever, nausea, and sometimes toxemia, vomiting, cramps and tenesmus, stools contain blood, mucus and pus, alterations in consciousness, and mild and asymptomatic infections.
Tetanus	*Clostridium tetani*	Dogs, cats, and equine species	Tetanus spores introduced into the body through a wound, laceration or burn contaminated with soil, street dust or feces, or injected street drugs.	An acute disease induced by a neurotoxin: painful muscular contractions, primarily of neck muscles, secondarily of trunk muscles, abdominal rigidity, and generalized spasms.
Tuberculosis	*M. tuberculosis* *M. bovis*, and *M. avium*	Non-human primates, cattle, dogs, poultry, swine, and sheep	Inhalation. Direct exposure to airborne bacilli from sputum of infected persons. Direct invasion of mucous membranes or breaks in skin. Bovine tuberculosis from exposure to infected cattle (airborne, ingestion of raw milk or dairy products).	Tuberculin sensitivity appears in a few weeks and lesions commonly heal. May progress to pulmonary tuberculosis (fatigue, fever, cough, chest pain, hemoptysis fibrosis, cavitation) or extrapulmonary involvement (miliary, meningeal) by lymphohematogenous dissemination.
Tularemia (Rabbit Fever)	*Francisella tularensis*	Lagomorphs (rabbits and hares), wild rodents, birds, and dogs. **Vectors**: Ticks, deerflies, fleas, and mosquitoes	Inoculation of skin, conjunctival sac or oropharyngeal mucosa with blood or tissue while handling infected animals, or by fluids from infected flies, ticks or other animals; able to pass through unbroken skin. Bite of arthropods and ticks. Ingestion of contaminated food and drinking water. Inhalation of contaminated dust. Rarely through bites of animals.	Indolent ulcer at site of infection, swelling of the regional lymph nodes (ulceroglandular); sudden onset of pain and fever.

2. Rickettsial Diseases

Disease/Infection in Human	Infectious Agent	Animal Hosts (Common) & Vectors	Mode of Transmission	Early Signs and Symptoms
Q fever, Query fever, Rickettsia	*Coxiella burnetii*	Cattle, sheep, and goats. **Vectors**: Ticks - several species (transmit C. burnetii to domestic animals but not to humans)	Airborne dissemination of rickettsiae in dust from contaminated premises. Direct contact with infected animals and their birth products (especially sheep), wool from sheep, straw, fertilizer and laundry of exposed persons. Ingestion of raw milk from infected cows has been responsible in some cases.	Acute febrile disease: sudden onset, chills, headache, weakness, malaise, severe sweats; pneumonitis, pericarditis, hepatitis, generalized infections.
Rickettsial pox	*Rickettsia akari*	Wild mice, rats, and voles. **Vectors**: Mites- Leponyssoides sanguineus	Mite bites	Skin lesion at the site of a mite bite associated with lymphadenopathy. Fever, sweats, headache, disseminated vesicular rash, may be confused with chickenpox.
Rocky Mountain Spotted Fever (RMSF), New World spotted fever, Tick-borne typhus fever, Sao Paulo fever	*Riskettsia rickettsia*	Wild rodents, rabbits, and dogs. **Vectors**: Ticks East and South USA - dog tick, Dermancentor variabilis; Northwest USA - wood tick, D.andersoni; Southwest USA - Lone Star tick, Amyblyomma americanum; Latin America - A. cajennense	Bite of an infected tick: several hours of attachment are required before the rickettsiae become reactivated to infect humans. Direct contamination of skin with crushed tissues or feces of tick.	Sudden onset with moderate to high fever, malaise, deep muscle pain, severe headache, chills, conjunctival injection, maculopapular rash appears on extremities 3rd day and spreads rapidly, and hemorrhages are common.
Asian tick fever	*Riskettsia siberica*	Wild mice and rats **Vectors**: Rat fleas	Flea bites from rat fleas, rat to rat spread by lice, and ingestion of contaminated food.	

3. Viral Diseases

Disease/Infection in Human	Infectious Agent	Animal Hosts (Common) & Vectors	Mode of Transmission	Early Signs and Symptoms
Marburg Disease, Ebola Hemorrhagic Fever	Filovirus	African green monkey (Macaca sp.)	Direct contact with monkey tissues	
South American and Korean Hemorrhagic fever	Hemorrhagic fever virus	Wild rodents (Mastomys ratalensis)	Direct contact with rodents and contact and contamination of food, etc. with rodent excreta	
Hepatitis A	Hepatitis A Virus	Marmosets (experimentally infected), chimpanzees, macaque monkeys, and owl monkeys	Person-to-person by faecal-oral route. Ingestion of contaminated food (i.e. shell fish) and water. Hands may play an important role in the	Many infections are asymptomatic, abrupt onset with fever, malaise, anorexia, nausea and abdominal

			direct as well as the indirect spread of HAV.	discomfort, followed within a few days by jaundice.
Herpes B Encephalitis, Herpes simiae, B virus	*Cercopithecine Herpes Virus 1*	Rhesus and other Macaca sp., Old World monkeys, rabbits, guinea pigs and mice	Monkey bite or by direct or indirect contact with/exposure to naked skin (broken or mucous membranes) to infected saliva, tissues, tissue fluid or monkey cell cultures. Splashes or droplets of infected fluids to eye. Aerosols exposure of CHV-1 is likely to be minimal. Human-to-human transmission has been documented in one case.	Acute, usually fatal, ascending encephalomyelitis, febrile onset with headache, vesicular skin lesions at site of exposure and variable neurological patterns.
Lymphocytic meningitis	*Lymphocytic choriomeningitis virus*	Rodents and numerous other mammals (monkeys)	Inhalation of infectious aerosolized particles of rodent urine, feces or saliva. Ingestion of food contaminated with virus, contamination of mucus membranes, skin lesions or cuts with infected body fluids. Congenital transmission. Tissue culture transmission	Biphasic febrile illness: mild influenza-like illness or occasionally, meningeal or meningoencephalomyeli-tic symptoms, transverse myelitis, a Guillain-Barre-type syndrome; orchitis or parotitis; infection asymptomatic in one third of individuals; temporary or permanent neurological damage is possible; pregnancy-related infection has been associated with abortion, congenital hydrocephalus, chorioretinitis and mental retardation.
Rabies	*Rabies virus*	All mammals with varying susceptibility. Urban rabies - dogs and cats. Sylvatic or rural rabies - wild carnivores and bats, with sporadic disease among dogs, cats and livestock. In USA and Canada - primarily foxes and raccoons and in Europe - foxes.	Virus-laden saliva of a rabid animal is introduced by a bite or rarely by a scratch (rarely into a fresh break in skin or through intact mucous membranes). Airborne spread demonstrated in caves and in laboratory setting.	Acute viral encephalomyelitis, invariably fatal after the onset of symptoms; onset with apprehension, behavioral changes, headache, fever, malaise and sensory changes referred to site of preceding animal bite wound; progresses to paresis or paralysis; spasm of muscles on attempts to swallow may lead to fear of water; delirium and convulsions; duration of 2 to 6 days.

4. Viral Diseases Spread by Arthropods (Arthropod-Borne Viruses)

Disease/Infection in Human	Infectious Agent	Animal Hosts (Common) & Vectors	Mode of Transmission	Early Signs and Symptoms
Tick-borne Hemorrhagic Fevers (various)	Asian arboviruses	Wild rodents, hares, wild-caught monkeys	Tick bites	Subtropical climate conditions favour cycle.
California Encephalitis	*California serogroup*	Wild rabbits and rodents. **Vectors:** Woodland mosquitoes - *Aedes triseriatus* (LaCrosse), Spring Aedes (Snowshoe hare) California serogroup	Bite of infective mosquitoes; viruses are transmitted between woodland mosquitoes and small animals - human infection is tangential.	Onset is abrupt, typically with a severe bifrontal headache, fever, vomiting, lethargy and convulsions; less frequently, there is only aseptic meningitis; fatalities and neurologic sequelae are rare.
Colorado Tick Fever	*Colorado tick fever virus*	Small mammals, ground squirrels, and *Deromyscus* spp. **Vectors:** Tick - *Dermacentor andersoni*	By bite of an infective tick; immature ticks acquire infection by feeding on infected viremic animals; ticks remain infected through the various moults and transmit virus to humans by feeding as adult ticks.	Acute febrile, often diphasic, dengue-like disease with infrequent rash; headache, chills, muscle pain, photophobia; brief remission followed by second bout of fever lasting 2-3 days; neutropenia, thrombocytopenia; occasional encephalitis, myocarditis, or hemorrhagic symptoms (especially in children); deaths are rare.
Eastern/Western Equine Encephalitis	*Eastern equine encephalitis virus* *Western equine encephalitis virus*	Horses, other animals, and birds. **Vectors:** EEE - *Culiseta melanura* (USA and Canada) (bird to bird) - *Aedes, Coquillettidia spp.* (bird or animal to humans). WEE - *Culex tarsalis* (Western USA and Canada) (major epidemic vector)	By the bite of infective mosquitoes	Acute inflammatory disease of short duration involving brain, spinal cord, and meninges; EEE mild cases often occur as febrile headache or aseptic meningitis; severe infections are marked by acute onset, headache, high fever, meningeal signs, stupor, disorientation, coma, tremors, occasional spastic convulsions and paralysis; up to 60% case fatality rate; WEE infections are asymptomatic or present as mild, nonspecific illness, mortality rate is about 3%.
Powassan Encephalitis, Arbovirus	*Powassan encephalitis virus*	Woodchuck, snowshoe hare, coyotes, foxes, raccoons, skunks, and	By the bite of infective ticks. Consumption of raw milk from certain infected animals.	Resembles mosquito-borne encephalitis clinically; acute

		domesticated cats and dogs. **Vectors:** Tick - *Ixodes cookei*, *Ixodes marxi, Ixodes spinipalpus*	Larval ticks ingest virus by feeding on rodents, sometimes other mammals and birds.	inflammatory disease of short duration involving parts of brain, spinal cord and meninges; asymptomatic and mild cases with febrile head ache or aseptic meningitis; severe infections with stupor, disorientation, coma, tremors, convulsions and spastic paralysis; high incidence of neurologic sequelae; 0.3 - 60% case fatality rate (highest case fatality rate among Arboviruses).
St. Louis Encephalitis, SEV, SELV, Mosquito-borne encephalitis, arbovirus, viral encephalitis	*St. Louis encephalitis*	Wild birds, other mammals. **Vectors:** Mosquitoes - *Culex* spp. - *C. pipiens, C. tarsalis, C, quinquefasciatus, and C. nigripalpus*	By bite of infective mosquitoes	Acute inflammatory disease of short duration involving brain, spinal cord and meninges; most infections are asymptomatic; severe infections marked by acute onset, headache, high fever, nausea, myalgia, and malaise, followed by meningeal signs, stupor, coma, convulsions and paralysis; children may develop urinary tract symptoms; severity increases with age, over 60 has the highest rate of acute encephalitis; fatality rate of 2-22%.
Venezuelan Equine Encephalitis, Venezuelan equine encephalomyelitis, VEE, Venezuelan equine fever, arbovirus	*Venezuelan equine encephalitis virus*	Horses. **Vectors:** Mosquitoes - *Culex (Melanoconion), Aedes, Mansonia, Psorphora, Haemogogus, Deinocerites, Sabethes, Anopheles*	Bite of infected mosquito. Laboratory infections by aerosols. No evidence of transmission from horses to humans.	Influenza-like manifestations; abrupt onset of severe headache, chills, fever, myalgia, retro-orbital pain, nausea and vomiting; conjunctival and pharyngeal injection; most infections mild with symptoms 3-5 days; some cases have diphasic fever, CNS involvement, encephalitis with disorientation, convulsions, paralysis, coma and death.

5. Fungal and Protozoa Diseases

Disease/Infection in Human	Infectious Agent	Animal Hosts (Common) & Vectors	Mode of Transmission	Early Signs and Symptoms
Balantidiasis, Balantidiosis, Balantidial dysentery	*Balantidium coli*	Nonhuman primates and pigs	Fecal-oral route. Ingestion of fecally-contaminated water.	Infection of colon characterized by diarrhea or dysentery; accompanied by abdominal colic, tenesmus, nausea, and vomiting with bloody and mucoid stools.
Coccidioidomycosis, Valley fever, Desert fever	*Coccidioides immitis*	Domestic animals, cattle. horses, sheep, swine, wild desert rodents and other animals	Inhalation of air-borne spores and fungus present in desert soil. Laboratory accidents involving cultures.	Systemic mycosis beginning as a respiratory infection; primary infection asymptomatic or influenza-like; 1/5 clinical cases develop erythema nodosum; rare progression to disseminated disease; progressive, frequently fatal granulomatous disease with lung lesions and abscesses throughout body. Meningitis common, 90% fatal if not treated.
Amebiasis, Amebic dysentery, Ameboma	*Entamoeba histolytica*	Non-human primates and dogs	Ingestion of fecally-contaminated water and food (raw vegetables) by fecally contaminated hands of food handlers.	Approximately 90% of most infections are asymptomatic, only evidence may be seroconversion; debilitated, pregnant or immunocompromised individuals may develop an abrupt onset of fever, severe abdominal cramps, profuse bloody diarrhea and tenesmus; complications include massive hemorrhage, peritonitis, amebomas and liver abscesses.
Giardiasis, *G. intestinalis, G. duodenalis*, giardia enteritis, Lambliasis, lamblia intestinalis, "beaver fever"	*Giardia intestinalis*	Non-human primates, dogs, beavers and other wild and domestic animals.	Person-to-person, faecal-oral route is most important. Infected food handlers. Ingestion of fecally-contaminated water and food found in soil and on surfaces.	Varies from asymptomatic in most individuals to a sudden onset of diarrhea with foul-smelling, greasy-looking stool that lacks mucous and blood; associated with abdominal cramps, bloating, fatigue and weight loss; restricted to upper small intestine

				with no invasion; normally illness lasts 1 - 2 weeks; chronic infections can last months to years.
Histoplamosis, *Ajecllomyces capsulatus*	*Histoplasma capsulatum*	Dogs, cats, cattle, horses, rats, skunks, opossums, foxes and other animals	Inhalation of fungi and may also grow in soil.	Systemic mycosis of varying severity with primary lesion in lungs; disease appears as a mild, flu-like respiratory illness with symptoms including malaise, fever, chest pain, dry or non-productive cough, headache, loss of appetite, shortness of breath, joint and muscle pain, chills; five clinical forms - asymptomatic, acute benign respiratory, acute disseminated, chronic disseminated, chronic pulmonary.
Toxoplasmosis, congenital toxoplasmosis, Toxoplasma infection	*Toxoplasma gondii*	Cats and other felines, most warm blooded animals and birds	Consuming undercooked infected meats (pork, mutton, and beef). Ingestion of infective oocysts in milk, food or water. Inhalation of oocysts. Transplacental. Contact with soil containing infected cat feces. Blood transfusions or organ transplantations. Transmitted to food by flies or cockroaches.	Most infections are asymptomatic; mild cases with a localized lymphadenopathy accompanied with fever, sore throat, rash, mimicking infectious mononucleosis in some individuals; immunocompromised host suffers from widespread dessimination of the infection with pneumonitis, myocarditis, and encephalitis; some immunocompetent individuals develop **severe symptoms; congenital cases can result in** abortion and stillbirth, live births may result in severe central nervous system involvement along with chorioretinitis; transplacental infection is least likely during 1st trimester.

Disease/Infection in Human	Infectious Agent	Animal Hosts (Common) & Vectors	Mode of Transmission	Early Signs and Symptoms
African Trypanosomiasis, African Sleeping Sickness	*Trypanosoma brucei* and other *Tyrpanasoma* spp.	Wild and domestic animals. **Vectors:** *Glossina palpalis, G. tachinoides, G. morsitans, G. pallidipes, G. swynnertoni, G. fuscipes*	By bite of infective tsetse fly of the genus *Glossina*: fly is infected by ingesting blood that carries trypanosomes, parasites multiply in fly for 12-30 days until infective form develops in salivary glands. Congenital transmission.	Systemic protozoal disease; infection occurs in three stages - chancre at primary tsetse fly bite site, hemolymphatic stage with fever, lymphadenopathy and pruritis, meningoencephalitic stage with invasion of the CNS causing intense headaches, somnolence, abnormal behaviour, loss of consciousness and coma; death may follow within a few months or several years; frequently fatal if untreated.
Family Trypanosomatidae, Leishmaniasis, Kala-azar	*Leishmania* **spp.:** *L. donovani, L. tropica, L. braziliensis, L. mexicana, L. Chagasi,*	Wild rodents, Canidae including domestic dogs. **Vectors:** Phlebotomine (sandflies)	By bite of infective female sandflies: sandfly is infected by ingesting protozoan from zoonotic reservoir. Congenital transmission from mother to child. Transmission from person to person. Blood transfusion.	*L. donovani* - chronic systemic disease characterized by fever (irregular with 2 daily peaks), hepatosplenomegaly; lymphadenopathy, anemia with leukopenia, and progressive emaciation and weakness; fatal if untreated; leishmanoid dermal lesions; cutaneous leishmaniasis. *Leishmania* spp. - local skin lesions, ulceration; self-limiting or progressive; mucocutaneous lesions in nasopharyngeal tissues can be fatal.

Prevention

Engineering Controls and Safe Work Practices

The most common hazards associated with laboratory and fieldwork animals are bites, transmission of disease and development of allergic reactions. Healthy animals may be infected with organisms which are pathogenic to humans. We are usually aware of hazards from animal bites and scratches, but harmful contact may also result from splashes of their body fluids onto our mucous membranes or into non-intact skin. The following measures must be used to reduce the risks from working with laboratory animals:

- Use appropriate equipment and techniques for handling or restraining animals.
- Use work procedures and handling methods designed to control the spread of aerosols. For example, perform animal manipulations within ventilated hoods when possible.
- Keep animal quarters and handling areas clean and hygienic.
- Use gloves, lab coats and other protective clothing and equipment to minimize contact with animal products such as hair, fur, dander, saliva and urine. Do not wear street clothes when working with animals.
- When possible, use an animal species or sex that is known to be less allergenic than others.
- Animal health must be monitored by qualified personnel, and sick or infected animals must be quarantined as required.
- Workers should be educated about animal-related allergies and ways of avoiding them. Those who have become sensitized to animals or develop allergic reactions should seek medical attention and counseling and must follow the requirements for reporting incidents.

Personal Protective Equipment

Personal protective equipment (PPE) - also known as barrier equipment - is used to prevent blood, body fluids, and other potentially infectious agents from making direct contact with an individual. The type and amount of PPE depends upon the task or activity performed. Remember: PPE is the least effective type of hazard control and the last resource to rely on**.** See **Section 12** for more information.

Appendix 22: Human Safety Considerations for Wildlife Use

The following section has been taken from the Canadian Council of Animal Care's *Guidelines on the Care and Use of Wildlife*, 2003. Please see the complete document for more information: www.ccac.ca/Documents/Standards/Guidelines/Wildlife.pdf

J. HUMAN SAFETY CONSIDERATIONS

Guideline 45:
Many species of wildlife are capable of inflicting serious injury or transmitting disease to persons handling them. Appropriate handling and restraint techniques should be used, and training in how to apply them should be provided to avoid injury to both animals and humans.

Investigators are responsible under occupational health and safety legislation for their own health and safety as well as that of their coworkers in the field. Investigators must ensure that the hazards to human health and safety when working with wild animals are clearly identified and communicated to the project personnel, and that training, written procedures and any necessary protective clothing and equipment are provided to ensure that personnel are protected against possible injury or exposure to potentially dangerous wild animals or their fluids and waste. Personnel should work in teams of at least two people in the field, especially when involved in physical or chemical restraint and handling of animals or other high risk situations. Appropriate physical and/or chemical restraint may be necessary to prevent injury to an animal and/or personnel. Investigators should maintain a record of any injuries incurred while handling wildlife in the field or in a holding facility. Applicable local regulations regarding the documentation and reporting of workplace injuries should be consulted. A record must be kept of all training given to staff with the date of the training and signature of the staff member.

1. Drug Hazards

Guideline 46:
The risks involved in using drugs for the capture and immobilization of wildlife must be identified and communicated to all personnel involved in the project. At least two people on the team should be trained in first aid and CPR (cardiopulmonary resuscitation), local medical authorities should be informed of the potential hazards, and an evacuation plan to medical facilities should be discussed prior to fieldwork.

Guideline 47:
Personnel using drugs for wildlife should have current training and inform other members of the team of the risks of human exposure. There should be adequate quantities of applicable reversal drugs on hand in the field if these exist.

Anesthesia of free ranging wildlife may place personnel at risk of injury. Injury can occur from animal attacks, capture equipment, or exposure to potent drugs. Every possible effort must be made to minimize the probability of human injury when undertaking chemical restraint and anesthesia of wildlife. It is the responsibility of the investigator to ensure that personnel have knowledge of current procedures with the subject species and thorough knowledge of the emergency care of personnel exposed to the pharmaceuticals involved. Training for those authorized to use immobilization drugs must include first aid and emergency procedures relevant to the region. Members of the field team must be familiar with and competent in such first aid procedures as may be required in an accidental exposure emergency. Because smaller volumes of drugs are more easily delivered via remote drug delivery systems, most drugs used for wildlife anesthesia are extremely potent and pose significant hazards to the people using them. This is especially true for the potent opioid drugs such as carfentanil, A3080, etorphine, and the potent alpha-2 agonist, medetomidine (Sawyer & Hoogstraten, 1980; Petrini & Keyler, 1993).

Guideline 48:
Every reasonable attempt should be made to recover any darts that miss the target animal and contain chemicals which could pose a public health risk.

2. Hazardous Physical or Environmental Situations

Guideline 49:
It is the responsibility of the investigator to ensure that hazardous conditions involved in field work are identified to the personnel involved. Some situations require particular experience and/or training, such as working around aircraft, diving, climbing, working at high altitude or in extreme temperature conditions, and working on ice.

When working in such locations, the investigator must ensure that the hazards involved are clearly described to field staff and that appropriate training and protective equipment and clothing are provided. The investigator is responsible for ensuring that field staff are competent to work under difficult conditions.

3. Equipment Hazards

Guideline 50:
Personnel involved in wildlife restraint should have current training in the use of pertinent equipment (e.g. ATVs [all terrain vehicles], boats, firearms, drugs, dart rifles, pistols, and jab sticks).

4. Emergency Preparedness

Guideline 51:
The investigator is responsible for ensuring that an emergency plan is in place.

An emergency plan appropriate for the intended study must be developed involving collaboration with local emergency personnel where necessary. This may include: making plans for evacuation; informing local medical authorities of the project and possible safety issues; and putting a checkup and/or response system in place. A procedure for accessing emergency medical services must be developed. Materials and equipment, such as helmets, face masks/protectors, gloves, firearms, or respirators, should be supplied to facilitate the safe conduct of projects. Field personnel should also be provided with appropriate and effective means of communication with each other and with emergency personnel.

5. Biohazards

Guideline 52:
The investigator must ensure that all potentially hazardous biological or zoonotic agents which may be encountered in the field situation or that are particular to the species under study are identified for field staff before field work is started, and that the necessary training and preventive medical care is obtained.

The investigator is responsible for identification of any specific biohazards or zoonotic agents which may reasonably be expected to be encountered in the field. Field staff must be informed about the possible routes of disease transmission and exposure, and trained in the use of protective equipment, medical interventions and safety procedures which are to be used to manage the hazard. In the interest of human health and safety, it is important that all wildlife that die from unknown causes in the field or in holding facilities undergo a

thorough postmortem to determine the cause of death. Depending on the postmortem results, it may be necessary to obtain medical assistance to protect personnel from diseases and parasites.

Investigators should familiarize themselves with the known biohazards specific to the species under study. All individuals involved in wildlife projects should have medical checkups and be given access to any recommended vaccinations. Where exposure to infectious agents can reasonably be expected (e.g. field work with bats), all field staff must be provided with immunization or prophylactic drugs, if available and appropriate.

Investigators who become ill should seek immediate medical assistance and advise their physician of their possible exposure to potentially hazardous animals, diseases and environmental conditions. The investigator must ensure that safety procedures are established for the conduct of postmortems in the field and that appropriate protective equipment (e.g. gloves, aprons, eye protection and respiratory protection) is provided. The investigator is responsible for ensuring that all personnel are trained in the postmortem techniques appropriate for the species. Where an animal that can reasonably be expected to be infectious is to be trapped or handled, the investigator must provide hazard information, safety equipment, and training to minimize the potential of transmission of the infectious agent. If wild animals potentially infected with an infectious agent or identified as potentially carrying a zoonotic agent are to be brought back to the laboratory or confined in proximity to personnel, the investigator must ensure that the animals are housed according to the requirements of the *Containment Standards for Veterinary Facilities* (CFIA, 1996) and the *Guide to the Care and Use of Experimental Animals*, vol. 1, 2nd ed. (CCAC, 1993).

All potential accidents or exposures, or suspected exposures, to infectious biological agents must be reported immediately to the nearest medical authorities as described in the emergency plan. The investigator must be notified and a record of the accident or injury kept. Any unexpected illness must also be reported immediately in a similar manner.

Appendix 23: Animal Facilities

The following guidelines are taken from the World Health Organization's *Laboratory Biosafety Manual*, 2004.

Animal Facility Biosafety Level 1

1. Animal facilities should have limited access.
2. Animal facilities should be a physically separated unit/room. If they adjoin to other laboratories, the animal rooms must be separate from other activities in laboratories to allow for isolation and decontamination as required.
3. Appropriate personal protective equipment (gloves and laboratory coats).
4. *Good Laboratory Techniques* must be followed (Appendices).
5. The animal facility director must establish appropriate policies, procedures, and protocols for all operations (e.g. animals, feed, waste, equipment use, etc.).
6. A safety of operations manual must be created [standards operating procedures (SOPs)], and all personnel must adopt it.
7. An appropriate health and medical surveillance program for personnel must be in place (see **Section 17.4**).

Animal Facility Biosafety Level 2

1. All the requirements for Animal Facility Biosafety Level 1 must be met.
2. Biohazard warning signs should be posted on doors and other appropriate places.
3. The facility must be designed for easy cleaning and housekeeping.
4. Doors must open inwards and be self-closing.
5. Heating, ventilation and lighting must be adequate.
6. If mechanical ventilation is provided, the airflow must be inwards. Exhaust air is discharged to the outside and should not be re-circulated to any part of the building.
7. Access must be restricted to authorized persons.
8. No animals should be admitted other than those for experimental use.
9. There should be an arthropod and rodent control program.
10. If present, windows must be secure, resistant to breakage, and, if able to be opened, must be fitted with arthropod-proof screens.
11. After use, work surfaces must be decontaminated with effective disinfectants (see Appendices).
12. Biological safety cabinets (Classes I or II) or isolator cages with dedicated air supplies and HEPA-filtered exhaust air must be provided for work that may involve the generation of aerosols.
13. An autoclave must be available on-site or in appropriate proximity to the animal facility.
14. Animal bedding materials must be removed in a manner that minimizes the generation of aerosols and dust.
15. All waste materials and bedding must be decontaminated before disposal.
16. Use of sharp instruments should be restricted whenever possible. Sharps should always be collected in puncture-proof/resistant containers fitted with covers and treated as biologically hazardous.
17. Materials of autoclaving or incineration must be transported safely, in closed containers.
18. Animal cages and housing must be decontaminated after use.
19. Animal carcasses should be incinerated.
20. Protective clothing and equipment must be worn in the facility, and removed in leaving.
21. Hand-washing facilities must be provided. Staff must wash their hands before leaving the animal facility.
22. All injuries, however minor, must be treated appropriately, reported and documented.
23. Eating, drinking, smoking and application of cosmetics must be forbidden in the facility.
24. All personnel must receive appropriate training.