



# LABORATORY SAFETY MANUAL

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**TABLE OF CONTENTS**

LABORATORY SAFETY MANUAL

TABLE OF CONTENTS

DISCLAIMER

ACKNOWLEDGEMENTS

EMERGENCY INFORMATION

1. OBJECTIVE:
  2. INTRODUCTION:
  3. DEFINITIONS
  4. TEACHING LABORATORIES
  5. SUPERVISOR'S RESPONSIBILITIES
  6. LABORATORY PERSONNEL'S RESPONSIBILITIES
  7. TRAINING
  8. WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS)
  9. GENERAL RESEARCH LABORATORY SAFETY
  10. PERSONAL PROTECTIVE EQUIPMENT
  11. EMERGENCY PROCEDURES AND EQUIPMENT
  12. SPECIFIC CHEMICAL HAZARDS
  13. CHEMICAL HANDLING AND STORAGE
  14. FUME HOODS AND BIOLOGICAL SAFETY CABINETS
  15. HAZARDOUS WASTE DISPOSAL
  16. CHEMICAL SPILL PREVENTION AND PREPAREDNESS
  17. LABORATORY EQUIPMENT AND PROCEDURES
    - 17.17 OVENS, HOT PLATES AND HEATING MANTLES
    - 17.18 ULTRAVIOLET LAMPS
    - 17.19 PIPETTES
  18. ELECTRICAL SAFETY
    - 18.1 GENERAL
    - 18.2 STATIC ELECTRICITY AND SPARKS
  19. LABORATORY EQUIPMENT MAINTENANCE
    - 19.1 MACHINE GUARDING
    - 19.2 SHIELDING
  20. RADIATION SAFETY
  21. SECURITY
- APPENDIX A: TRAINING REQUIRED
- APPENDIX B: TRAINING RECORD AND ACKNOWLEDGEMENT OF RISK
- APPENDIX C: UNATTENDED PROCEDURES FORM
- APPENDIX D: SAMPLE LABORATORY SIGNAGE

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	1

<b>Revision Date</b>	<b>Approved by:</b>	<b>Responsibility</b>	<b>Page</b>
January 2016	Administration	Health & Safety Officer/Biosafety Officer	2

### DISCLAIMER

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

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	3

**ACKNOWLEDGEMENTS**

The following individuals of Algoma University made important contributions to the writing, editing, and production of this manual: the faculty and staff of the Department of Biology and the Department of Human Resources.

Algoma University's Laboratory Health and Safety Manual's general forms and content were additionally shaped by similar manuals from Wilfred Laurier University, The University of Guelph, Lakehead University and the University of Western Ontario.

<b>Revision Date</b>	<b>Approved by:</b>	<b>Responsibility</b>	<b>Page</b>
January 2016	Administration	Health & Safety Officer/Biosafety Officer	4

**EMERGENCY INFORMATION**

If danger is imminent call 911 immediately (note Physical Plant is notified when 911 is dialed from a landline phone and then call Security at ext. 4444 after reporting the incident).

	<b>Contact Information</b>
<b>Main Campus:</b>	<b>For Immediate Assistance:</b> INTERNAL PHONE: DIAL 9-911 EXTERNAL PHONE DIAL 911  <b>CALL SECURITY AT EXT. 4444 (if reporting after the incident)</b>
<b>Physical Plant</b>	<b>Physical Plant ext. 4040</b> <b>Director of Physical Plant ext. or 705-971-4024</b>
<b>Health &amp; Safety Officer</b>	<b>Ext. 4373 or 705-542-2886 after hours</b>
<b>Biology Lab Coordinator</b>	<b>Ext. 4311</b>

<b>Revision Date</b>	<b>Approved by:</b>	<b>Responsibility</b>	<b>Page</b>
January 2016	Administration	Health & Safety Officer/Biosafety Officer	5

## Laboratory Safety Manual

### 1. OBJECTIVE:

The objective of this manual is to provide information on health and safety policies and procedures and to define minimum standards for safe practices in the University’s research and teaching laboratories. These operating procedures may be supplemented or amended as new guidelines and standards are developed or legislated.

### 2. INTRODUCTION:

**The Ontario Health and Safety Act, Regulations and Algoma University Safety Policy require all employees, faculty, volunteers and students to be:**

- responsible for complying with the legislation, standards and programs, and with the instructions of their supervisors;
- responsible for working safely, and for reporting all unsafe and unhealthy conditions to their immediate supervisors, in the interest of their own health and safety and that of other employees, students and visitors; are
- held individually accountable for fulfilling their responsibilities.

The Algoma University Health and Safety Policy hold all students, faculty, staff, employees and volunteers equally responsible for safety, and compliance with their departmental safety policy, guidelines and procedures. *Each laboratory must have customized guidelines and procedures based upon the minimum standard set by Ontario legislation and Algoma University policy.*

Work in the laboratory requires ongoing attention and reinforcement of safety practices. Neglecting to take reasonable precautions may not only endanger your own life, but the safety of those working with you. Scientists at Algoma University conduct extensive research in the university’s laboratories and provide valuable educational opportunities to many students. However, while working in the laboratories, they are exposed to potential hazards unique to laboratory settings. The research laboratory is probably the most unique and challenging work and study space at the university because each laboratory is slightly different, given the research and experimentation being conducted. This manual provides a set of minimum standards and practices for the safe and healthy operation of a laboratory. Following the requirements set out in the manual will help meet the requirements of the Occupational Health and Safety Act of Ontario (OHSA) for the purposes of the operation of a laboratory. It is the ultimate responsibility of every supervisor to ensure that safe practices are developed and followed for their specific laboratory. It is not the intent of the University to impede any laboratory activities, especially research. It is hoped that pre-planning will be an integral part of any project undertaken so that applicable legislative requirements will be met.

### 3. DEFINITIONS

#### ACT

*Occupational Health and Safety Act of Ontario*

**SUPERVISOR** A person who has charge of a workplace or authority over a worker (OH&S Act of Ont. Sec. 1(1)). This includes faculty and staff, including TAs and IAs who supervise a laboratory. The laboratory supervisor is responsible for all those working in the laboratory (paid or unpaid, student, volunteer, or visitor) and must ensure the safety of all those who enter the lab.

#### COMPETENT PERSON

A person who:

- a) Is qualified because of knowledge, training and experience to organize the work and its performance;
- b) Is familiar with the Act and the regulations that apply to the work;
- c) Has knowledge of any potential or actual danger to health or safety in the workplace (OH&S Act of Ont. Sec. 1(1))

#### DUE DILIGENCE

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	6

## Laboratory Safety Manual

Taking all reasonable precautions in the circumstance to protect the health and safety of a worker.

### LABORATORY PERSONNEL

At Algoma, all individuals who perform procedures in a laboratory. Some of these individuals may have supervisory functions.

### DEPARTMENT

An academic department, duly constituted by the Senate and Board of Governors (e.g., Department of Biology).

### LABORATORY

For the purposes of this manual any space where scientific research, experimentation or analysis is conducted. Computer “labs” are excluded from this definition.

### TEACHING LABORATORY

A laboratory designed solely for the purpose of student instruction in the execution of experimental procedures associated with an approved academic course at Algoma.

### RESEARCH LABORATORY

A laboratory designed to conduct research and to train individuals in advanced laboratory procedures and practice that may or may not be associated with an approved academic course.

### UNATTENDED PROCEDURES/EQUIPMENT

A procedure or piece of equipment that is left operating when no one is in the lab.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	7



**4. TEACHING LABORATORIES**

All students will participate in a general laboratory safety lecture at the commencement of their laboratory work. The general laboratory safety lecture will include (but is not restricted to) the following safety rules:

**GENERAL GUIDELINES**

- Students cannot work in the laboratory unless supervised by the Instructor responsible for the laboratory.
- If you have any doubts to a certain situation (spill, chemical reagent, disposal of waste, etc.) **ASK FOR HELP** from an instructor.
- Always be well prepared before entering the laboratory. A good plan of action and knowledge of the properties of the substances to be used as well as of the dangers linked to the experiment will permit the individual to carry out the experiment in a calm, serious and safe manner.
- Smoking is strictly prohibited in the laboratory. Never bring butane lighters to lab.
- No rough-housing or pranks in the laboratory.
- **Eating or drinking is strictly prohibited in the laboratory.**

**CLOTHING AND SAFETY APPAREL**

- Safety glasses/goggles/face shields must be worn when designated by the instructor.
- To minimize the danger of fire, long hair should be tied back.
- Avoid wearing loose clothing or clothes with excess fabric.
- Lab coats must be worn at all times.
- Open-toed shoes and sandals are not permitted.

**LABORATORY ETIQUETTE**

- Textbooks, cell phones and coats must remain in the designated area; the closed cabinets next to the lab benches or on the coat racks. If working in a CL-2 designated lab items must be stored in provided lockers adjacent to the lab.
- Avoid touching your eyes.
- Keep things away from your mouth such as pencils, hands, scoopulas, pens, etc.
- Cleanliness is essential in the laboratory to prevent contamination or mixing of substances which are incompatible. Always use clean glassware and do not clutter your work station.
- Wash your hands thoroughly before leaving lab.

**LABORATORY SAFETY EQUIPMENT (Students will be shown):**

- Eyewash Station
- Emergency Shower
- Fire Extinguisher
- First Aid Kit
- Nearest Emergency Exit
- Sharps and Broken Glassware Disposal Containers
- Non-Hazardous Biological Waste Container(s)
- Hazardous Biological Waste Container(s)
- SDS Binder(s)
- PSDS Binder

**CHEMICAL SAFETY**

- Always read the label carefully before using any reagent. Several chemical names are similar and an identification error could lead to a serious accident.
- Never taste, inhale or touch the reagents.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	8

## Laboratory Safety Manual

- Do not bring reagent bottles to your bench. Only take the amount required from under fume hoods.
- Always use a spatula or a plastic container to manipulate or transport solid reagents.
- Never return unused chemicals to the reagent bottles.
- Never siphon liquid by mouth. Use pipette bulbs.
- Maintain a clean and uncluttered work station
- Never use a broken, damaged or defective apparatus always report these items to instructor and they will dispose of properly.
- Always use the fume hood for dangerous experiments, in particular, those which give off toxic, flammable or nauseating vapors
- Volatile liquids should be kept in closed bottles and away from flames.
- **ADD acids to water, NEVER water to acids.**
- Always verify that no volatile liquid is in proximity before lighting your Bunsen burner.
- Always use clean glassware. All glassware used during the laboratory session will be washed with Alconox cleaner and placed on the drying rack.

### WASTE DISPOSAL

- Dangerous substances should be thrown away in specified containers. Do not throw these substances down the sink or in the regular garbage.
- Check with your instructor if you are unsure of the disposal of your reagents.
- Dispose of sharps (razor blades, scalpel blades, needles) and broken glassware in the designated containers.
- Dispose of all animal waste in the correct containers as designated by your instructor.

### ACCIDENTS AND INJURIES

- Always report all accidents regardless of how minor to your laboratory instructor.
- If in doubt **ASK FOR HELP** from an instructor.
- If you spill a chemical, wipe it up as soon as possible and notify your instructor.
- If a chemical touches your skin, eyes or clothing, rinse immediately with an abundant amount of water. Inform your instructor as soon as possible.
- If you do get chemicals in your eyes flush them with flowing water from the eyewash station for at least 20 minutes. The eyewash stations are located in the hallway (CC302 & CC304) and in the lab (CC414) notify a classmate or instructor and they will lead you there and help you.
- If there is a chemical spill on an individual's body escort that individual to the emergency shower located in the hallway (CC302 & CC304) and the lab (CC414). All contaminated clothing must be removed and the individual must remain under the shower for at least 15 minutes.
- Note the location of all fire extinguishers, showers and eye-wash stations.
- If clothing catches on fire roll individual on floor and utilize the fire blanket, or douse with water from the emergency shower immediately.

## 5. SUPERVISOR'S RESPONSIBILITIES

The supervisor of the laboratory has overall responsibility for safety in the lab. It is recommended that regular monthly safety inspections be conducted by the supervisor, and that records of these inspections be kept on file. Prior to any work being performed by a new laboratory worker it is the supervisor's responsibility to ensure that workers are aware of safety rules and follow them. In addition the supervisor is responsible for ensuring that:

- a. All employees must be provided with appropriate safety orientation when they are first assigned to a laboratory.
  - a. Specific WHMIS Training to the lab
  - b. Training on special or unusual hazards in the lab

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	9

## Laboratory Safety Manual

- c. Training in the use of laboratory specific emergency equipment and emergency response
- d. Records of training must be kept and copies provided to Human Resources
- b. All laboratory workers attend the prescribed training sessions provided by Human Resources. See Appendix A Training Matrix.
- c. All workers are aware of safety rules and procedures, that they follow them, and that they are aware of all emergency procedures and locations of emergency equipment.
- d. Workers are familiarized with all hazards, including those associated with specific operating procedures. The employee must be made aware of these hazards before work begins.
- e. Adequate emergency equipment is available and is in proper working order.
- f. An Accident/Incident Report Form is filled out and sent to Health and Safety for every accident or incident that occurs in his/her laboratory.
- g. That appropriate emergency information and cautionary signage is posted in the lab and updated regularly.
- h. An appropriate alternate supervisor is appointed when the laboratory supervisor is absent.

### 6. LABORATORY PERSONNEL'S RESPONSIBILITIES

Any person who is involved in laboratory work is responsible for meeting all legislated requirements, and those set by the University. It is expected that adherence to this manual and all associated guidelines, procedures and policies is an acceptable start for the establishment of a well-rounded laboratory safety program. Every supervisor is strongly encouraged to develop written health and safety protocols for all laboratory procedures that are hazardous.

***It is the responsibility of every person that steps into the lab to be familiar with requirement for entry, basic protective equipment requirements, emergency procedures, location of safety equipment and exit routes.***

Every person working in a laboratory is responsible for ensuring that he or she:

- a. Follows all applicable safety rules and practices outlined in this manual and by the laboratory supervisor.
- b. Uses and wears personal protective equipment as required.
- c. Reports unsafe equipment and working conditions to the laboratory supervisor.
- d. Reports all accidents/incidents to the laboratory supervisor.
- e. Completes all applicable health and safety training offered by Health and Safety program and the laboratory supervisor.

### 7. TRAINING

Training is an essential part of the Health and Safety program at Algoma University. Basic training is provided through the Office of Human Resources - Health and Safety, however, each area handling hazardous materials will have specific instructions. It is the area supervisor's responsibility under the Occupational Health and Safety Act and Algoma University policy to provide workplace specific training to students, staff and volunteers. All personnel using hazardous materials must complete Workplace Hazardous Materials Information System (WHMIS) training annually. Area Supervisors are encouraged to formalize their training materials in an official document, including information related to hazards, personal protective equipment and safe-work procedures. At minimum the New Laboratory Trainee Orientation Checklist (Appendix B) must be completed. Training for new personnel must be completed prior to conducting any work in the lab with hazardous materials.

It is the responsibility of the laboratory supervisor to ensure that:

- a. All laboratory personnel have received adequate training in the use of specific equipment, and regarding the materials and procedures in the laboratory in which they will be working.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	10

## Laboratory Safety Manual

- b. All training is documented, and documentation is maintained for all personnel throughout the employment of the employee.
- c. Records of student and volunteer training are to be maintained by the Instructor and/or Principal Investigator.

Training must be offered by the area Supervisor detailing hazards, procedures and protocols. This training is usually offered when an employee is new to an area or task. A checklist has been developed to assist Supervisors with this training, and also serve as a record of training (Appendix B). Training must include:

1. Familiarization with the specific laboratory manual and procedures.
2. Laboratory specific safety orientation given by the Supervisor.
3. Training in proper use of the equipment i.e. fume hoods, biosafety cabinets and autoclave, as required.
4. Spill response.
5. Microbial practices and universal precautions (for CL2 biosafety labs).
6. Specific safe work procedures for the particular agents in use.
7. Laboratory biosecurity practices.
8. Annual retraining of emergency procedures, and pertinent updates on changes to biosafety program.

All training must be documented by the supervisor and the records maintained. For a guide to Algoma University required training for new Biosafety lab employees/students, refer to appendix A and B.

Supervisors must clearly indicate potential risk to the user. An example of such a document can be found in appendix B. Its use is suggested during the training process and should be signed and dated by both the user and supervisor.

### 8. WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS)

The Workplace Hazardous Materials Information System (WHMIS) is a legislated program that applies to all Algoma faculty, staff and students. WHMIS has been developed as a tool to help employers and employees protect their health and safety. WHMIS ensures that information passes from the producer or supplier of a hazardous material to the employer and from the employer to the employee. This transfer involves three mechanisms: the use of warning labels, Safety Data Sheets (SDSs) and training on how to use the information provided.

### 9. GENERAL RESEARCH LABORATORY SAFETY

Research laboratories will be classified according to the hazards and risks of the research they perform. Each laboratory will have signage notifying entrants the hazards in the lab (Appendix D):

1. Type 1 Laboratory-no chemical or biological hazards. Low risk, less controls required.
2. Type 2 Laboratory-chemical or biological hazards present
3. Type 3 CL2 Laboratory (as per the Biosafety Program)

#### 9.1 LABORATORY ACCESS

- Access to laboratory and support areas is limited to authorized personnel.
- The laboratory doors are closed and locked when the lab is unoccupied.
- Children under the age of sixteen years should not generally be permitted in the laboratory.
- Pregnant women and immune-compromised persons should be advised of the potential risks and documented (if applicable).

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	11

## Laboratory Safety Manual

- Post hazard warning signs on every outside door indicating the nature of the hazard contained in the laboratory. If the hazardous materials in use require special provisions for entry, this information must be included on the sign. The name and contact information of the lab supervisor must also be listed. (Visit the Health and Safety website to order signs).

### 9.1 GENERAL SAFETY

- The storage or consumption of food or drink in laboratories is prohibited
- Storing personal belongings, utensils, applying cosmetics, and inserting or removing contact lenses are all prohibited in any laboratory.
- The wearing of contact lenses is permitted only when other forms of corrective eyewear are not suitable.
- Storage of personal belongings is permitted in designated areas only. (e.g., in cabinets under lab benches, on provided hooks or in provided lockers adjacent to lab)
- Know and understand the hazards, safe handling and operating procedures of the materials, equipment and methods being used. Review SDSs, equipment manuals, and standard operating procedures as applicable.
- Familiarize yourself with the location of fire alarms, emergency exits, fire extinguishers and eyewash/safety shower stations.
- If you are unsure of any aspect of the work to be done (e.g., safe handling of material, operation of equipment, experimental technique, etc.), ask your supervisor before proceeding.
- Mouth pipetting is strictly prohibited.
- Footwear must cover feet completely; no open-toe shoes.
- Approved eye or face protection must be worn continually when working with chemicals.
- Wearing of jewellery is not recommended in the laboratory.
- Restrain loose clothing and long hair.
- Pranks, horseplay, running, practical jokes and unauthorized experimentation are not permitted.
- Report accidents and near misses promptly to your supervisor.
- Application of cosmetics or lip balm in the lab is prohibited.
- Smoking is prohibited in all laboratories and all areas on-campus except for marked designated smoking areas.

### 9.2 HOUSEKEEPING

Good housekeeping practices are essential in every workplace. They are especially important in the laboratory environment, where spills from broken reagent containers, sample bottles, reaction vessels, etc. can create unnecessary exposure to potentially hazardous substances. Laboratory personnel are responsible for ensuring that their work spaces are kept as clean as the work allows. Laboratory supervisors are responsible for ensuring the overall cleanliness of the lab. The following housekeeping points will help lead to a neat, organized, efficient and most important a safe work environment:

- Stairways, hallways, and aisles must be kept clear and must not be used for storage. This includes equipment and personal property.
- Access to emergency equipment and exits must never be blocked.
- Laboratories are to be kept clean and tidy.
- Laboratory floors, entrances and exits must be kept clear of obstructions at all times.
- Laboratory benches and other laboratory furniture should be arranged such that the path to any emergency exit is not impeded and may be reached easily from any point in the lab.
- Instructions for housekeeping staff must be posted on all exterior doors to labs containing hazardous materials. Form available from Health and Safety.
- Spills must be cleaned up immediately.
- Electrical cords (or other tripping hazards) must not traverse work areas. Extension cords must not be used as permanent wiring.
- Extension cords and power bars must be CSA or UL approved.
- Equipment and chemicals must be properly stored and labelled.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	12

## Laboratory Safety Manual

- Spilled chemicals must be cleaned up immediately by the user if he/she feels safe doing so. Proper protective equipment must be worn when cleaning spills. Consult SDS. Report all spills to supervisor.
- Waste must be placed in appropriate and labelled containers.
- Old or unlabelled equipment/chemicals must not be allowed to accumulate. They must be identified, and then disposed of immediately when no longer required.
- Ensure that cleanup is done once experiments are completed and that the work area is tidied at the end of each day.
- Electrical cords, hoses, and air lines must be secured.
- Do not store large, awkward, heavy or breakable items on high shelves
- A step stool must be available to access items stored on high shelves

### 9.3 FOOD STORAGE AND CONSUMPTION

- Storage and consumption of food and/or drink (including water) in research and teaching laboratories and chemical storage areas is strictly prohibited.
- The use of laboratory equipment including but not limited to glassware, refrigerators, freezers, microwave and other ovens, etc. to store or prepare food is strictly prohibited. Ice from laboratory ice-makers may not be consumed.

### 9.4 WORKING ALONE

It is prudent to avoid working alone in a laboratory, especially outside of regular business hours. If possible, it is advisable for individuals working in separate laboratories to cross-check periodically. Working in the laboratory outside of traditional office hours or working without immediate access to a supervisor poses additional risks since there may be generally few, if any, other people around. It is necessary to be vigilant of potential health and safety problems at these times, since in the event of an emergency, assistance may not be readily available.

Experiments known to be potentially hazardous should not be undertaken at any time by a person working alone. The Supervisor is responsible for determining if the work requires more than one person to be present. A person having to work alone can make arrangements with Security to periodically check in on the laboratory when individuals are working alone. For work with hazardous materials or procedures the supervisor has the right to require that at least one other person be present.

Therefore:

- New or unfamiliar procedures should never be performed without supervision.
- Only work of relatively low risk should be performed without supervision.
- Lab supervisors must approve all after hour work in labs and document.
- Ensure appropriate personal protective and emergency response equipment such as first aid kit, emergency shower, eyewash and fire extinguisher is available.
- Ensure that a communication system is available and that contact numbers are known.

### 9.5 UNATTENDED PROCEDURES

Non-routine, unattended laboratory procedures should be minimized. Only procedures that are deemed safe if left unattended may continue without personnel present in the laboratory. The laboratory supervisor must review procedures to ensure all hazards are controlled prior to leaving the experiment unattended.

The following are requirements for non-routine unattended laboratory procedures.

- Unattended procedures should be visited periodically. An Unattended Procedures Form must be posted in the area outlining the procedure and providing contact information for the person conducting the experiment. See Appendix C for a blank copy of the Unattended Procedures Form.
- Unattended heating may be done only with heating equipment that reliably maintains stable temperatures.
- Remove any flammable or combustible materials from the area, including hazardous waste.
- Sash doors must be closed on all fume hoods.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	13

### 9.6 LABORATORY ENTRANCE RESTRICTIONS

In light of potential hazards in laboratory settings, and to protect the integrity of the research being performed and the security of equipment and supplies, the laboratory supervisor should escort all visitors to the lab. The supervisor may not knowingly permit entrance to the lab to anyone not qualified to be in or about the workplace.

For special circumstances, for example the 'Take your kids to work program', written permission from a parent or guardian and departmental approval may be required to permit the entrance of a minor into a laboratory.

### 9.7 HYGIENE

- Hands must be washed thoroughly:
  - before donning gloves,
  - anytime they are believed to be contaminated with chemical or biological hazards,
  - after handling materials known or suspected to be contaminated.
  - before touching non-lab equipment (e.g. telephone, cell phone, computers etc.),
  - after gloves have been removed,
  - before leaving a laboratory.
- Open wounds, scratches, and grazes should be covered with waterproof dressings.

## 10. PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) must be used as required and consistent with the hazards present in each laboratory, as determined by the laboratory supervisor and documented by a risk assessment and as required by the Personal Protective Equipment Protocol. While hygienic research procedures and engineering controls such as fume hoods are the primary means of protecting laboratory personnel, PPE is a necessary second level of protection. It reduces the transfer of laboratory specific hazards to non-laboratory spaces.

All personnel in a laboratory should consult with their supervisor regarding protective equipment appropriate to the individual laboratory. (Ontario Regulation 851 Section 79) It is the responsibility of the supervisor to select the PPE appropriate to the work being done. The Canadian Standards Association publishes standards with information that may assist the supervisor with the selection. In some cases the department will pay for the PPE, in other cases PPE may be provided from research grant funds, or students may be required to purchase their own PPE.

The quantity and types of personal protective equipment a laboratory should have available will depend on its size and the type of work being performed.

Lab personnel must be familiar with any personal protective equipment provided for their use. They must know:

- Why it is needed
- When it is needed
- Where and how to properly store it
- How to use it
- How to maintain it
- The limitations of each item

It is the responsibility of anyone working in the lab to use the PPE that is required. All the personnel in the lab should wear personal protective equipment, not just those actively working. Appropriate clothing should be worn at all times.

This section provides minimum standards for personal protective equipment.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	14

## Laboratory Safety Manual

### 10.1 PROTECTIVE CLOTHING

- Protective laboratory clothing (uniforms, coats, gowns) must be correctly worn by all personnel including visitors, trainees, and others entering or working in the laboratory
- It is recommended that the minimum skin protection in a laboratory in which hazardous chemical are used requires continuous coverage from shoulders to toes, including closed toed shoes.
- Laboratory coats must be worn at all times. The coat must cover the arms and the middle body, and be buttoned properly.
- Avoid wearing laboratory coats outside the work area.
- Laboratory coats must never be washed with domestic laundry.
- Long pants are recommended to protect legs against chemical splashes.

### 10.2 EYE AND FACE PROTECTION

Canadian Standards Association (CSA) approved eye protection must be worn by students, staff, and visitors in all areas where hazardous or unknown substances (either chemical or biological) are stored, used or handled, when there is a risk of splash. Eye protection must provide adequate resistance to impact and splash for the work being done.

- Minimum eye protection for the laboratory consists of approved safety glasses with permanent side shields. Note that safety glasses do not provide significant splash resistance and therefore should only be worn for light work that does not involve the use of liquids.
- Goggles must be worn when there is a risk of splash of a hazardous material.
- Contact lenses are not protective devices and must not be worn when working with chemicals. They are permitted only when other forms of corrective eyewear are not suitable and goggles must be worn if wearing them in the lab.

### 10.3 FOOT PROTECTION

Closed-toed, closed-heeled shoes constructed of a resistant material (preferably leather) are required for work in all laboratories. Chemical-resistant safety shoes may be warranted in specific cases as determined by the laboratory supervisor. Sandals do not provide adequate protection and must not be worn in any laboratory setting. High-heeled shoes are strongly discouraged as they increase the potential for trips and falls in the lab.

### 10.4 HEARING PROTECTION

Equipment such as grinders or homogenizers in laboratories may warrant the use of hearing protection. Hearing protection may consist of ear plugs or ear muffs depending on the amplitude and frequency of the noise.

Hearing protection is required in areas where the eight hour time weighted average noise level is greater than 85dB.

Health and Safety can take noise level measurements to determine the average noise level. Laboratory supervisors should contact HSO at extension 4373 to arrange for this testing.

### 10.5 RESPIRATORY PROTECTION

Under normal circumstances, respirators should not be required for laboratory situations at Algoma. Appropriate use of fume hoods should generally eliminate respiratory hazards. However, there are situations that the use of a respirator may be necessary; for example, when working with lab animals where allergens are a problem. The use of a respirator should also be considered when permanent engineering controls are inadequate (e.g., emergency spill situations) or not functioning as a result of an emergency situation.

All users of respiratory protection must be fit tested and instructed in the proper use and care of the respirator. All users of respiratory protection must be instructed in the limitations of the respirator. Additionally, the respirator chosen must suit the known hazard. Laboratory supervisors should contact HSO at extension 4373 to arrange for fit testing.

### 10.6 HAND PROTECTION

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	15



## Laboratory Safety Manual

### 10.6.1 Selection of Gloves

Gloves must be used to provide protection against chemical or biological agents, exposure to extreme temperatures, and abrasions or lacerations. Table 1 provides general guidelines for appropriate hazard-based selection of gloves. Gloves must be removed before using lab computers, telephone, cell phones.

*Table 1 Guide to Hazard Based Glove Selection*

HAZARD	DEGREE OF HAZARD	PROTECTIVE MATERIAL
<b>Abrasion</b>	Severe	Reinforced heavy rubber, staple reinforced heavy leather
	Less Severe	Rubber, plastic, leather, polyester, nylon, cotton
<b>Sharp Edges</b>	Severe	Metal mesh, staple reinforced leather, Kevlar, aramid-steel mesh
	Less Severe	Leather, terry cloth (aramid fiber)
	Mild with delicate work	Lightweight leather, polyester, nylon, cotton
<b>Chemicals and fluids</b>	Risk varies according to the chemical, its concentration, and time of contact among other factors. Refer to the manufacturer, or product SDS	<b>Dependent on chemical.</b> Examples include: Natural rubber, neoprene, nitrile rubber, butyl rubber, PTFE (polytetrafluoroethylene), Teflon, Viton, polyvinyl chloride, polyvinyl alcohol, Saranex, 4H, Barricade, Chemrel, Responder, Trelchem
<b>Cold</b>		Leather, insulated plastic or rubber, wool, cotton
<b>Electricity</b>		Rubber insulated gloves tested to appropriate voltage (CSA Standard Z <sub>259-4-M</sub> <sub>1979</sub> ) with leather outer glove
<b>Heat</b>	Greater than 350°C	Zetex
	Up to 350°C	Nomex, Kevlar, heat resistant leather with linings
	Up to 200°C	Nomex, Kevlar, heat resistant leather, terry cloth (aramid fiber)

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	16

## Laboratory Safety Manual

	Up to 100°C	Chrome-tanned leather, terry cloth
<b>General Duty</b>		Cotton, terry cloth, leather
<b>Product Contamination</b>		Thin film plastic, lightweight leather, cotton, polyester, nylon
<b>Radiation</b>		Lead-lined rubber, plastic or leather, refer to Health and Safety Officer for more details.

### 10.6.2 Chemical Resistance

No one type of glove material is appropriate for protection against all potential chemical exposures as the permeation rate (rate at which the chemical seeps through the glove material) of glove types varies significantly with different chemicals. Consult the SDS and consider the work being performed to determine an appropriate glove. Table 2 provides some basic information about selecting gloves suitable for chemical applications. The following links provide more detailed information on proper glove material selection.

- Ansell Chemical Resistance Guide: [http://www.ansellpro.com/download/Ansell\\_7thEditionChemicalResistanceGuide.pdf](http://www.ansellpro.com/download/Ansell_7thEditionChemicalResistanceGuide.pdf)
- Best Manufacturing Company's Chemrest: [www.showabestglove.com](http://www.showabestglove.com)

*Table 2 Characteristic, Advantages, Disadvantages and Uses of Selected Chemical Resistant Glove Materials.*

TYPE	ADVANTAGES	DISADVANTAGES	FOR USE WITH:
Natural Rubber Latex	Low cost; good physical properties, dexterity	Poor against oils, greases, organic solvents, ethidium bromide. May cause allergic reactions.	Bases, acids, alcohols, dilute aqueous solutions. Fair vs, aldehydes, ketones.
Natural Rubber blends	Low cost, dexterity, generally better chemical resistance than natural rubber.	Physical properties often inferior to natural rubber. May cause allergic reaction.	Bases, acids, alcohols, dilute aqueous solutions. Fair vs, aldehydes, ketones.
Polyvinyl chloride (PVC)	Low cost, very good physical properties, average chemical resistance.	Plasticizers can be stripped.	Strong acids and bases, salts, aqueous solutions, alcohols, oils greases, and petroleum products.
Neoprene	Average cost, average chemical resistance, average physical properties, high tensile strength, high heat resistance.	Poor vs. chlorinated hydrocarbons.	Oxidizing acids, alcohols, anilines, phenol, glycol, ethers, solvents, oils, mild corrosives.
Nitrile	Low cost, excellent physical properties, dexterity.	Poor vs. chlorinated organic solvents.	Oils, grease, aliphatic hydrocarbons, xylene, perchloroethylene, trichloroethane, ethidium bromide, Fair vs.

<b>Revision Date</b>	<b>Approved by:</b>	<b>Responsibility</b>	<b>Page</b>
January 2016	Administration	Health & Safety Officer/Biosafety Officer	17

## Laboratory Safety Manual

			toluene.
Butyl	Good resistance to polar organics, high resistance to gas and water vapour.	Expensive, poor vs. hydrocarbons, chlorinated solvents.	Glycol ethers, ketones, esters, aldehydes, polar organic solvents.
Polyvinyl alcohol (PVA)	Resists broad range of organics, good physical properties.	Very expensive. Water sensitive, poor vs. light alcohols, acids and bases.	Aliphatic and aromatic hydrocarbons, chlorinated solvents, ketones (except acetone), esters, ethers.
Fluro-elastomer (Vitron®)	Good resistance to organic and aromatic solvents. Flexible.	Extremely expensive. Poor physical properties. Poor vs. some ketones, esters, amines.	Aromatics and aliphatic hydrocarbons, chlorinated solvents, oils, lubricants, mineral acids, alcohols.
Norfoil, silver Shield™, 4H™	Excellent chemical resistance.	Poor fit, stiff easily punctures, poor grip.	Use for Hazmat work. Good for range of solvents, acids and bases.

### 10.6.3 Use and Care of Gloves

The following guidelines should be considered when using gloves:

- Reusable gloves (insulated, chemical resistant, etc.) may be used only where necessary and must be appropriately decontaminated.
- Gloves should be inspected for damage prior to use. Replace gloves showing any sign of deterioration such as holes, tears, or discoloration.
- Gloves should be of adequate length to provide protection of the arm.
- Remove gloves by pulling inside out to prevent exposure during removal.
- Remove gloves before touching computers or phones, opening doors or contacting items that one would expect to be free of contamination (either biological or chemical).
- Wash hands thoroughly after removing gloves.
- Never reuse disposable gloves.

## 11. EMERGENCY PROCEDURES AND EQUIPMENT

Detailed emergency procedures are outlined in the Algoma University Emergency Plan. This document must be available in all laboratories and accompany all telephones on-campus. Safety must be an intrinsic part of each laboratory operation; work must be planned so that exposure to potentially hazardous material does not occur. Despite planning, accidents do occur. Accidents may involve spills of potentially hazardous agents in the laboratory or failure of equipment and facility safeguards that may place the laboratory worker at higher risk of exposure.

The probability of severe injury or infection can be significantly reduced if emergency plans are established and are familiar to laboratory workers.

It is not possible to recommend a single plan of action that would be applicable in all situations. The following basic principles, however, may be useful in developing specific procedures for dealing with an accidental spill of potentially infectious material:

- Evacuate the affected area
- Notify Security ext. 4444 or if an emergency dial 9-911
- Do not re-enter the affected area until the extent of the hazard is determined
- Determine the need to treat persons exposed to the hazardous agent
- Decontaminate the affected area

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	18

## Laboratory Safety Manual

- All incidents **MUST** be reported to your supervisor and to Human Resources – Health and Safety Officer as quickly as possible after the injured party has received appropriate treatment.

For emergencies involving failure of equipment or facility safeguards, the most important action should be to stop work with the hazardous agent and safely contain the material until corrective action has been taken. In cases of serious injury or sudden illness, the supervisor should determine whether to override containment. Emergency response personnel should also be alerted to the potentially infectious hazards.

Specific emergency procedures relative to the particular hazard shall be documented by the supervisor.

### The SUPERVISOR shall:

- ensure that everyone in the laboratory is thoroughly familiar with the emergency plan to be followed in the event of an incident;
- ensure that all project participants receive refresher emergency plan training on a regular basis; such training shall be documented; and
- ensure that all incidents involving biohazardous materials that could result in exposure, contamination, etc. are reported immediately to the supervisor.

### 11.1 REPORTING ACCIDENTS, INJURIES OR NEAR-MISSES

All accidents, incidents and near misses must be reported to Health and Safety via the [Incident Report and Investigation Form](#). To meet regulatory requirements, these forms must be submitted to Health and Safety Officer within 24 hours of occurrence, with the exception of critical injuries, which must be reported immediately to the Health and Safety Officer by telephone, extension 4373. Accidents that occur in the teaching labs also need to be reported to the Biology Lab Coordinator by telephone, extension 4311.

Critical injuries meet at least one of the following criteria:

- place life in jeopardy,
- produce unconsciousness,
- result in substantial loss of blood,
- involve fracture of a leg or arm but not a finger or toe,
- involve amputation of a leg, arm, hand or foot, but not a finger or toe,
- consist of burns to a major portion of the body, or
- causes the loss of sight in an eye. (R.R.O. 1990, Reg. 834)

When required, accidents will be reported to the Workplace Safety & Insurance Board (WSIB) or the Ministry of Labour. In those cases where an employee does not have an immediate supervisor or is unable to contact the supervisor, the employee must contact human resources directly. All lab related accidents, injuries and near misses will be discussed at Joint Health and Safety Committee meetings.

### 11.2 LABORATORY FIRST AID

The emphasis in any laboratory must be accident prevention.

- If an accident does occur and there is exposure to a poisonous or toxic substance only a qualified medical practitioner should administer an antidote or give medical treatment. The only exception to this is administering topical calcium gel when an exposure to hydrogen fluoride has occurred.
- The chemical SDS must always be available for information regarding treatment.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	19

## Laboratory Safety Manual

Hazards common to chemical laboratories require specialized first-aid such as:

### BURNS

All burns should be evaluated by a qualified first aider or a doctor. ***If the burn is extensive or severe, shock may follow. Call extension 4444 immediately before administering first aid steps listed below***

#### Thermal Burns:

- Immerse burned area in cold water as quickly as possible.
- Loosen any tight clothing and remove any jewelry.
- Never remove clothing, jewelry etc. that is stuck to the burn! After the pain has subsided, cover the burn loosely with sterile gauze

#### Chemical Burns:

- Remove the casualty from contact as quickly as possible.
- Remove contaminated clothing under an emergency shower, if possible.
- Copious flushing of the affected skin with water is necessary to remove the cause of the burn. When burns are caused by a dry chemical, excess should be brushed away prior to flushing with water.
- Do not use neutralizing or buffering agents.
- If casualty was wearing chemical goggles, leave them in place until the head and face have been thoroughly flushed.
- Do not apply antidotes – leave this to the attending physician, unless instructed by your supervisor.

### EYE INJURIES:

***Contact lenses should not be worn in a chemical laboratory as they may cause difficulty with eye irrigation.***

#### Chemical exposure to the eye

Splashes of irritant chemicals or exposure to the vapour or mist of some chemicals can lead to serious eye injury. Protective glasses, goggles or face shields must be worn to protect the face and eyes from chemical hazards. SDS for the chemical in use will recommend the appropriate protective eyewear.

If a chemical splash to the eyes occurs the following steps must be followed:

- Immediately flush the eye using an eyewash fountain.
- Forcibly hold the eyelids open so that the entire surface of the eye is flushed.
- Continue flushing for a minimum of 15 minutes.
- Seek medical attention.

#### Foreign body in the eye

Loose, unattached foreign bodies, under or on the eye lid can often be removed with a wet piece of clean cotton on an applicator. Do not try to remove a particle on the cornea, attached to the surface of the eye, or embedded in the eye. Seek medical attention and request the services of a physician, preferably an ophthalmologist.

### POISONING

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	20

## Laboratory Safety Manual

Poisoning by swallowing is a rare occurrence in a laboratory, provided that good hygiene is maintained by laboratory workers. Nearly all chemicals handled in a laboratory are “poisonous” if swallowed. All chemicals should be treated with due respect, but the term “poison” should be reserved only for those which are highly toxic.

DO NOT induce vomiting; DO NOT give the casualty any food or drink.

### Inhalation Poisoning

This type of poisoning can occur through inhalation of gases, vapours, fumes, mists or dusts. Such substances include:

- chlorine
- bromine
- hydrochloric acid
- sulfur dioxide
- formaldehyde
- acrolein
- ammonia

Some of these have warning properties which makes dangerous exposure unlikely, unless the exposed person is physically unable to leave the area of exposure. The serious effects caused by these are essentially extreme local irritation of the mucus membranes, most importantly the lungs.

Other compounds may be present in dangerous concentrations before it is realized. Among these are:

- Halogenated hydrocarbons
- Tetrachloroethane
- Carbon tetrachloride
- Methyl bromide
- Ethylene chlorhydrin
- Oxides of nitrogen
- Carbon disulfide
- Benzene

Others may have a very slight odour or no odour at all, even in dangerous concentrations, as in the case of:

- Carbon monoxide
- Methyl chloride
- Aniline
- Arsine
- Mercury

Carbon monoxide, hydrogen sulfide and hydrogen cyanide can cause almost immediate unconsciousness in higher concentrations. Others may have delayed symptoms due to dangerous over-exposure, such as:

- Oxides of nitrogen
- Phosgene
- Cadmium fumes
- Aniline chlorine
- Hydrochloric acid

Many compounds are dangerous due to long-term exposures to concentrations too low to cause acute symptoms, for example:

- Benzene
- Carbon tetrachloride

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	21

- Chlorinated hydrocarbons
- Mercury
- Lead
- some dusts

### Poisoning by Skin Contact

Skin contact with various chemicals may result in:

- A defatting action from solvents
- A rapid and deep destruction of tissues from strong acids and alkalis
- Contact dermatitis

Toxicity by skin absorption is a definite hazard from a considerable group of chemicals, such as:

Acrylonitrile	Ethylenimine
Allyl chloride	Hydrofluoric Acid
Allyl alcohol	Nitroaniline
Aniline	Nitrobenzene
Antimony trichloride	Phenol
Arsenic trichloride	Oxylidine
Cresols	Tetrachloroethane
Cyanides	Tetraethyl lead
Ethylene chlorohydrin	Toluidine

Many of these chemicals present little or no evidence of local skin effects, but are undoubtedly hazardous because of toxicity through skin absorption. Cresol and phenol have severe local as well as systemic effects.

For some chemicals the effects of absorption through the skin are approximately as severe, dose by dose, as they are from inhalation or swallowing. Such chemicals include:

Allyl alcohol	Aniline
Ethylene chlorohydrin	Ethylenimine
Hydrofluoric acid	

### CHEMICAL CONTACT

For skin contact:

- For a small, easily accessible area of the skin (e.g., hand)
  - Proceed to the nearest sink.
  - Remove contaminated clothing and jewellery.
  - Rinse for at least 15 minutes.
- For a large or inaccessible area of skin
  - Remove contaminated clothing and jewellery
  - Go to the nearest emergency shower.
  - Rinse for at least 15 minutes.
  - Seek medical attention if required. Provide applicable SDS to medical personnel.

For contact with the eyes:

- Go to the nearest eyewash station.
- Rinse for at least 15 minutes.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	22

## Laboratory Safety Manual

- If wearing contact lenses, remove them as quickly as possible, while continuing to flush.
- Hold your eyelids open with your fingers.
- Roll your eyeballs, so that water can flow over the entire surface of the eye.
- Lift your eyelids frequently to ensure complete flushing.
- Cover the injured eye with dry sterile gauze pads.
- Seek medical attention. Provide applicable SDS to medical personnel.

### 11.2 ACCIDENT/INCIDENT INVESTIGATION

Accident/incident investigation is an important component in the continuous improvement of the university's health and safety practices and procedures. The active participation of both supervisors/instructors and employees/students in this program is essential.

The purpose of an investigation is to identify and address all causes of an accident or incident, and to uncover the underlying factors and root causes, which may not be immediately evident on initial review of the accident/incident. It is essential that the scene of an accident/incident be preserved so a thorough and accurate investigation can be performed. Scenes of critical injuries must be preserved by law until permission is given by the Ministry of Labour Inspector.

### 11.3 LABORATORY ORIENTATION

As part of orientation, it is the supervisor's responsibility to ensure that all lab personnel are familiar with the use and location of the following equipment and safety aids in all areas in which they will be working.

- Fire extinguisher
- Eye wash station
- Safety shower
- Fire alarm pull station
- Emergency routes and exits
- Electrical equipment
- First aid kits
- Spill kits
- SDSs
- PSDS

All personnel working in a laboratory are strongly encouraged to become familiar with the building's evacuation plan, and to identify their Building Coordinators and Emergency Wardens.

### 11.4 LABORATORY EMERGENCY PROCEDURES

It is the laboratory supervisor's responsibility to communicate to all lab personnel the emergency procedures associated with the particular materials, equipment, samples, procedures, personnel, and other factors associated with the lab. Laboratory supervisors are responsible for ensuring that there are appropriate evacuation procedures in place for those persons with mobile difficulties.

All lab personnel, including students, must participate in emergency drills as applicable and respond to all fire alarms by following emergency procedures and promptly evacuating the building. Elevators may not be used during an evacuation. Buildings that have been evacuated may be re-entered only after permission has been given by the Sault Ste. Marie Fire Department.

### 11.5 LABORATORY FIRES

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	23



## Laboratory Safety Manual

Upon discovery of fire or smoke:

- Activate the nearest emergency pull station
- Notify others in the area of the danger
- Evacuate the area to a safe location closing the doors as you exit
- From a safe location call Security at extension 4444 and/or 9-911
- Report your name and the exact location of the fire/smoke, including building, floor level and room number.

Attempt to extinguish the fire only if you are trained to do so and if you can extinguish the fire without putting your own safety or the safety of others at risk:

- Never try to extinguish a fire larger than a waste paper basket.
- Locate a fire extinguisher appropriate for the type of fire.
- Position yourself between the fire and the exit, so that you always have a route out of the area.
- PASS – Pull pin to unlock extinguisher, Aim at the base of the fire stand 2-3m away, Squeeze the lever to discharge agent, Sweep the spray from left to right until the flames are totally extinguished.
- Most portable extinguishers contain only enough material for 8 - 25 seconds of action, depending on their size.
- If at any time the fire becomes uncontrollable, activate the fire alarm and leave the building by the nearest safe emergency exit.
- Report to the Building Evacuation Coordinator or other emergency responders to ensure that all relevant information is available to them.

If your clothing catches on fire:

- Stop
- Drop to the floor
- Roll to smother the flames
- Get to the safety shower, if possible, and rinse with copious amounts of water
- Seek medical attention

### 11.6 EMERGENCY EQUIPMENT

#### 11.6.1 Fire Extinguishers

There are five classes of fires. The fifth class is not applicable to laboratories, as it represents cooking oil fires. The four applicable classes are listed below:

- Ordinary Combustibles e.g. paper, wood, rubber, many plastics
- Flammable Liquids e.g. flammable and combustible liquids, oils, greases, tars, oil based paints, flammable gases, lacquer.
- Energized Electrical Equipment e.g. wiring, fuse boxes, circuit breakers, plugged-in electrical equipment
- Combustible Metals e.g. sodium, lithium, aluminum, titanium

The type of fire extinguisher used to control a fire depends on the type of fire itself. Extinguishers are rated A, B, C, D and F or combinations thereof. Each laboratory has an ABC (dry chemical) and may also have a BC (CO<sup>2</sup>) rated extinguisher. Any laboratory using combustible metals must have a D-rated extinguisher.

Fire extinguishers should be conspicuously located. Additional signage should prominently indicate the location of the extinguisher. Fire extinguishers should be located near the exit(s) of the laboratories and must be unobstructed and easily accessible at all times.

Any use of a fire extinguisher must be reported immediately, so the extinguisher can be recharged or replaced. Contact Physical Plant extension 4040.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	24

11.6.2 Emergency Showers and Eyewash Stations

Emergency (safety) showers and eyewash stations provide on-the-spot decontamination after exposure to a chemical. Treatment in the first 15 to 20 seconds following an exposure is critical to prevent serious injury, particularly when working with a corrosive substance.

- Design and construction of all new installations of eyewash stations and emergency showers should meet the requirements in American National Standards Institute (ANSI) standard Z358.1.
- Eyewash stations and emergency showers for each laboratory must be readily available and easily accessible, i.e., less than 30 metres from a hazard, and with direct-path accessibility within 10 seconds or less.
- Eyewash stations and emergency showers must be unobstructed at all times.
- Emergency showers and eyewash stations should have prominent additional signage to indicate their location.
- Eyewash stations must be activated at least weekly by personnel in the work area to verify that they are operating properly and to flush pipes.
- Any malfunction of an emergency shower or eyewash station must be reported immediately. Contact Physical Plant extension 4040.

*Guidelines are based on ANSI Standard Z358.1.*


**12. SPECIFIC CHEMICAL HAZARDS**

All chemicals used in the laboratories at Algoma should be handled with caution, in keeping with good laboratory practices. Certain chemicals or classes of chemicals require specific handling precautions, described briefly in the following sections. It is beyond the scope of this manual to address the hazards associated with all of the chemicals that may be found in the university's laboratories and the precautions required in working with them. For more information about the toxicity, safe handling and use of specific chemicals, the appropriate SDS and if necessary references such as those listed below should be consulted:

- NIOSH Pocket Guide to Chemical Hazards, (<http://www.cdc.gov/niosh/npg/npg.html>)
- Sax's Dangerous Properties of Industrial Materials, Richard Lewis. Published by John Wiley and Sons Inc.
- Figure 1 RPR Compatibility Chart

*Figure 1 RPR compatibility Chart*

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	25

 <b>CHEMICAL COMPATIBILITY CHART</b>			
COLOUR	CHEMICAL TYPE	EXAMPLES	ERG #
1	<b>Inorganic Acids Acidic Inorganic Solutions / Salts</b>	Sulfuric, Hydrochloric, Phosphoric & Boric Acid, Copper, Ferric, Tin & Zinc Chloride, Copper & Cupric Sulfate, Sodium Sulfate	154
2	<b>Strong Organic Acids Smelly Acids</b>	Glacial Acetic Acid, Oxalic Acid, Butyric Acid	153
3	<b>Inorganic Alkali Solutions Inorganic Alkaline Salts Inorganic Salts that decompose on contact with acids</b>	Ammonium, Barium, Sodium, Potassium & Zinc Hydroxide, Sodium & Potassium Phosphate, Magnesium Oxide, Zinc Oxide, Calcium Oxide, Potassium, Sodium & Barium Chloride, Sodium & Zinc Sulfides, Sodium Thiosulphates	154
4	<b>Inorganic Cyanides Thiocyanate Ferri/Ferrocyanides</b>	Sodium Cyanide, Potassium Cyanide, Potassium Thiocyanate Ferric, Ferrous Ferrocyanide/Ferricyanide	157
5	<b>Non-Flammable Organic Liquids Organic Solids</b>	Formalin, Starch, Methyl Orange, Malachite Green, Acetylsalicylic Acid, Ethylene Glycol, Propylene Glycol, Glycerin, Glycerol, Water based indicating solutions, Sodium Acetate, Sodium Benzoate, Benzoic Acid, Citric Acid,	132
6	<b>Flammable Organic Liquids</b>	Isopropyl Alcohol, Methanol, Ethanol, Propanol, Butanol, Acetone, Cyclohexane, Phenolphthalein, Denatured Alcohol	131
7	<b>Inorganic Oxidizing Acids Inorganic Oxidizing Agents</b>	Nitric Acid greater than 70%, Perchloric Acid, Silver, Sodium & Lead Nitrate, Sodium Nitrate, Sodium & Hydrogen Peroxide, Potassium, Sodium Persulphate, Potassium Bromate, Sodium Periodate	140
8	<b>Air, Water and shock sensitive</b>	Calcium, Sodium, Lithium, Magnesium Metals, Zinc Dust, Sulphur, Calcium Carbide, Metals in fine powder form, Carbon, Charcoal	138

*RPR Environmental Colour Compatibility Chart- Patent Pending*

### 12.1 FLAMMABLES

Flammable liquids and gases play an important part in many laboratory operations. Accidents with flammables can be avoided by exercising a reasonable amount of care. Flammable liquids and gases present two hazards: toxicity and flammability. A fire hazard exists when a flammable liquid has sufficient volatility so that vapours will mix with the air in ignitable concentrations. The degree of hazard depends upon whether or not a material can burn, its volatility or vapour pressure, its ability to form flammable or explosive mixtures, the ease of ignition of these mixtures and the relative densities of both liquid with respect to water and also the vapour with respect to air.

Flammable or combustible liquids must be used in a fume hood when:

- their use releases flammable vapours which could be potentially explosive,
- liquids are heated to a temperature equal to or greater than their flash point, or
- unstable liquids are used.

Steps must be taken to ensure their appropriate use, handling and storage.

- Ensure containers are grounded appropriately when transferring liquid from one container to another.
- Ensure that potential ignition sources are identified and removed from the area surrounding the flammable material.
- When not required for immediate use, flammable and combustible liquids must be stored in a flammable solvent cabinet.
- The maximum allowable quantity is 235 L in a laboratory.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	26

## Laboratory Safety Manual

- The maximum allowable container size is 5 L. Should larger containers be required, contact the Health and Safety Officer
- All distillations, reactions etc. involving flammables should be set-up in a metal pan, preferably in a fume hood.
- Flammable liquids should be remote from equipment containing sources of ignition and/or open flames or sparks.
- Glass bottles containing flammables should be protected from breakage and spill by use of a metal bucket or acid carrier when in transport.
- No open flames or other sources of ignition are permitted while appreciable amounts of flammables are being poured, or otherwise exposed to the air.
- Fume hood inspection and maintenance is scheduled by Physical Plant.

### 12.2 OXIDIZERS

Oxidizers are capable of igniting flammable and combustible material even in oxygen-deficient atmospheres. They can increase the intensity of a fire by adding to the oxygen supply and causing ignition and rapid burning of normally non-flammable materials. Oxidizers can also:

- React with other chemicals, causing a release of toxic gases.
- Decompose and liberate toxic gases when heated.
- Burn or irritate skin, eyes, breathing passages and other tissues.

#### 12.2.1 Solids

Solid oxidizing agents have the ability to form explosive mixtures with common materials such as sugar, charcoal, starch, sawdust and sulfuric acid. Examples of solid oxidizers include metallic:

- Chlorates;
- Perchlorates (these are especially dangerous and their use should be avoided);
- Nitrates;
- Chromates; and
- Permanganates.

#### 12.2.2 Liquids

Liquid oxidizers are often strong acids as well, making them powerful corrosives. Examples include:

- Perchloric acid. Use of perchloric acid should be avoided if possible. If use is necessary, procedures must be performed by personnel trained in specific handling. All work must be performed in specialized, dedicated chemical fume hoods. Note that anhydrous perchloric acid and perchlorate crystals which may form around the cap of the container are shock-sensitive explosives.
- Nitric acid
- Chromic acid
- Sulfuric acid

Personal protective equipment when working with these compounds should include a face shield, goggles, synthetic rubber apron, lab coat and synthetic rubber gloves.

### 12.3 TESTING FOR PEROXIDES

There are certain common compounds that can form dangerous levels of potentially explosive peroxides upon storage and contact with air (see Table 3). All peroxide chemicals must have a label refer to figure 2.

In order to allow a simple and quick determination of whether peroxides are present in a solution, commercially available peroxide test strips can be purchased from laboratory supply companies.

*Table 3 Examples of Peroxidizable Chemicals*

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	27

<i>Peroxide Hazard in Storage: Discard After 3 Months</i>	
Divinyl acetylene	Potassium metal
Divinyl ether	Sodium amide
Isopropyl ether	Vinylidene chloride
<i>Peroxide Hazard in Concentration: Discard After 1 Year</i>	
Acetal	Dioxane
Cumene	Ethylene glycol dimethyl ether (glyme)
Cyclohexane	Furan
Cyclopentene	Methyl acetylene
Diacetylene	Methylcyclopentane
Dicyclopentadiene	Methyl isobutyl ketone
Diethyl ether	Tetrahydroduran
Diethylene glycol dimethyl ether (diglyme)	Vinyl ethers
<i>Hazard Due to Peroxide Initiation of Polymerization: Discard after 1 Year</i>	
Acrylic Acid	Styrene
Acrylonitrile	Tetrafluoroethylene
Butadiene	Vinyl acetylene
Chloroprene	Vinyl chloride
Chlorotrifluoroethylene	Vinyl pyridine
Methyl methacrylate	

Table reproduced October 15, 2015 from: <https://ehs.princeton.edu/laboratory-research/chemical-safety/reactive-materials/peroxide-forming-chemicals>

*Figure 2 Sample Peroxide Label*

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	28

**WARNING PEROXIDE FORMER**

This material will form explosive peroxides during storage and must not be kept for more than \_\_\_\_\_ months after opening.

Date Received \_\_\_\_\_

Date Opened \_\_\_\_\_

Discard unopened container 12 months after receipt. To schedule disposal with RPR contact biology lab coordinator, x4311.

**DO NOT USE IF OPENED MORE THAN \_\_\_\_\_ MONTHS**

As an alternative to the commercially available strips, the following colorimetric test can be performed.

1. Prepare a 5 % (w/v) potassium iodide or sodium iodide aqueous solution (5 g of KI or NaI per 100 mL of water).
2. Add a couple of drops of iodide solution prepared above to ~ 2 mL of glacial acetic acid.
3. Add ~ 2 mL of the solution in question to the ~ 2 mL of glacial acetic acid/iodide solution.
4. Yellow indicates a low concentration of peroxide (<0.01 %). Brown indicates a high/hazardous concentration of peroxide (> 0.01%).

Note that this test method above should not be applied to solutions that may contain inorganic peroxides.

**12.4 CORROSIVES**

Corrosive chemicals are commonly found in laboratories as solids, liquids and gases. These materials have the ability to damage tissue at the site of contact.

**12.4.1 Corrosive Liquids**

Corrosive liquids can be particularly hazardous as they act rapidly upon contact. Examples of common corrosive liquids are:

- Strong acids (chromic acid, hydrochloric acid, nitric acid, etc. Hydrofluoric acid may be fatal through inhalation, absorption or ingestion and causes extensive, deep and painful burns. Avoid use if possible.)
- Strong bases (aqueous sodium hydroxide, potassium hydroxide, ammonia, etc.)
- Strong oxidizing agents (peroxides, etc.)

**12.4.2 Corrosive Solids**

Inhalation of corrosive dusts presents a particular hazard as the point of contact and the injured tissue, which may belong to the lungs, is internal, creating significant damage that may be difficult to treat and heal. Examples of corrosive solids are lithium oxide, sodium sulphide and phenol, phosphorus pentoxide, calcium oxide, etc.

**12.4.3 Use and Handling of Corrosives**

Specific precautions to take when using or handling corrosive materials include the following:

- Ensure that acids are always added to water and not vice versa.
- Be prepared for heat generation when diluting or dissolving in water.
- Ensure all work is completed in a chemical fume hood with adequate ventilation.
- Must wear appropriate personal protective equipment.

**12.5 HIGHLY REACTIVE MATERIALS**

Reactive materials are used for various purposes in the lab, often because of their reactive properties. Particular care must be taken to ensure safe handling, use and storage of these sensitive chemicals.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	29

### 12.5.1 Water Reactive

The following situations may occur with water reactive chemicals on contact with water:

- Liberation of heat (causing potential ignition of the chemical itself or nearby flammable material);
- Release of flammable, toxic, or oxidizing gas;
- Release of metal oxide fumes (applicable to water reactive metals);
- Formation of corrosive acids.
- Examples are Magnesium, Calcium, Lithium, Potassium, ect.

Care must be taken to ensure that water reactive chemicals are handled and stored away from sinks, water baths or other sources of moisture.

### 12.5.2 Pyrophorics

Pyrophoric chemicals ignite spontaneously on contact with air. Pyrophorics must be handled and stored in such a way as to prevent exposure to air (e.g. storage under an inert gas or under kerosene).

EXAMPLES: Alkali Metals (lithium, potassium), Metal Powders (zinc, iron), Metal Hydrides.

### 12.5.3 Explosives

Explosives are regulated by the Canadian Explosives Act and corresponding regulations.

#### 12.5.3.1 Picric Acid

Picric acid (2,4,6-trinitrophenol) is a reagent used as a component in some biological specimen preserving solutions. When dehydrated, picric acid itself is a dangerous explosive. When in contact with metal, highly shock-sensitive picrate salts can be formed. Use of Picric Acid should be avoided if possible. Prior to bringing the substance there must be demonstrated need and a full risk assessment completed. If use is necessary, procedures must be performed by personnel trained in specific handling. The following are guidelines for the storage and handling of picric acid:

- Picric acid must be stored in water.
- Containers of picric acid are to be inspected at least every 6 months and distilled water added to the containers as necessary to ensure that the picric acid never dries out.
- Ensure the lid of the container of picric acid is securely fastened.
- Containers and lids for storage of picric acid or solutions of picric acid must not be of metal construction.
- Metal spatulas are never to be used to remove material from its container.
- Always wipe the neck of the bottle, and the cap with a wet cloth before returning to storage.

Disposal costs associated with dry picric acid are substantial and are the responsibility of the applicable lab supervisor or department.

### 12.6 CRYOGENIC MATERIALS

Cryogenics are very low temperature materials such as dry ice (CO<sub>2</sub>(s)), liquefied air, nitrogen, helium, oxygen, argon and neon.

The following hazards are associated with the use of cryogenics:

- Asphyxiation due to displacement of oxygen (for materials other than liquefied air and oxygen);
- Freezing and brittling of materials from extreme cold;
- Frostbite;
- Explosion due to pressure build-up; and
- Condensation of oxygen and fuel such as hydrogen or hydrocarbons resulting in explosive mixtures.

The following are precautions for handling cryogenics:

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	30

## Laboratory Safety Manual

- Always handle these liquids carefully to avoid skin burns and frostbite. Exposure that may be too brief to affect the skin of the face or hands may damage delicate tissues, such as the eyes.
- Protect skin and eyes from contact; wear eye protection and insulated gloves.
- Wear safety goggles when breaking large pieces of dry ice or using mixtures of dry ice and solvent.
- Wear a face shield when removing samples from storage dewars due to the possibility of rupture from pressure build-up.
- Use and store in well-ventilated areas. Alarmed oxygen sensors may be required in areas where the volume of gas could result in the displacement of oxygen, thereby causing an asphyxiation hazard.
- Keep away from sparks or flames.
- Use materials resistant to embrittlement (e.g. rubber tubing).
- Watches, rings, bracelets or other jewelry that could trap fluids against flesh should not be worn when handling cryogenic liquids.
- Never store dry ice in a refrigerator/freezer (especially deep chest freezers). Dry ice will sublime at -78°C and could asphyxiate the person opening the equipment.
- Boiling and splashing always occur when charging or filling a warm container with cryogenic liquid or when inserting objects into these liquids. Perform these tasks slowly to minimize boiling and splashing. Use tongs to withdraw objects immersed in a cryogenic liquid.
- Cylinders and dewars should not be filled to more than 80% of capacity, since expansion of gases during warming may cause excessive pressure build-up.

### 12.7 DESIGNATED SUBSTANCES

There are eleven “designated substances” regulated by the Ontario Occupational Health and Safety Act because of their potential serious health implications. Use of designated substances in research or teaching should be avoided. However, because suitable substitution may not be possible, some of these substances are found in university laboratories. Designated substances are listed below:

- acrylonitrile
- arsenic
- asbestos
- benzene
- coke oven emissions
- ethylene oxide
- isocyanates
- lead
- mercury
- silica
- vinyl chloride

Designated substance regulations apply to all workers at workplaces where the substance is present and is likely to be inhaled, ingested or absorbed by the worker. The regulations require that the time weighted average exposure of the worker to the substance is less than limits prescribed in the regulations themselves. Generally designated substance regulations contain three key components:

- Assessment– the employer is required to consider the worker exposure or likelihood of exposure to the substance.
- Control program– a formal document program, required if the assessment discloses that a worker is likely to be exposed to the substance. The program must include engineering controls, hygiene practices, work practices and Physical Resources to ensure that the worker exposure to the substance is controlled.
- Monitoring– air emissions monitoring and medical surveillance are required to determine actual exposure to the substance.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	31



## Laboratory Safety Manual

It is the responsibility of the laboratory supervisor to ensure that such a program exists in their area. A designated substance assessment form for each designated substance in use or in storage must be completed and submitted to Health and Safety for review.

### 12.8 HAZARDS OF COMPRESSED GASES

Compressed gases are inherently hazardous due to the high pressure inside the cylinders. Knocking over an unsecured, uncapped cylinder of compressed gas can break the cylinder valve and result in a rapid escape of high-pressure gas that can transform a cylinder into an uncontrollable rocket or pinwheel, causing serious injury and damage. Compressed gases may also have flammable, oxidizing, dangerously reactive, corrosive or toxic properties. Inert gases such as nitrogen, argon, helium and neon can displace air, reducing oxygen levels in poorly ventilated or restricted areas and causing asphyxiation.

#### 12.8.1 Handling and Transport of Gas Cylinders

The following guidelines should be used for safe handling and transport of gas cylinders.

- Return unlabelled cylinders unopened to the supplier. Colour coding does not provide sufficient identification.
- When cylinders are being transported, regulators must be removed and the protective cap must be attached.
- An appropriate cylinder cart must be used for transporting cylinders. Cylinders must be chained or strapped to the cart.
- Ensure that propane tanks designed for outdoor use are not stored or used indoors.
- Label empty cylinders clearly with either “EMPTY” or “MT” and move to the designated storage area for empty cylinders for pickup by the supplier.
- Never bleed a cylinder completely empty; leave a residual pressure of at least 25 psi to prevent contamination or “suck back”.
- Do not lubricate regulators. The mixture of lubricant and oxidizing gases could be explosive.
- Do not force, lubricate or modify cylinder valves in any way.
- Cylinders containing flammable gases must be grounded to prevent accumulation of electrostatic charge.
- Never expose skin or clothing to compressed gas flow as high velocity gas could penetrate the skin and cause serious injury.
- To use a cylinder:
  - Ensure the pressure regulating valve (adjusting screw) is closed.
  - Open the cylinder valve slowly.
  - Open the pressure regulating valve to the desired pressure.
- To shut off the gas:
  - Close the cylinder valve.
  - Open the pressure regulating valve to relieve the pressure.

#### 12.8.2 Valves and Regulators

- Verify that the regulator is appropriate for the gas being used and the pressure being delivered. Regulators are not universal and have to be chosen based on the gas and the cylinder in use. Compressed Gas Association (CGA) connector numbers must be the same on the regulator and cylinder valve.
- Cylinder valve connections on regulators are designed to minimize the chances of using the wrong regulator by having threads that will fit only with the type of gas the regulator is designed for.
- Label all regulators appropriately and do not use regulators interchangeably with different gases.
- Do not rely on the pressure gauge to indicate maximum pressure ratings; check the regulator's specifications.
- Do not use adaptors or Teflon tape to attach regulators to gas cylinders. Regulator inlet connections are designed to fit the outlet connection of the cylinder valve of a particular gas. Gas tight connections are made using metal-to-metal seals and can be weakened or the lines plugged through the use of Teflon tape.
- When tightening the regulator nut and hose connections, always use a cylinder wrench or other tightly fitting wrench.
- Do not use an oversized wrench, adjustable wrench, pliers or pipe wrench. These tools may damage the fittings and make it impossible to tighten them properly.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	32

### 12.8.3 Leaks

Most leaks occur at the valve in the top of the cylinder and may involve the valve threads, valve stem, valve outlet, or pressure relief devices. Lab personnel should not attempt to repair leaking cylinders. It is important to note that cryogenic liquid cylinders will vent periodically as part of their normal operation to relieve pressure. When a vent valve becomes frozen open, treat the cylinder as if it is leaking.

Where action can be taken without serious exposure to lab personnel:

- Move the cylinder to an isolated, well-ventilated area (away from combustible materials if the cylinder contains a flammable or oxidizing gas). Call 911.
- Whenever a large or uncontrollable leak occurs, evacuate the area immediately and call 9-911 from any campus phone and Security

### 12.8.4 Storage of Gas Cylinders

Storage of gas cylinders is regulated through the Ontario Fire Code Section 5.6. Only cylinders in use may be located in research or teaching labs.

- All cylinders must be secured to a wall, bench or fixed support using a chain or strap placed 1/2 to 2/3 high on the cylinder body. Cylinder stands may be used as an alternative to straps.
- Cylinders should be strapped individually.
- Do not store full and empty cylinders together.
- Oxidizers and flammable gases should be stored in areas separated by at least 20 feet or by a non-combustible wall.
- Cylinders should not be stored near radiators or other heat sources.
- No part of a cylinder should be subjected to a temperature higher than 52°C. A flame should never be permitted to come in contact with any part of a compressed gas cylinder.
- Do not place cylinders where they may become part of an electric circuit.
- Ensure that each cylinder is properly and prominently labelled as to its contents.

### 12.8.5 Segregation of Gas Cylinders

As with other chemical storage, certain compressed gases are incompatible with each other. Table 4 below describes the segregation required for compressed gases.

*Table 4 Segregation of compressed gases by type*

	Flammable compressed gases	Oxidizing Compressed gases	Non-flammable Toxic compressed gases	Non-flammable, non-toxic compressed gases
Flammable compressed gases	√	x	x	√
Oxidizing Compressed gases	x	√	√	√
Non-flammable Toxic compressed gases	x	√	√	√
Non-flammable, non-toxic compressed gases	√	√	√	√
Examples:				
Flammable compressed gases	Methane, propane, acetylene, hydrogen			
Oxidizing Compressed gases	Oxygen, bromine, chlorine			

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	33

Non-flammable Toxic compressed gases	Carbon monoxide, Hydrogen Sulphide
Non-flammable, non-toxic compressed gases	Helium, nitrogen, air, Carbon dioxide, argon

### 12.9 OTHER TOXIC MATERIALS

Some other chemical materials warrant mentioning due to their hazards and/or extensive usage. The primary hazards are identified below:

- Ethidium bromide – known mutagen.
- Chloroform – acutely toxic and carcinogenic.
- Hydrogen sulphide – acutely toxic. Attacks the respiratory system. Highly flammable.
- Formalin/Formaldehyde – carcinogen.

## 13. CHEMICAL HANDLING AND STORAGE

Because of limited space and waste disposal costs, and in keeping with good housekeeping practices and the desire to minimize hazardous materials within the laboratories, it is essential to procure reagents, solvents, etc. as needed, rather than buying in bulk.

**13.1 GENERAL TRANSPORT PRACTICES** Use a cart when transporting several containers or containers that are large, awkward or heavy. Carts should have high edges for containment, or chemicals should be in secondary containers. Transport off-site requires compliance with federal Transportation of Dangerous Goods regulations.

### 13.2 GENERAL STORAGE PRACTICES

- Store large containers on lower shelves.
- Avoid storing containers above eye level.
- Window sills, heaters and ledges may not be used as storage areas.
- Avoid storage on the floor unless the chemical container is in its original shipping carton and packing, or the container is an approved safety can.
- Inspect chemicals in storage regularly to ensure that:
  - There are no leaks. Caps and containers are in good condition. Look for signs of discolouration, bulging and pressure build-up. Containers' exteriors are free of spills and stains.

### 13.3 STORAGE OF FLAMMABLES AND COMBUSTIBLES

Definitions:

Flammable liquid – a liquid having a flash point below 37.8°C and a vapour pressure not more than 275.8 kPa (absolute) at 37.8°C.

Combustible liquid– any liquid having a flash point between 37.8°C and 93.3°C

Storage of flammable and combustible liquids in the laboratory is regulated by the Ontario Fire Code. Maximum quantities listed below are for single fire compartments with a minimum fire resistance rating of one hour.

- Ensure that the flammable and combustible material in the open lab area is minimized and is for immediate use only (less than a total of 300 L, of which no more than 50 L is flammable liquid: Ontario Fire Code)
- Ensure that all additional flammable material (up to a total of 500 L of which not more than 235 L is flammable liquid) is stored in approved flammable storage cabinets.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	34

## Laboratory Safety Manual

- Ensure that flammable materials requiring refrigeration are stored in refrigerators/freezers designed and certified for this purpose.
- Household refrigerators must not be used to store flammable liquids.
- Storage containers are to be less than 5 L unless they are safety containers conforming to ULC/ORD-C30. Safety containers must be less than 25 L capacity.

### 13.3.1 Approved Flammable Storage Cabinets

To be approved for storage of flammables, cabinets must conform to at least one of the following standards:

- ULC-C1275, "Storage Cabinets for Flammable Liquid Containers";
- ULI 1275, "Flammable Liquid Storage Cabinets";
- Factory Mutual Research Approved; or
- Meet NFPA 30.

Flammable storage cabinets either need to be vented actively to the outdoors or capped with the plugs supplied with the cabinet itself. While it is recommended that flammable storage cabinets are not vented, venting is acceptable provided that the venting design does not interfere with the integrity of the cabinet.

### 13.3.2 Chemical Segregation

It is critical that chemicals be stored to ensure that incompatible chemicals are not in close proximity. Figure 1 outlines the colour coded segregation system used by the Institution. It is suggested that solvents/reagents etc. be labelled according to the storage system to facilitate proper storage.

### 13.4 Partial List of Incompatible Chemicals

Consult the Chemical Management Program for more information on incompatible chemicals.

### 13.5 CONTAINMENT

Care should be taken to ensure that chemicals/reagents/samples/solutions etc. are stored to minimize the risk of spills. Primary storage containers should be of a composition to maintain their structural integrity throughout the lifespan of the material they are holding through normal storage and use. Secondary containment should be used in all storage locations. This is containment (over-packs, spill trays, etc.) used in addition to the primary container to prevent release of material to the environment in the event that the primary container fails.

## 14. FUME HOODS AND BIOLOGICAL SAFETY CABINETS

Fume hoods and biological safety cabinets are critical pieces of laboratory equipment. If used and maintained properly, they are the most effective engineering control in protecting laboratory personnel against exposure to hazardous materials. Fume hoods are used to reduce levels of hazardous products produced or used during experiments by confining them to an area separate from the laboratory, diluting them with large quantities of air and expelling them long distances from the building.

### 14.1 CHEMICAL FUME HOODS

All work involving hazardous chemicals should be performed in an appropriate chemical fume hood.

It is recommended that for normal use, fume hoods have face velocities of 80-100 fpm with a sash opening of 12" to ensure effective protection from the materials being used. Face velocities less than or significantly greater than this may limit the

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	35

## Laboratory Safety Manual

applications of the particular hood. Physical Plant coordinates a program for annual calibration and testing of fume hood air flow alarms.

Physical Plant is responsible for routine preventative maintenance of fume hood exhaust fans. This includes inspection of pulleys, belts, alignment, flexible connections, dampers and operation of the fan as well as greasing of fan bearings and motor bearings as applicable. Parts are replaced as required. If a problem with fume hood ventilation is identified, contact your local Physical Plant department; see the contact list at the beginning of this manual.

### 14.2 BIOLOGICAL SAFETY CABINETS

Biological safety cabinets are designed to protect people and the environment from contamination by micro-organisms and to prevent contamination of the samples/cultures within the cabinet. The units have high efficiency particulate air (HEPA) filters to clean the supply and exhaust air.

Generally biological containment cabinets should not be used for chemicals as they may have lower face velocities, recirculate the air within the cabinet itself which could lead to the build-up of fumes, and consist of filters that are not suitable for the collection of chemical vapours. Refer to the Biosafety Manual for detailed information on types, use, operation and maintenance of biological containment cabinets.

### 14.3 PROPER USE OF FUME HOODS/BIOLOGICAL SAFETY CABINETS

As noted above, chemical fume hoods and biological safety cabinets are the primary source of protection against hazardous materials. For these critical pieces of equipment to be effective the user must:

- Make sure that the exhaust blower is operating and air is entering the hood, prior to starting an experiment. If the monitor is alarming or not functioning please call Physical Plant at ext. 4040. If the hood is not working properly please call Physical Plant and have the hood repaired prior to using it.
- Do not place your face inside the hood. Keep hands out as much as possible. Perform all work involving hazardous or volatile materials in operating fume hoods.
- Connect all electrical devices outside of the hood to avoid sparks which may ignite a flammable or explosive chemical.
- Note that the hood is not a substitute for personal protective equipment.
- Always work at least 6 inches in from the opening of the fume hood.
- Do not modify fume hood.
- Do not use your fume hood as a storage area
- Avoid blocking off baffle exhaust slots in any manner. Elevate large equipment "2" inches off the base of the fume hood.
- Large pieces of equipment or numerous persons standing in front of the fume hood will cause turbulence.
- Be aware of other room ventilation factors that may interfere with your fume hood operation, such as open doors to labs, open windows, blocked exhaust ports or heating and air conditioning vents.
- Avoid cross drafts and disruptive air currents in front of the fume hood.
- Use the sash as a safety shield when boiling materials or conducting an experiment with reactive chemicals.
- Prepare a plan of action in case of an emergency, such as a power failure, especially when using extremely hazardous chemicals or acids.
- Work with the sash at the proper operating level as indicated by the arrows.
- When fume hood is not in use, keep sash closed.
- When fume hood is not in use, ensure that all materials are in sealed containers.
- Minimize the sash opening for maximum protection.
- Avoid storing chemicals/equipment in the fume hood/cabinet, as this restricts the air flow. Flammable solvents/reagents must not be stored in the fume hood/cabinet.
- Avoid blocking the baffle(s); place equipment on legs if possible to maintain effective airflow.
- Work a minimum of 10 cm into the fume hood/cabinet.
- Never work in a fume hood/cabinet that is in alarm.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	36

## Laboratory Safety Manual

- Ensure that the fume hood/cabinet is not cluttered.
- Ensure that all waste, reagents, solvents and samples are sealed when not being used.
- Ensure that all electrical connections are outside of the fume hood/cabinet.
- Ensure that the fume hood/cabinet is kept clean and neat.
- Always close the sash when not in use

### 14.4 FUME HOOD MAINTENANCE

Physical Plant will coordinate the maintenance of all fume hoods, biohazard hoods and associated local exhaust ventilation systems. In this document, the term "fume hood" is used to mean any of these systems.

- Before beginning any maintenance work or repairs, the worker who is to perform the work will contact the designated person to inform them about the nature of the work and to receive any special instructions, such as safety precautions.
- Prior to and during the maintenance work the designated person is responsible for ensuring that the fume hood is free from hazard. Health and Safety will become involved when there are unresolved health and safety issues.
- Before beginning work, the worker will attach a sign to the hood in a prominent place indicating the hood is out of order. Such signs are available from the Department of Physical Plant. Whenever possible, the sign will state the estimated time required for repairs. This will also include all other fume hoods interconnected to the fume hood being worked on.
- The worker will lockout the hood before beginning work. This will also include all other fume hoods interconnected to the fume hood being worked on.
- The worker will wear an appropriate respirator and the appropriate disposable gloves and other protective equipment required for the work being done. These must be specified by the designated person identified by the fume hood user department. If assistance is required contact the Health & Safety Officer.

## 15. HAZARDOUS WASTE DISPOSAL

All Laboratories must properly dispose of chemicals, regardless of their size or nature of their work. Improper disposal procedures can be extremely hazardous to personnel and the environment. Disposal of hazardous waste is regulated through the provincial Ministry of the Environment (MOE). Hazardous wastes are never to be flushed down the drain or left to evaporate in a fume hood. Hazardous waste disposal is managed through Health and Safety. Waste is picked up directly from laboratories. Refer to Algoma's "Hazardous Chemical Waste Procedure."

Hazardous waste disposal fees are considerable. There is no cost to the labs or departments for waste disposal, except in the following cases:

- Waste disposal costs resulting from lab "clean-ups";
- Disposal of atypical wastes e.g. explosives, PCBs, compressed gases etc.

Hazardous wastes include the following substances:

- Toxic agents including drugs, chemicals, natural and synthetic products;
- Corrosive substances;
- Flammable materials including flammable liquids, finely divided metals or powders, and flammable solids;
- Oils and other petroleum products;
- Explosives;
- Oxidizers and organic peroxides;
- Compressed gases;
- Pesticides and herbicides;
- Pyrophoric materials;

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	37

## Laboratory Safety Manual

- Materials that will leach toxic materials, e.g., contaminated soils;
- Biohazardous agents;
- Radioactive materials; and
- Sharps (needles, blades, broken glassware, etc.).

All hazardous waste must be suitably contained, properly labeled and properly disposed.

### 15.1 MINIMIZING HAZARDOUS WASTE

In keeping with environmental responsibility, it is important to minimize waste generation. The following points may be of assistance:

- Buy only what you need.
- Miniaturize experiments.
- Choose non-hazardous substances over hazardous substances (e.g. use digital or ethanol-based thermometers over mercury-based thermometers).
- Return unused material to the supplier if possible (e.g. gas cylinders).
- Redistribute usable materials.
- Recycle/recover materials when this can be accomplished efficiently, effectively and safely.
- Do not accept donations of materials that you don't plan to use in the near future.

### 15.2 PACKAGING AND LABELLING REQUIREMENTS

The generator of waste is responsible for providing appropriate waste containers and for ensuring that all hazardous waste is packaged and labelled appropriately. The following guidelines should be followed:

- Incompatible materials may not be combined in a single waste container.
- Chemical liquid waste containers may not to be filled beyond approximately 75% of their capacity to allow for vapour expansion.
- Container materials must be compatible with the contained wastes (e.g. hydrofluoric acid cannot be stored in glass containers; corrosives may not be stored in metal containers).
- Containers must be in good condition.
- Wastes must be identified appropriately (e.g. biohazard bags may not be used for chemical wastes if no biohazard exists).
- Non-hazardous wastes must be segregated from hazardous waste streams to avoid unnecessary expenses.
- Hazardous waste containers must be labelled with the first date that waste was added to the container. As per provincial legislation waste may not be kept for longer than 3 months.
- Hazardous waste must be clearly labelled with the identity of the waste and the generator of the waste.
- Labels must identify:
  - The date (or range of dates) the waste was generated.
  - The type of waste, i.e., liquid, acid, solvent, solid, gas, etc.
  - If the waste is a mixture, the percentage of ingredients must be noted.
  - Known hazards of the waste.
  - Full name of the supervisor who's lab generated the waste, i.e., researcher or department.
  - Name of the supervisor and his/her location.
  - Incompatibility of waste to other chemical and/or substance.

### 15.3 CHEMICAL WASTE

Hazardous chemical waste is picked up regularly by a hazardous waste contractor. Note that consumer products such as cleaning solvents, paints, paint thinners, oils and pesticides must be disposed as hazardous waste.

If you have waste for disposal complete a hazardous waste disposal label and attach it to waste containers.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	38

### 15.3.1 Unknown Waste

Waste of unknown composition will not be picked up by the hazardous waste contractor. It is the responsibility of the laboratory supervisor to identify or categorize the “unknown”.

### 15.4 BIOHAZARDOUS WASTE

Biohazardous wastes are defined as hazardous pathological waste by the Ontario Environmental Act. This waste is to be stored in specific approved containers available from Biology Lab Coordinator.

#### ***Deactivation by Steam Sterilization***

All biohazard waste is to be autoclaved prior to disposal through the regular waste system.

- Liquid cultures, biohazardous fluids and contaminated rinse fluids are collected in glass flasks and autoclaved prior to disposal via the drain.
- Contaminated solids, papers, and disposable non-sharps are collected in bench- top and floor-model biohazard bag receptacles and autoclaved prior to disposal through the regular waste collection system.
- Disposable plastic pipettes are returned to their sleeves following use, and autoclaved before disposal through the regular waste collection system.
- In addition to the general disposal process each risk group and specific agents may have additional decontamination or disposal requirements. Refer to SDS for specific requirements.

#### Risk Group 1

There are no additional requirements in Risk Group 1.

#### Risk Group 2

Some of the agents in risk group 2 may require specific disinfectants. Some of these agents may require inactivation with a solvent or solution other than a disinfectant prior to disposal or clean-up.

Refer to the Algoma University Biosafety Manual for details.

### 15.5 SHARPS WASTE

Any item with corners, edges or projections that are capable of cutting or piercing the skin is considered a sharp. Sharps must be separated from regular waste streams to prevent unnecessary needlestick injuries and/or lacerations. Sharps must be collected into puncture and leak proof containers.

All sharps require incineration regardless of whether they are contaminated or not. Arrange for proper disposal through Health and Safety.

#### 15.5.1 Broken Laboratory Glassware

Clean broken glassware, including Pasteur pipettes and broken laboratory glassware, must be separated into an appropriately marked glass waste container. Custodial staff will remove glass waste once the containers are full. Contaminated broken glassware must be packaged and labelled according to the contaminant.

#### 15.5.2 Syringes, Needles, Scalpels and Blades

- Dispose of syringes, needles, scalpels and blades in standard “Sharps” containers.
- When a container is full, autoclave according to Canadian Council of Ministers of the Environment, (CCME) guidelines for biomedical waste (i.e. 120°C at 105 kPa for more than 60 minutes). If autoclaving is not possible, the container will be disposed of through a hazardous waste contractor. Contact Health & Safety for more details.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	39



### 15.6 BATTERIES

Waste batteries can be deposited into receptacles for recycling that are located in various departments on campus.

## 16. CHEMICAL SPILL PREVENTION AND PREPAREDNESS

Prevention of chemical spills is critical to any work involving chemicals. However, laboratory personnel should be aware of spill clean-up procedures and be prepared to respond should a spill occur. General procedures for responses to minor or major chemical spills are given below. It is at the discretion of the Supervisor to determine what constitutes a minor or major chemical spill given the hazards of the chemical and concentration. Any spills of hazardous materials that cannot be contained, e.g. down a sink, outside, in a hallway or public area must be reported immediately to Security at ext. 4444.

### 16.1 TRAINING

It is the responsibility of the laboratory supervisor to ensure that lab personnel are trained in appropriate chemical spill response specific to the chemicals contained within their laboratory. Training should be documented and renewed as deemed necessary by the supervisor.

### 16.2 SPILL KITS

Each laboratory using hazardous chemical materials must have easy access to a chemical spill kit that is prominently located, readily visible and identifiable. A spill kit may be shared between laboratories provided that all personnel are aware of its location and that it is easily accessible at all times. Specific contents of a spill kit should be based on the hazardous properties and volumes of the materials present in the lab(s).

If mercury or mercury compounds are present in the laboratory (including mercury in thermometers) a mercury spill kit must be available.

It is recommended that an inventory list be included on/in spill kits to allow for easy inspection. Inspections should be performed regularly and documented (e.g. on an inspection tag). Inspections should include verification of contents and ensuring that supplies are not expired and are in good condition.

### 15.3 SPILL CLASSIFICATION

*Major spills*– These are spills that require further assistance for clean-up. Major spills include all chemical spills which occur in areas which cannot be easily decontaminated or contained, such as in sinks, drains, outside of the laboratory, or in large quantities. Major spills involve chemicals or quantities of materials in excess of those outlined in Table 5:

*Table 5 Guidelines for Classification of a Major Spill*

Material	Quantity
Air and water reactive materials	All quantities
Flammable liquids	Greater than 4L
Combustible liquids	Greater than 4L
Non-flammable organic liquids	Greater than 4L
Concentrated acids	Liquids greater than 1L Solids greater than 1 kg
Concentrated bases and alkalis	Liquids greater than 1L Solids greater than 1 kg
Mercury	Greater than 30 mL

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	40

## Laboratory Safety Manual

Oxidizers	Liquids greater than 1L Solids greater than 500g
Highly toxic, highly malodorous materials (e.g. phenol, mercaptoethanol, hydrofluoric acid)	Liquids greater than 100 mL Solids greater than 50g
Low hazard material	At the discretion of laboratory personnel
Compressed gas leaks	If the leak cannot be stopped by closing the valve on the gas cylinder ?

The table above provides guidelines for quantities only. Other considerations for classifying a spill as major include whether respiratory protection is required, whether the material is unknown, and whether personal injuries have been sustained.

Laboratory personnel should never attempt to clean up a spill if they have not been trained in the proper chemical spill response or if they are unsure of the proper procedures.

*Minor Spills*– These are spills that can be cleaned up by trained laboratory personnel, and do not meet the criteria for a major spill, above.

### 16.4 SPILL RESPONSE

#### Response to a Major Spill:

- Evacuate the immediate area, turn off spark producing equipment, use emergency shut off for gas, close doors, restrict the area, and notify others in the area of the spill.
- Assist contaminated personnel with use of emergency eyewash or shower if applicable.
- From a safe location, Call Security. Identify the chemical involved, quantity spilled and hazards.
- Activate fire alarm if there is risk to the safety of other people in the building.
- Be available to provide technical information to emergency responders, e.g. identify of the spilled chemical(s), SDS, identity of other equipment and hazardous materials in the lab.

#### Response to a Minor Spill:

- Attend to injured or contaminated personnel.
- Restrict the area and notify others in the lab of the spill.
- Take action to minimize the effects of the spill.
- If a flammable material is involved, turn off ignition sources (i.e. shut off power to area, turn off Bunsen burners, use emergency shut off for gas etc.)
- Select and wear all appropriate personal protective equipment.
- It is the responsibility of the user of the hazardous material to clean up the spill, if he/she feels it is safe to do so.
- Apply spill pillow/pads or other absorbent material, first around the outside of the spill, encircling the material, then absorb to the center of the spill.
- All personal protective equipment must be disposed of correctly, and must not be worn outside the laboratory.
- Dispose of all materials used to clean up the spill in a sealed container.
- Label and dispose of all bags or containers as hazardous waste. If you are unsure of the proper clean-up procedure, contact your supervisor for guidance. Health and Safety is also available to provide guidance at ext 4373.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	41

### 16.5 OTHER SITUATIONS

Chemical spill on the body:

- Remove all contaminated clothing.
- Flood exposed area with running water from a safety shower for at least 15 minutes.
- Have another individual contact Security at ext. 444 and 9-911 to obtain medical attention.
- Report the incident to your supervisor.

Chemical splashed in the eye(s):

- Immediately rinse eyeball and inner surface of eyelid with water continuously for 15 minutes. Forcibly hold eye lid(s) open to ensure effective wash behind eyelids.
- Have another individual contact Security at 9-911 and obtain medical attention.
- Report the incident to your supervisor.

## 17. LABORATORY EQUIPMENT AND PROCEDURES

Many pieces of laboratory equipment can be hazardous if not used and maintained appropriately. Personnel should be trained in the use of laboratory equipment prior to using the equipment. General precautions for the use of some apparatus are provided in the following sections. Specific operational instructions provided in manufacturer's instruction manuals and in-lab standard operating procedures must be followed. These manuals/procedures should be located with the equipment or otherwise easily accessible. Maintenance or repairs on any laboratory equipment should be performed only by competent personnel trained and qualified to perform such work. Safety devices on laboratory equipment must not be disabled.

### 17.1 NEW EQUIPMENT

When purchasing new equipment, preference should be given to equipment that

- Limits contact between the operator and hazardous material, and mechanical and electrical energy
- Is corrosion-resistant, easy to decontaminate and impermeable to liquids
- Has no sharp edges or burrs.
- Meets relevant Provincial standards. Prior to purchase, contact Physical Plant and/or Health and Safety Office to review requirements.

### 17.2 REFRIGERATORS AND FREEZERS

#### General:

Refrigerators/freezers used for chemical storage must have signs indicating their purpose. Food and beverages are not permitted in a refrigerator containing chemicals. To reduce odour build-up in a refrigerator seal all containers tightly and wipe any spilled material from the container prior to storing in the refrigerator. All containers must be clearly and legibly labelled (ie. WHMIS labels).

#### Approved equipment:

Refrigerators/freezers must be CSA certified and in the case of explosion-safe refrigerators must also be UL listed. Converting domestic units into flammable storage units is not permitted.

#### Chemical storage:

##### Non-flammable chemicals

Domestic refrigerators/freezers are suitable for storage of non-flammable chemicals.

##### Flammable chemicals

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	42

## Laboratory Safety Manual

Laboratory explosions have resulted when ordinary domestic refrigerators have been used for storage of flammable liquids, and leaking vapours have reached one of the many ignition sources within such refrigerators. **Domestic refrigerators/freezers are not be used to store flammable liquids. You can contact the Health and Safety Officer if you are uncertain of your situation.** Flammable chemicals requiring refrigeration must be stored in a refrigerator/freezer designed for the safe storage of flammables. Flammable liquids are defined by the Ontario Fire Code as having a flash point of less than 37.8 degrees Celsius.

**Explosion-safe** or **laboratory-safe** refrigerators/freezers must be used. These units have no electrical sparking devices, relays, switches, or thermostats that could ignite flammable vapours inside the cabinet. Flammable storage refrigerators may incorporate design features such as thresholds, self-closing doors, magnetic door gaskets, and special inner shell materials that control or limit the damage if a reaction occurred within the storage compartment.

Please note that the more costly **explosion-proof** refrigerators/freezers are not required (unless the refrigerator/freezer is in a location where there is a volatile atmosphere such as a solvent dispensing room). These units are similar in design to the explosion-safe units, but also have all operating components sealed against entrance of explosive vapours. Electrical junction boxes are also sealed after connections are made.

### Service and repair

Refrigeration equipment is to be serviced by a person certified under the regulation (Environmental Protection Act). Refrigeration equipment can be disposed of only after the refrigerant has been removed and the equipment tagged by a person certified under the regulation.

### 17.3 THERMOMETERS

Thermometers are often thought of as innocuous lab devices that pose little harm due to their simplicity. However, there are several things lab workers should be aware of when choosing and using thermometers:

#### Mercury thermometers

Although mercury thermometers are not harmful when intact, they pose a threat to [human health](#) and the environment when broken or disposed of as trash. When a mercury thermometer breaks, drops of the liquid metal become lodged in floor cracks and behind equipment. When spills occur and/or are not contained safely, the mercury vapour concentration in a lab may exceed safe limits. There is also potential for acute exposure if mercury droplets come into direct contact with the skin and are absorbed.

A spill is even more dangerous when mercury thermometers break in ovens or in incubators because mercury evaporates readily at high temperatures, creating high mercury concentrations and acute exposures.

Elimination of these hazards can be done by removal and replacement of mercury thermometers with alcohol or mineral spirits based thermometers. For this reason, the use of mercury based thermometers will be banned from January 1<sup>st</sup> 2016.

#### What to do if you break a mercury thermometer

1. Isolate the immediate area to avoid tracking of droplets on footwear or contamination of clothing or equipment.
2. Wear nitrile gloves (mercury is absorbed through the skin), a lab coat, and safety glasses.
3. Obtain a mercury spill kit to properly clean up the spill.
4. Use tongs or other tools to pick up glass from the broken thermometer.
5. Carefully inspect the area to ensure that all the mercury is cleaned up, as very small droplets are difficult to see when spilled and can spread over a large area.
6. Package the spills material, glass and any other contaminated objects in a sealable plastic container and dispose of according to hazardous waste disposal procedures.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	43

## Laboratory Safety Manual

**Do not dispose of intact thermometers in the regular garbage. Intact thermometers must be disposed of as a hazardous waste. In the case of larger mercury spills or those at elevated temperatures, follow procedures for hazardous materials spills that pose an immediate health threat.**

### 17.4 ATOMIC ABSORPTION SPECTROMETERS

Sample preparation for atomic absorption (AA) procedures often requires handling flammable, toxic and corrosive products. Use the SDS and/or other suitable reference and follow the recommended safety precautions. Atomic absorption equipment must be adequately vented, as toxic gases, fumes and vapours are emitted during operation. Other precautions for carrying out atomic absorption analysis are as follows:

- Wear safety glasses suitable for protection against impact.
- Inspect the integrity of the burner, drain and gas systems prior to use.
- Allow the burner head to cool to room temperature before handling.
- Avoid viewing the flame or furnace during atomization unless wearing protective eyewear.
- Handle hollow cathode lamps with care, as they are under negative pressure. Dispose of hollow cathode lamps as hazardous waste to minimize implosion risks.

### 17.5 AUTOCLAVES

Autoclaves are pressurized sterilizing chambers. They are generally used to sterilize glassware, instruments, gloves, liquids in bottles, biological waste, and other materials by steam under pressure. Autoclaves are typically at pressures a little under two atmospheres, and at temperatures of up to 135°C. Autoclaves present potential burn and explosion hazards due to high temperature and pressure. The stored energy in the steam is tremendous and autoclaves differ from other steam receivers in that they have to be opened frequently, and residual pressure may not be detectable by the pressure gauge. Prior to using an autoclave, users must receive training on safe use and adhere to the user guidelines and standard operating procedures.

- Autoclaves are inspected annually by a qualified inspector and must have a certificate of inspection prior to use.
- The inspection certificate is to be posted in a conspicuous location near the autoclave.
- Inspections and tests are to be performed by trained, qualified personnel.
- Autoclaves must be equipped with a safety/pressure release valve set at or below the maximum pressure of the autoclave.
- PPE to be worn when loading or unloading an autoclave, as follows:
  - heat insulating gloves;
  - goggles and a face shield if a splash hazard exists;
  - splash apron; and
  - closed-toed shoes.
- Oils, waxes, certain plastics, flammable materials, radioactive materials and samples containing substances that may emit toxic fumes may not be autoclaved.
- Ensure that lids to all containers are loosened to prevent pressure build-up during heating and a vacuum upon cooling.
- Ensure that containers of liquid are no more than 2/3 full.
- Use secondary containment to prevent spillage (i.e. put items in trays that will catch spills should they occur).
- When unloading the autoclave:
  - ensure that the autoclave has depressurized prior to opening the door.
  - stand to the side of the autoclave, away from the door and crack open the door approximately 1" to allow steam to escape and pressure within liquids and containers to normalize
  - let autoclaved items stand for at least 10 minutes

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	44

## Laboratory Safety Manual

- open the door and carefully remove the items from the autoclave, transferring them to a safe location where they can cool completely. Superheated liquids can "bump" when they are removed from the autoclave causing a spray of boiling liquid if proper containers aren't used.
- If the autoclave becomes non-functional, label it as such and initiate maintenance/repairs as appropriate and in accordance with department policies.
- Check the autoclave periodically to ensure that the seals to the closures are in good condition, and that safety devices to prevent excessive temperatures and pressures are in working order.

### Required Controls:

1. **Safe working pressure** - a suitable reducing valve or other suitable automatic appliance to prevent the safe working pressure being exceeded.
2. **Safety valve** - a suitable safety valve adjusted so as to permit steam to escape as soon as the safe working pressure is exceeded.
3. **Accurate steam pressure gauge** - to indicate the pressure of the steam in the vessel.
4. **Isolating valve** - one for each autoclave.
5. **Interlocks** between the door locking mechanism and the steam inlet valve to ensure that steam cannot be turned on unless the door is properly closed and fully locked.
6. That the door cannot be unlocked unless the steam inlet valve is closed and the exhaust valve is completely open.
7. **A test cock** or other equivalent device to give an audible and visual indication of internal pressure in the autoclave. This test cock has to be interlocked with the door locking mechanism, so that the test cock will be completely open before the door can start to unlock.

### 17.6 BLENDERS, GRINDERS AND SONICATORS

When used with infectious agents, mixing equipment such as shakers, blenders, grinders, sonicators and homogenizers can release significant amounts of hazardous aerosols, and should be operated inside a biological safety cabinet whenever possible. Do not use flammable solvents in equipment such as blenders and stirrers as they can also produce a large amount of flammable vapours.

Ensure equipment has safety features that will minimize leaking and prevent operation if blades are exposed.

Ensure that any equipment that could move during use is secured to a bench or the floor as applicable.

Ensure equipment is in good condition prior to use.

Allow aerosols to settle for at least one minute before opening containers.

### 17.7 CENTRIFUGES

Safe use of centrifuges requires proper maintenance and operation. Failed mechanical parts or improper operation can result in release of projectiles, hazardous chemicals and biohazardous aerosols. Maintenance and repairs must be performed only by trained, qualified personnel.

To maintain your safety, sample integrity and the equipment:

- Ensure that centrifuges have an interlocking device that will prevent both the lid from being opened when the rotor is in motion and the centrifuge from starting when the lid is open
- Ensure that centrifuge tubes are free of hairline cracks, stress lines and chipped rims prior to use.
- Ensure that tube materials are chosen such that they provide the necessary chemical resistance and speed rating.
- Avoid over-filling tubes.
- Cap or stopper centrifuge tubes.
- Use sealed centrifuge buckets (safety cups) or rotors that can be loaded and unloaded in a biological safety cabinet or chemical fume hood as appropriate.
- Decontaminate the outside of the cups/buckets and rotors before and after centrifugation.
- Inspect o-rings regularly and replace if they are cracked or dry.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	45

## Laboratory Safety Manual

- Ensure that the centrifuge is properly balanced. Load the rotor with samples arranged symmetrically. Opposing tubes must be of equal weight. If necessary, use "water blank" tubes to balance sample tubes of unequal weight. Do not use sight or volume to conclude that tubes are balanced. Use an electronic balance to balance tubes before using them in an ultracentrifuge.
- Ensure that the prescribed speed limitations of the rotor or centrifuge are never exceeded.
- Unless fitted with a suitable exhaust system, do not centrifuge materials capable of creating flammable or explosive vapours.
- Remain with the centrifuge until it has reached its programmed speed.
- Abort the run immediately if you hear abnormal vibration, whining or grinding noises.
- Check the rotor lid and balance.
- At the end of the run ensure that the rotor and centrifuge are cleaned according to manufacturer's instructions. Never use abrasive cleaners.
- Rotors are easily damaged. Never use metal tools to remove tubes or clean the rotors.
- If the centrifuge is connected to a vacuum pump, ensure that the pump exhaust is connected to a trap.
- If biohazardous materials are being centrifuged and the centrifuge is connected to a vacuum pump, ensure that a HEPA filter is installed between the centrifuge and the vacuum pump.

### 17.8 ELECTROPHORESIS

The use of voltages of approximately 200 V and currents of more than 80 mA in electrophoresis procedures could create the potential for an electrical shock if the equipment is not operated properly.

- Use physical barriers to prevent inadvertent contact with the equipment.
- Ensure that electrophoresis equipment is properly grounded.
- Inspect electrophoresis equipment regularly for damage and potential buffer tank leaks.
- Locate equipment away from high traffic areas and away from wet areas such as sinks or washing apparatus.
- Use of ground fault circuit interrupters is recommended.
- Display warning signs to identify the electrical hazards (i.e. "Danger – High Voltage").
- Turn off power before connecting leads, opening the lid or reaching into the chamber.
- Ensure that lead connectors are insulated.

### 17.9 GAS CHROMATOGRAPHS

Gas chromatography (GC) procedures involve the use of compressed gas cylinders and may involve the use of flammable solvents and toxic chemicals. Be familiar with the use and handling of compressed gas cylinders, with hazardous properties, precautionary measures, and handling instructions for any hazardous materials being used. Refer to SDSs and/or other reliable reference material. The following guidelines will assist in the safe operation of GCs:

- Wear proper eye protection. GC columns are fragile and breakage could result in small projectiles during handling. As well, samples are prepared in various hazardous solvents that could damage the eyes upon contact.
- When cutting a GC column, be sure that the cut is made away from the body.
- Ensure that GC column cutters are capped or otherwise stored to prevent injury when not in use.
- Discard small pieces of GC columns as sharps waste.
- Ensure that the oven is allowed to cool before installing or removing a column or injector or prior to performing maintenance.
- Ensure that gases are turned off prior to removing or installing a column.
- Test for leaks after the installation of the column and whenever a leak is suspected.
- Use a technique that will not damage or sacrifice the integrity of the instrument.
- **Electron capture detectors (ECD) have a radioactive source and therefore need to be registered as part of the University's Radiation Safety program.**

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	46

## Laboratory Safety Manual

- Ensure that the instrument and gases are turned off and the power cord disconnected prior to performing maintenance.

### 17.10 GLASSWARE

Improper use of glassware can lead to many injuries in the laboratory. Glassware is used in almost every type of chemical and biological lab. Depending on the processes being performed, specific safety precautions should be taken to reduce breakage and implosions. Following are some general safety tips for using glassware:

- Borosilicate glass (e.g. Pyrex, Kimax) should be the only type of glass used in the lab for any processes requiring heat or pressure. Soft glass should only include reagent bottles, measuring equipment, stirring rods and tubing. Exceptions may include experiments requiring UV or other light sources.
- Glassware should be inspected prior to each use to ensure that cracks, chips or other defects are not present.
- Glassware that is to be used in evacuated processes should be heavy-walled and covered with fabric-backed (i.e. duct) tape or plastic mesh to prevent flying glass should an implosion occur.
- Glass tubing and stirring rods that have been cut to size should be fire-polished prior to use to remove sharp edges that can cause a laceration to a worker, or to tubing, stoppers or other soft materials.
- Be sure to cool hot glass slowly after polishing. Quick-cooling can cause weaknesses in glass that may cause it to break when reheated or pressurized.
- When inserting glass tubing into a rubber stopper:
  - Always lubricate the stopper hole with water or preferably glycerine first.
  - Hold both tubing and stopper with thick cloth or gloves, less than 5 cm from the point of insertion.
  - Push the tubing into the stopper by applying slight pressure and a gentle twisting motion.
  - Never try to pull out glass tubing stuck in a rubber stopper or tubing. Cut the stopper or tubing instead.
- Glassware should be cleaned with care to avoid breakage that can cause lacerations. Never clean broken glass out of a drain by hand - use tongs or forceps.
- Store glassware on shelves with a lip or a closed cupboard, and don't stack glassware.

### 17.11 HEATING BATHS

Heating baths are designed to heat materials to constant temperature. They may be filled with a variety of materials including water, mineral oil, sand, glycerin, paraffin or silicone oils, depending on the bath temperature required. Bath temperatures may range up to 300°C. Often materials used in heating baths are flammable and excessive temperatures could result in a fire. The following are precautions for heating baths:

- Locate on a stable surface, away from flammable and combustible materials including wood and paper.
- Ensure liquid has cooled before moving the heating bath.
- Heating bath containers should be durable, non-breakable, and set up with a firm support so they will not tip over.
- Do not fill over the "full mark".
- Do not place heating baths near either flammable or combustible material.
- Ensure baths are equipped with controls that will turn off the power if the temperature exceeds a pre-set limit.
- Ensure that the thermostat is set well below the flash point of the heating liquid in use.
- Equip the bath with a non-mercury thermometer to allow a visual check of the bath temperature.
- Take care not to allow water to get into oil baths as violent splattering may result.
- DO NOT LEAVE ON OVERNIGHT.

Steam baths are often safe alternatives for heating because they provide a consistent temperature that will not exceed 100°C. However, care must be taken to prevent scalding due to dermal exposure to the steam or steam lines.

Water baths are the most common bath found in the laboratory. When using a water bath:

- Clean the bath regularly; a disinfectant, such as a phenolic detergent, can be added to the water.
- Decontamination can be performed by raising the temperature to 90°C or higher for 30 minutes once a week.
- Unplug the unit before filling or emptying.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	47



**17.12 HIGH PERFORMANCE LIQUID CHROMATOGRAPHS**

High performance liquid chromatography (HPLC) procedures often require handling of flammable and toxic solvents. Refer to SDSs and/or other reliable reference material. The following guidelines will assist in the safe operation of HPLCs.

- Wear appropriate eye protection. Since the HPLC is operated at high pressures, it is possible for fittings to fail, resulting in a sudden release of solvent.
- Use “elephant trunk” ventilating system above fraction collectors, especially with normal phase HPLC.
- Inspect and empty the waste containers as required.
- Ensure that waste collection vessels are vented.
- Ensure secondary containment of waste containers.
- Never clean a flow cell by forcing solvents through a syringe: syringes under pressure can leak or rupture, resulting in sudden release of syringe contents.
- High voltage and internal moving parts are present in the pump and autosampler. Switch off the electrical power and disconnect the power cord when performing routine maintenance.

**17.13 HYDROGENATORS**

When used properly, commercially available hydrogenators allow hydrogenation reactions performed at elevated pressures using various catalysts to be carried out safely:

- Ensure that the apparatus is appropriate for the specific reaction to be performed.
- Inspect the reaction vessel prior to each use to ensure that there are no scratches, chips, etc. that would make them unsuitable for use in high pressure experiments.
- Ensure that oxygen is removed from the reaction solution before the introduction of hydrogen.
- Ensure that the safe pressure limit of the vessel is not approached as pressure will increase with heating.
- At the end of the reaction, purge the system repeatedly to prevent the production of a hydrogen-oxygen mixture.
- Take particular care to ensure that catalysts are not allowed to dry once filtered from reaction mixtures as they are usually saturated with hydrogen and may spontaneously ignite on exposure to air. Filter cakes should be immediately transferred to water and purged with an inert gas such as nitrogen or argon.

**17.14 LASERS**

Algoma University does not have any lasers installed in any of its laboratories at this time. The use of lasers and the corresponding management of their hazards must comply with ANSI Z136.1. The hazards associated with the use of Class 3B or 4 lasers include eye or skin burns, fire and electrocution. All Class 3B and Class 4 lasers must be registered with the Health & Safety Officer prior to use and a Laser Safety Protocol will have to be developed.

**17.15 MASS SPECTROMETERS**

Mass spectrometers (MS) require the handling of compressed gases and flammable and toxic chemicals. Be familiar with the use and handling of compressed gas cylinders, the hazardous properties, recommended precautionary measures, and handling instructions for any hazardous materials being used. Refer to SDSs or other reliable reference material. Specific precautions for working with the mass spectrometer include:

- Avoid contact with heated parts while the mass spectrometer is in operation. Inspect gas, pump, exhaust and drain system tubing and connections before each use.
- Ensure that pumps are vented outside the laboratory, as pump exhaust may contain traces of the samples being analyzed, solvents and reagent gas.
- Used pump oil must be handled as hazardous waste

**17.16 NUCLEAR MAGNETIC RESONANCE SPECTROMETERS**

Nuclear magnetic resonance spectrometers (NMRs) use superconducting magnets, thereby introducing hazards related to high-strength magnetic fields and cryogenic liquids (i.e. liquid nitrogen and liquid helium, which are used for cooling). Improper

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	48

## Laboratory Safety Manual

operation of the instrument or improper activities near the instrument could lead to significant personal injury or death, costly equipment damage and loss of data.

- Ensure that warning signs are posted at or beyond the 5-gauss line indicating the hazards, The 5-gauss line is the distance from the centre of the magnet where a magnetic field strength of 5 gauss is present, and where the field strength is strong enough to act upon objects.
- Individuals with medical devices (e.g. cardiac pacemakers and metal prostheses) must remain outside the 5-gauss line. The magnetic fields generated are strong enough to affect the operation and integrity of some of these medical devices.
- Keep ferromagnetic materials outside the 5-gauss perimeter. Strong magnetic fields surrounding the NMR attract objects containing steel, iron, and other ferromagnetic materials. This includes most ordinary tools, electronic equipment, compressed gas cylinders, steel chairs, and steel carts. Unless restrained, such objects can suddenly fly toward the magnet which can cause personal injury and extensive damage to the NMR. Only non-ferromagnetic materials should be used near the instruments. If in doubt, keep it out!
- Cards with magnetic strips, cellular phones, laptops and mechanical watches should remain outside the 5-gauss perimeter. Strong magnetic fields can damage the strip of magnetic media found on credit cards, ATM cards, driver's licenses, and other cards. Cell phones, and laptop computers are also susceptible to damage inside this perimeter. Mechanical wrist and pocket watches will also malfunction and be permanently damaged when exposed to a strong magnetic field.
- If damaged, the magnet may quench. Leave the room immediately. A quench refers to the sudden release of gases from the dewar. Rapid expansion of liquid helium or nitrogen to gas can displace breathable oxygen in an enclosed space, creating the possibility of asphyxiation. Do not re-enter the room until the oxygen level has returned to normal.
- Only qualified, trained and competent personnel may complete helium or nitrogen fills, due to the hazards and precautions associated with the use of cryogenic liquids. Appropriate protective equipment including a minimum of safety glasses and gloves must be worn.
- During variable temperature experiments, do not exceed the boiling or freezing points of your sample. A sample subjected to a temperature change can build up excessive pressure, which can break the tube. Ensure safety glasses are worn near the magnet when performing variable temperature experiments.
- Inspect NMR sample tubes prior to use and discard any tubes that are cracked, chipped, scratched or otherwise in poor condition.
- Use care when handling NMR sample tubes as they are very fragile.
- Do not operate the NMR in the presence of flammable gases or fumes.
- Do not look down the upper barrel of an NMR if a probe is in place. Pneumatic ejection of a sample from the probe could cause injury.
- Take care that solvents used for sample preparation will not undergo unwanted reactions with the analyte.

### 17.17 OVENS, HOT PLATES AND HEATING MANTLES

Ovens are commonly used in the lab to evaporate water from samples, provide a stable elevated environment and to dry glassware. Heating mantles are used to heat reaction or sample solutions in round-bottom flasks or reaction vessels, and hot plates are used to heat various general laboratory solutions. Bunsen burners may be used only after obtaining approval from the supervisor. The following precautions should be followed to ensure safe use:

- Ensure that laboratory ovens and hot plates are designed to prevent contact between flammable vapours and heating elements/spark-producing components.
- Avoid heating toxic, even mildly volatile materials in an oven unless it is continuously vented outdoors.
- Glassware that has been rinsed with an organic solvent is to be rinsed with distilled water or equivalent before being placed in an oven for drying.
- Hot plates or ovens whose thermostat fails must be removed from service until repaired. Heating devices whose temperature rises above that required could create significant fire hazards.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	49

## Laboratory Safety Manual

- Heating mantles must be used in conjunction with a variable autotransformer; care must be taken not to surpass the maximum voltage of the mantle recommended by the manufacturer.
- Discontinue use of any heating mantle where the heating elements have become exposed.

### 17.18 ULTRAVIOLET LAMPS

Exposure to ultraviolet light (UV) may result in serious and painful injury to the eyes or skin depending on the wavelength and intensity of the light and the duration of exposure.

- Label all UV light sources conspicuously with the following warning (or equivalent): “Warning – this device produces potentially harmful UV light. Protect eyes and skin from exposure.”
- Ensure that the UV light source is shielded.
- Ensure that appropriate PPE is worn and is sufficient to protect the eyes and skin. PPE should include at least UV resistant face shield, gloves, and lab coat.
- Shielding the equipment or the work area may be warranted.

### 17.19 PIPETTES

Basic safety practices related to pipetting:

- Use pipettes calibrated “to deliver” – this reduces the risk of creating aerosols by retaining the last drop in the tip
- Use pipettes or tips with plugs – these prevent contamination of pipetting device
- Work over plastic-backed absorbent material – the droplets will be absorbed rather than ‘splash’
- Don’t mix liquids by bubbling air from a pipette through the fluid, or by alternate suction and forceful expulsion through the pipette.
- Discharge pipettes as close as possible to the fluid level and, if possible by running the liquid down the wall of the tube or bottle..
- Pipettes and tips should be decontaminated with disinfectant immediately after use.
  - Pipet tips can be ejected directly into a container (bottle, beaker) containing disinfectant
  - Serological pipettes can be laid horizontally in a pan and completely immerse with disinfectant – care must be taken when moving the pan as this does create a spill hazard.
  - Alternatively, pipettes can be filled with disinfectant and left to drain by gravity into an oversized waxed cup in an autoclave bag. For disposal, the bag can be closed over the pipettes and the whole autoclaved in an upright position, or the pipettes can be transferred to a tray for autoclaving.
  - If you do use a vertical container, exercise caution as drops may fall and create aerosols during transfer. Also, if the top of an unplugged pipette protrudes above the disinfectant, displacement of contaminated air might produce an aerosol.

## 18. ELECTRICAL SAFETY

### 18.1 GENERAL

Use of electrical equipment must be in accordance with the Electrical Safety Program. The Ontario Electrical Safety Code states that every piece of electrical equipment that is sold, displayed, or connected to a source of power in Ontario must be approved. Follow this link to the [Electrical Safety Authority](#), which lists the recognized Certification Marks on products that are approved for use in Ontario. If equipment is imported to Algoma University without accreditation, an inspection by the Electrical Safety Authority or equivalent approved organization must be completed before the equipment is used. Plant Operations personnel will not connect any uncertified equipment. For further information contact the Health & Safety Officer at ext. 4373.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	50

General guidance for electrical safety in the laboratory is provided below:

- Report defects/faults to your supervisor.
- All electrical apparatus must be properly grounded.
- Never remove the ground pin of a 3-pronged plug.
- Inspect electrical cords regularly and have frayed or damaged cords replaced.
- Extension cords must only be used as a temporary solution.
- “Piggy-backing” of extension cords is prohibited.
- Never use a power bar beneath workbenches where chemicals are handled.
- DO NOT use electric wires as supports and never pull on live wires.
- Ensure that all wires are dry before plugging into circuits.
- Electrical devices (unless certified explosion-proof) should be connected outside of the hood to avoid sparks which may ignite a flammable or explosive chemical.
- Use of Ground Fault Interrupter Circuits (GFCI) is preferable in receptacles located near sinks.
- Circuit breaker panels within laboratories must be easily accessible and clearly marked. Familiarize yourself with their location.
- Only qualified and trained people should repair or modify electrical or electronic equipment
- All electrical equipment including extension cords and power bars must be CSA or UL approved.

### 18.2 STATIC ELECTRICITY AND SPARKS

Static electricity and sparks may cause a fire under the right circumstances. Always be conscious of the potential for generating sparks.

- Electrical equipment must have spark protection in areas where there is a danger of fire or explosion.
- Some protection from static electricity and sparks is obtained by proper grounding and bonding of containers and equipment.
- A dry atmosphere promotes the formation of electrical charges.
- Common sources of sparks and static electricity are:
  - decanting of organic liquids from one metal container to another
  - plastic aprons
  - metal clamps, nipples or wires used with non-conducting hoses
  - gases released quickly from cylinders under high pressure
  - switches and thermostats
  - electrical contacts (e.g. light switches and thermocouples, refrigerators) may produce sparks

## 19. LABORATORY EQUIPMENT MAINTENANCE

### 19.1 MACHINE GUARDING

Control of hazards that involve the contact of machine components with workers that may result in injury are collectively known as "Machine Guarding". However, the specific provisions required for various types and pieces of equipment must be evaluated to address the level of hazard and need for guarding. Most laboratory equipment is purchased with appropriate guarding in place, however it is the supervisor's responsibility to ensure that the guarding in place is protective of workers operating the equipment. Further, it is important that once guards are in place, that they remain in place and are not removed or altered by anyone. Maintenance procedures must be carried out by individuals who are trained to perform maintenance safely.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	51

### 19.2 SHIELDING

Appropriate shielding must be used whenever an operation involves chemicals with the potential for explosion or severe splashing. Examples include:

- when a reaction is attempted for the first time;
- when a familiar reaction is carried out on a larger scale than usual;
- whenever operations are carried out under non-ambient conditions; or
- whenever a severe splashing potential exists for corrosive materials. (Ontario Regulation 851 Section 89)

Appropriate shielding is required when using equipment with thermal hazards.

### 20. RADIATION SAFETY

Currently, there is no radioisotope work being conducted at Algoma University. The Health & Safety Officer must be contacted at [healthandsafety@algomau.ca](mailto:healthandsafety@algomau.ca) if any work is being considered.

### 21. SECURITY

It is a requirement of Algoma University to keep all chemical, biological and physical hazards from being used inappropriately or by unauthorized individuals. A security risk assessment has been conducted and the following standards must be upheld by all laboratory users and supervisors.

Inventories of biohazards and chemicals are required

- Biosafety lab doors are to be closed at all times.
- All laboratory doors must be closed and locked whenever the lab is unoccupied.
- Supervisors are to ensure that a list of authorized personnel is filed with Security.
- Key access must only be granted to those personnel who are authorized and have completed all relevant training.
- Personnel are expected to inquire the purpose of a visit if unknown individuals access the lab and confirm with their supervisor.
- Supervisors are to alert laboratory personnel when new personnel will be accessing the lab.
- Visitors may enter a lab only if they are given permission by the laboratory supervisor and are escorted by a trained lab occupant.
- Security will escort any unauthorized individuals from a lab, secure the lab and file a report with the Supervisor and Health & Safety Officer.
- Inventories of all chemicals and pathogens are kept on file and are regularly maintained. See Section 15.1 for more detail.
- Any incident, emergency, loss, theft, unauthorized access or breach of containment will be reported immediately to the lab Supervisor and Security at ext. 4444. The Joint Health and Safety Committee and the Biosafety Committee (where applicable) will investigate any such occurrence.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	52

<b>Revision Date</b>	<b>Approved by:</b>	<b>Responsibility</b>	<b>Page</b>
January 2016	Administration	Health & Safety Officer/Biosafety Officer	53

## Laboratory Safety Manual


### APPENDIX A: TRAINING REQUIRED

Training Session	All Employees	Office Employees	Laboratory Employees/Researchers/Graduate Students	Physical Plant Mechanics/Electricians /Housekeepers	Security Services
New Hire Orientation (Includes Basic Health and Safety)	Y	Y	Y	Y	Y
WHMIS Training			Y (1)*	Y (1)*	Y (1)*
First Aid		Contact HR	Contact HR	Contact HR	Y
Fire Safety		Contact HR	Contact HR	Contact HR	
Fire Extinguisher		Contact HR	Y	Contact HR	Y
Biosafety			Contact HR (1)*		
Hazardous Materials Awareness				Y	Y
Radiation Safety			Contact HR		
TDG			Contact HR	Contact HR	
Lab Specific Training			Y	Contact HR	Contact HR

\* Denotes frequency of required training in years.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	0

## APPENDIX B: TRAINING RECORD AND ACKNOWLEDGEMENT OF RISK

 <b>New Laboratory Trainee Orientation Checklist</b>			
<b>Employee Name:</b>			<b>Start Date:</b>
<b>Department:</b>			<b>Supervisor:</b>
TOPIC	EXAMPLES	RECEIVED	
		YES	N/A
<b>GENERAL SAFETY</b>			
<b>Sharps disposal</b>	Safe clean-up of sharps, broken glass bin, disposal procedure	<input type="checkbox"/>	<input type="checkbox"/>
<b>Work order procedure</b>	Reporting physical deficiencies to Physical Plant (ticket system)	<input type="checkbox"/>	<input type="checkbox"/>
<b>First Aid Kit Location</b>	Where to access first aid kit and designated first aider	<input type="checkbox"/>	<input type="checkbox"/>
<b>Telephone System</b>	Emergency key on phone, lab emergency contact list	<input type="checkbox"/>	<input type="checkbox"/>
<b>Emergency exits and procedures</b>	Closest emergency exits, pull stations, fire extinguishers, area fire warden	<input type="checkbox"/>	<input type="checkbox"/>
<b>Working alone policy and procedures</b>	Which experiments are too hazardous for after-hours work and when alone, Keep In Touch program with Security	<input type="checkbox"/>	<input type="checkbox"/>
<b>Location and use of emergency facilities</b>	Closest safety shower, emergency eyewash station	<input type="checkbox"/>	<input type="checkbox"/>
<b>Hazardous waste disposal procedures</b>	Storage and segregation of waste, inventories and reporting requirements	<input type="checkbox"/>	<input type="checkbox"/>
<b>Personal Protective Equipment</b>	Requirements for selection, use, care and how to safely remove	<input type="checkbox"/>	<input type="checkbox"/>
<b>Lab Safety Policy/Procedures</b>	Lab safety manual	<input type="checkbox"/>	<input type="checkbox"/>
<b>Hazard Reporting Procedures</b>	How to contact security/physical plant & your supervisor	<input type="checkbox"/>	<input type="checkbox"/>
<b>Security</b>	Procedures for visitors, and keeping the lab secured	<input type="checkbox"/>	<input type="checkbox"/>
<b>CHEMICAL SAFETY</b>			
<b>WHMIS</b>		<input type="checkbox"/>	<input type="checkbox"/>
<b>Safe chemical handling procedures</b>	Correct use of a chemical fume hood, flammable liquids, toxic chemicals	<input type="checkbox"/>	<input type="checkbox"/>
<b>Chemical spill kit</b>	Location of kit and procedure for clean-up of spills	<input type="checkbox"/>	<input type="checkbox"/>
<b>SDS</b>	Location of SDS/using SDS online	<input type="checkbox"/>	<input type="checkbox"/>
<b>Specific Hazards (List)</b>	e.g. hydrofluoric acid/machine guarding	<input type="checkbox"/>	<input type="checkbox"/>
<b>BIOSAFETY</b>			
<b>Biological Safety</b>	Trainee will be working with biohazards: <input type="checkbox"/> Yes <input type="checkbox"/> No (Proceed to section Other Hazards and Risks)	<input type="checkbox"/>	<input type="checkbox"/>
<b>Biological agents</b>	Risk groups, method of transmission, blood borne pathogens	<input type="checkbox"/>	<input type="checkbox"/>

<b>Revision Date</b>	<b>Approved by:</b>	<b>Responsibility</b>	<b>Page</b>
January 2016	Administration	Health & Safety Officer/Biosafety Officer	1



<b>Universal precautions</b>	Use of PPE, good hygiene/housekeeping practices, good microbial practices	<input type="checkbox"/>	<input type="checkbox"/>
<b>Biosafety cabinet</b>	Correct use of a biosafety cabinet	<input type="checkbox"/>	<input type="checkbox"/>
<b>Aerosols</b>	How to avoid aerosol generation	<input type="checkbox"/>	<input type="checkbox"/>
<b>Autoclave</b>	Safe operation	<input type="checkbox"/>	<input type="checkbox"/>
<b>Needle sticks/sharps injuries</b>	Safe use of needles/sharps	<input type="checkbox"/>	<input type="checkbox"/>
<b>Shipping and Receiving</b>	How to correctly receive a package	<input type="checkbox"/>	<input type="checkbox"/>
<b>Transporting biological materials</b>	Procedures for on-campus transport	<input type="checkbox"/>	<input type="checkbox"/>
	On public roadways (requires TDG certificate, arranged through H&S)	<input type="checkbox"/>	<input type="checkbox"/>
<b>Biological Spills</b>	Location of spill kit, how to safety clean up spills, when to report to Supervisor/ Security	<input type="checkbox"/>	<input type="checkbox"/>
<b>PHAC Modules</b>	Have PHAC modules assigned by Biosafety Officer	<input type="checkbox"/>	<input type="checkbox"/>
<b>Biological waste</b>	Separation and disposal procedures	<input type="checkbox"/>	<input type="checkbox"/>
<b>Radiation Safety</b>			
<b>Radiation</b>	Trainee will be working with radiological hazards: No –Proceed to section Other Hazards/Risks Yes -Contact H&S to arrange for basic radiation safety training and complete Radiation Safety Training Form with Trainee	<input type="checkbox"/>	<input type="checkbox"/>
<b>OTHER HAZARDS/RISKS</b>			
<b>Lab Specific</b>	List any other hazards/training provided specific to your lab or experimental procedures or check:	<input type="checkbox"/>	<input type="checkbox"/>

As a Supervisor, I attest that \_\_\_\_\_ has both received training in all of the areas of health and safety checked above and demonstrated proficiency in the standard operating procedures required for this laboratory sufficient to enable him/her to conduct themselves safely in my laboratory without direct supervision.

**Supervisor Signature:** \_\_\_\_\_

**Date:** \_\_\_\_\_

I attest that adequate training has been provided to me in order to conduct my laboratory duties safely and that I will follow all laboratory rules as they relate to Health and Safety. I acknowledge that some medical conditions that affect the immune system may put me at increased risk of contracting an infectious disease. Should I be at increased risk, I will discuss my

<b>Revision Date</b>	<b>Approved by:</b>	<b>Responsibility</b>	<b>Page</b>
January 2016	Administration	Health & Safety Officer/Biosafety Officer	2

## Laboratory Safety Manual

laboratory duties with my primary health care provider annually and should any accommodations be required to reduce my risk, I will share those with my Supervisor as soon as I am aware of them.

**Employee Signature:** \_\_\_\_\_

**Date:** \_\_\_\_\_

**Supervisors keep a copy for your records, and send original completed form to Human Resources, Attn: Health & Safety Officer**

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	3

**APPENDIX C: UNATTENDED PROCEDURES FORM**

<b>Experiment Run Dates:</b>	
<b>Supervisor/PI:</b>	<b>Phone:</b>
<b>After-hours Emergency Contact:</b>	<b>Phone:</b>
<b>Summary of Experiment, Equipment &amp; Hazards Involved:</b>	
<b>Description of Experiment or Procedure</b>	
<b>Equipment Involved</b>	
<b>Sources in use (describe briefly)</b>	
<b>Electrical</b>	
<b>Nitrogen</b>	
<b>Vacuum</b>	
<b>Water</b>	
<b>Other</b>	
<b>Specific Hazards (describe briefly)</b>	
<b>Corrosive</b>	
<b>Flammable</b>	
<b>Oxidizer</b>	
<b>Toxic</b>	
<b>Other</b>	
<b>Special Warning</b>	

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	1

## Laboratory Safety Manual

This form must be posted at the location of an experiment conducted while no laboratory personnel are present, i.e. after business hours or on weekends. A notice with the phrase "UNATTENDED PROCEDURE IN PROGRESS" along with the name and phone number of the emergency contact must also be posted on the laboratory entrances.

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	2

**APPENDIX D: SAMPLE LABORATORY SIGNAGE**

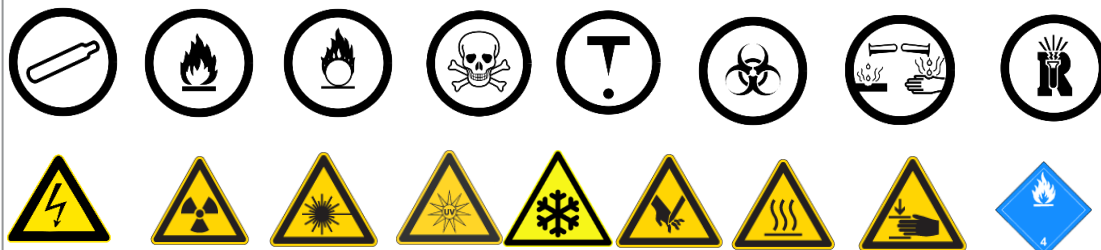
<b>Revision Date</b>	<b>Approved by:</b>	<b>Responsibility</b>	<b>Page</b>
January 2016	Administration	Health & Safety Officer/Biosafety Officer	3

### Laboratory Information Sheet

Lab Name/Number:

Type 1

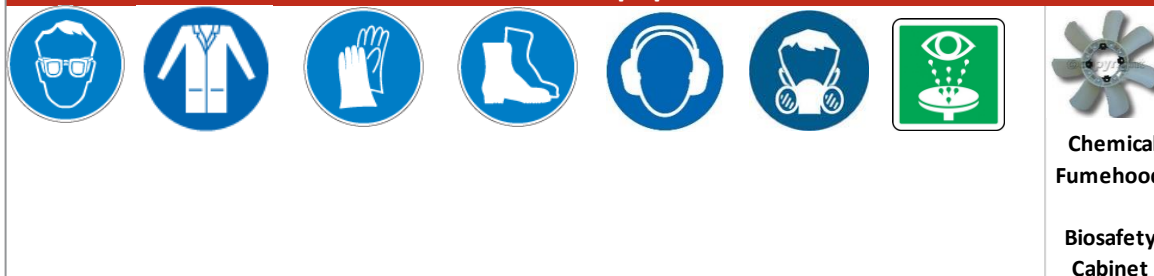
#### Hazards Present in this Lab



Other Hazards/Precautions (specify):



#### Protective Equipment



Chemical Fumehood  
Biosafety Cabinet

#### Contact List

	Name	Extension	After Hours
Principal Investigator			
Supervisor			
Staff			
Staff			
Departmental Office			
Other			

#### Emergency Procedures

Safety Information: Health & Safety Officer, ext. 4373

Emergency assistance (e.g. hazardous material spill, medical) 9-911 + Security ext. 4444

Fumehood Malfunction - ext. 4040

First Aid: Name, BLDG XXX, ext "2XXXX"

First Aid: Name, BLDG XXX, "2XXXX"

*valid until August 31, 2016*

Revision Date	Approved by:	Responsibility	Page
January 2016	Administration	Health & Safety Officer/Biosafety Officer	4