



Laboratory Safety Manual

For

Kwantlen Polytechnic University

Final Draft written and submitted by Fenton Fong

-PharmEng Technology, March 2010



This Final-draft version is the property of

Kwantlen Polytechnic University

Emergency Numbers

Any disaster, unusual occurrence, utility malfunction, or equipment failure that presents imminent danger to human health or property is an emergency and is to be reported immediately by telephone. For further information about the Kwantlen emergency response plan, refer to Kwantlen Polytechnic University Policy No. F4 Emergency Response Plan (See Appendix F).

The Kwantlen Facilities Dept is the first line of contact for First Aid, Security and Emergency Response, the locations and phone numbers are listed below.

General Contact Numbers

Fire/Policy/Ambulance ----- 9-9-1-1

First Aid

Dial Local 0 from any on-campus telephone between 07:30 and 17:30 or call:

Richmond Campus (room P525, parking level) ----- 604-599-2676

Surrey Campus (Birch Building room 112) ----- 604-599-2076

Security

Dial Local 0 between 07:30 and 17:30 or call:

Richmond Campus (room 1630) ----- 604-599-2676

Surrey Campus (Birch Building room 102) ----- 604-599-2076

Emergency Contact

Richmond Campus----- 604-599-2676

Surrey Campus ----- 604-599-2076

Emergency Contact –all on-campus telephones----- 811

Kwantlen University Facilities Dept Contacts

Manager/Director, Occupational Health and Safety ---- 604-599-2924

Manager, Facilities Operations----- 604-599-3484

KWANTLEN POLYTECHNIC UNIVERSITY

LABORATORY SAFETY MANUAL

1. KWANTLEN POLYTECHNIC UNIVERSITY HEALTH AND SAFETY	10
1.1 KWANTLEN UNIVERSITY SAFETY POLICY STATEMENT.....	10
1.2 INTRODUCTION TO LABORATORY SAFETY AT KWANTLEN	10
1.3 GENERAL HEALTH AND SAFETY PRINCIPLES.....	12
1.4 BASIC SAFETY PROCEDURES	15
1.5 RISK ASSESSMENT	18
1.6 WORKPLACE HAZARDOUS MATERIALS SAFETY INFORMATION SYSTEM (WHMIS)....	19
1.6.1 <i>Labeling</i>	19
1.6.2 <i>Material Safety Data Sheets (MSDS)</i>	22
1.6.3 <i>Training</i>	23
1.7 INVENTORY MANAGEMENT IN LABORATORIES	24
1.7.1 <i>Chemical Storage Guidelines</i>	24
1.7.2 <i>Flammable liquid storage cabinets</i>	26
1.7.3 <i>Packing and Moving Chemicals</i>	27
FIRE SAFETY	29
1.7.4 <i>The fire triangle</i>	29
1.7.5 <i>Classes of fire</i>	30
1.8 HAZARDOUS WASTE DISPOSAL	31
1.8.1 <i>Liquid and Solid Chemical Waste Disposal</i>	31
1.8.2 <i>Regular garbage</i>	32
1.8.3 <i>Sharps and needles</i>	32
1.8.4 <i>Glass waste and broken glass</i>	32
1.9 LABORATORY VENTILATION AND FUMEHOODS.....	33
1.10 COMPRESSED GASES AND CRYOGENICS.....	37
1.10.1 <i>Hazards of compressed gases</i>	37

1.10.2	<i>Cryogenic hazards</i>	40
1.11	PHYSICAL HAZARDS AND ERGONOMICS.....	41
1.11.1	<i>General Guidelines to Reduce Physical Hazards</i>	41
1.11.2	<i>Glassware</i>	42
1.11.3	<i>Systems under pressure or vacuum</i>	43
1.11.4	<i>Backflow preventers</i>	43
1.11.5	<i>Electrical Safety</i>	44
1.11.6	<i>Ergonomics</i>	48
1.12	EQUIPMENT SAFETY	50
1.12.1	<i>Centrifuges</i>	52
1.12.2	<i>Heated water baths/circulating baths, ultrasonic baths</i>	53
1.12.3	<i>Ovens and Hot Plates</i>	55
1.12.4	<i>Shakers, Blenders and Sonicators</i>	56
1.12.5	<i>Microwave Ovens</i>	57
1.12.6	<i>Safe use of Analytical equipment</i>	58
1.12.7	<i>Glassware safety</i>	58
1.13	PERSONAL PROTECTIVE EQUIPMENT	62
1.13.1	<i>Laboratory Coats or gowns</i>	62
1.13.2	<i>Gloves</i>	63
1.13.3	<i>Eye and Face Protection</i>	65
1.13.4	<i>Respiratory Protection</i>	66
1.13.5	<i>Hearing Protection</i>	67
1.13.6	<i>Foot Protection</i>	67
1.13.7	<i>Emergency Showers and Eyewash Stations</i>	67
1.14	EMERGENCY RESPONSE PROCEDURES	70
1.14.1	<i>Emergency Response to Chemical Spills</i>	70

1.14.2	<i>Emergency Response to Fire</i>	76
1.14.3	<i>Emergency Response to Chemical Exposure</i>	77
1.14.4	<i>Emergency Response to Exposure to Infectious Agents</i>	79
1.15	EMPLOYEE AND STUDENT SAFETY TRAINING	81
	SAFETY PROGRAM SITE-SPECIFIC INFORMATION	82
2.	PHYSICS DEPT AT SURREY CAMPUS	82
2.1.1	<i>Key Contacts for Safety Issues</i>	82
2.1.2	<i>Floor plan of Physics Laboratory</i>	82
2.1.3	<i>General Laboratory Safety Guidelines</i>	83
2.1.4	<i>Handling of Specific Classes of Hazardous Materials</i>	83
2.1.5	<i>Use of Personal Protective Equipment</i>	84
2.1.6	<i>General Procedures for Radiation Safety</i>	84
2.1.7	<i>Procedures for Clean Up of Chemical Spills</i>	85
2.1.8	<i>Procedures for Waste Management</i>	86
2.1.9	<i>Procedures for Emergency Response and First Aid</i>	86
2.1.10	<i>Equipment with Potential Safety Concerns</i>	86
2.1.11	<i>Regular Scheduled Maintenance of Equipment</i>	87
2.2	BIOLOGY DEPT AT RICHMOND CAMPUS	88
2.2.1	<i>Key Contacts for Safety Issues</i>	88
2.2.2	<i>Floor plan of Biology Laboratory</i>	88
2.2.3	<i>List of General Laboratory Safety Guidelines</i>	90
2.2.4	<i>Handling of Specific Classes of Hazardous Materials</i>	90
2.2.5	<i>Use of Personal Protective Equipment</i>	90
2.2.6	<i>Procedures for Equipment Operation</i>	90
2.2.7	<i>Procedures for Clean Up of Chemical Spills</i>	90
2.2.8	<i>Procedures for Waste Management</i>	91
2.2.9	<i>Procedures for Emergency Response and First Aid</i>	91

2.2.10	<i>List of Critical Equipment with Potential Safety Concerns</i>	92
2.2.11	<i>Regular Scheduled Maintenance of Critical Equipment</i>	94
2.3	CHEMISTRY DEPT AT SURREY CAMPUS.....	96
2.3.1	<i>Key Contacts for Safety Issues</i>	96
2.3.2	<i>Floor plan of Chemistry Laboratory</i>	96
2.3.3	<i>List of General Laboratory Safety Guidelines</i>	99
2.3.4	<i>Handling of Specific Classes of Hazardous Materials</i>	100
2.3.5	<i>Use of Personal Protective Equipment</i>	100
2.3.6	<i>Procedures for Equipment Operation</i>	100
2.3.7	<i>Procedures for Clean Up of Chemical Spills</i>	100
2.3.8	<i>Procedures for Waste Management</i>	100
2.3.9	<i>Procedures for Emergency Response and First Aid</i>	101
2.3.10	<i>List of Equipment with Potential Safety Concerns</i>	101
2.3.11	<i>Regular Scheduled Maintenance of Critical Equipment</i>	102
2.4	BIOLOGY DEPT AT SURREY CAMPUS.....	104
2.4.1	<i>Key Contacts for Safety Issues</i>	104
2.4.2	<i>Floor plan of Biology Laboratory</i>	104
2.4.3	<i>List of General Laboratory Safety Guidelines</i>	105
2.4.4	<i>Handling of Specific Classes of Hazardous Materials</i>	105
2.4.5	<i>Use of Personal Protective Equipment</i>	105
2.4.6	<i>Procedures for Equipment Operation</i>	106
2.4.7	<i>Procedures for Clean Up of Chemical Spills</i>	106
2.4.8	<i>Procedures for Waste Management</i>	106
2.4.9	<i>Procedures for Emergency Response and First Aid</i>	107
2.4.10	<i>List of Critical Equipment with Potential Safety Concerns</i>	107
2.4.11	<i>Regular Scheduled Maintenance of Critical Equipment</i>	109

2.5 ENVIRONMENTAL PROTECTION TECHNOLOGY (EPT) DEPT AT RICHMOND CAMPUS.....	111
2.5.1 <i>Key Contacts for Safety Issues</i>	111
2.5.2 <i>Floor plan of EPT Laboratory</i>	111
2.5.3 <i>List of General Laboratory Safety Guidelines</i>	113
2.5.4 <i>Handling of Specific Classes of Hazardous Materials</i>	113
2.5.5 <i>Use of Personal Protective Equipment</i>	113
2.5.6 <i>Procedures for Equipment Operation</i>	113
2.5.7 <i>Procedures for Clean Up of Chemical Spills</i>	113
2.5.8 <i>Procedures for Waste Management</i>	113
2.5.9 <i>Procedures for Emergency Response and First Aid</i>	114
2.5.10 <i>List of Equipment with Potential Safety Concerns</i>	114
2.5.11 <i>Regular Scheduled Maintenance of Equipment</i>	114
2.6 CHEMISTRY DEPT AT RICHMOND CAMPUS	116
2.6.1 <i>Key Contacts for Safety Issues</i>	116
2.6.2 <i>Floor plan of Chemistry Laboratory</i>	116
2.6.3 <i>List of General Laboratory Safety Guidelines</i>	118
2.6.4 <i>Handling of Specific Classes of Hazardous Materials</i>	118
2.6.5 <i>Use of Personal Protective Equipment</i>	118
2.6.6 <i>Procedures for Equipment Operation</i>	118
2.6.7 <i>Procedures for Clean Up of Chemical Spills</i>	118
2.6.8 <i>Procedures for Waste Management</i>	118
2.6.9 <i>Procedures for Emergency Response and First Aid</i>	119
2.6.10 <i>List of Equipment with Potential Safety Concerns</i>	119
2.6.11 <i>Regular Scheduled Maintenance of Equipment</i>	120
2.7 PHYSICS DEPT AT RICHMOND CAMPUS	121
2.7.1 <i>Key Contacts for Safety Issues</i>	121
2.7.2 <i>Floor plan of Physics Laboratory</i>	121

2.7.3	List of General Laboratory Safety Guidelines.....	123
2.7.4	Handling of Specific Classes of Hazardous Materials	123
2.7.5	Use of Personal Protective Equipment	124
2.7.6	General Procedures for Radiation Safety.....	124
2.7.7	Procedures for Clean Up of Chemical Spills	125
2.7.8	Procedures for Waste Management	125
2.7.9	Procedures for Emergency Response and First Aid.....	126
2.7.10	Equipment With Potential Safety Concerns	126
2.7.11	Regular Scheduled Maintenance of Equipment	127
APPENDIX A: WHMIS SYMBOLS AND HAZARD WARNING INFORMATION SYSTEM .		129
APPENDIX B: CHEMICAL STORAGE GUIDELINES AND COMPATIBILITY.....		132
APPENDIX C: GLOVE PPE SELECTION GUIDE.....		142
APPENDIX D: GUIDELINES FOR SPECIFIC TYPES OF CHEMICAL SPILLS.....		146
APPENDIX E: REFERENCES		149
APPENDIX F: KWANTLEN POLYTECHNIC UNIVERSITY POLICIES		152
INDEX		153

1. KWANTLEN POLYTECHNIC UNIVERSITY HEALTH AND SAFETY

1.1 KWANTLEN UNIVERSITY SAFETY POLICY STATEMENT¹

Kwantlen Polytechnic University actively pursues any course of action to ensure achievement of health and safety standards, including the enforcement of all applicable health, safety and environmental protection regulations, prompt actions to correct unsafe conditions, and continued safety education for all concerned. To achieve this goal, Kwantlen has established a Safety Committee whose roles and responsibilities are to:

- Assist in creating a safe and healthy workplace;
- Assist with employee concerns relating to health and safety;
- Promote compliance with applicable rules and regulations;
- Participate in worksite inspections;
- Participate in incident/accident investigations;
- Make recommendations to senior management.

The safety committee is comprised of approx. 20 individuals from each of the four campuses at Richmond, Langley, Cloverdale, and Surrey².

1.2 INTRODUCTION TO LABORATORY SAFETY AT KWANTLEN

The laboratory environment can be a hazardous place to work. In such environments, individuals are confronted with a wide array of chemicals, instrumentation, energy sources, and/or biological agents. Nearly all common laboratory techniques, practices, and procedures carry some risk of exposure

¹ From: <http://www.kwantlen.ca/hr/ohs/procedures.html> and <http://www.kwantlen.ca/hr/ohs/committee.html>

² <http://www.kwantlen.bc.ca/hr/ohs/committee/members.html>

and mechanical injury. It is important to understand and appreciate what these risks are, and how to work safely with them in a laboratory environment.

The purpose of this manual is to outline hazards and safety processes that are required to maintain a safe environment in Kwantlen Polytechnic University laboratories. This manual provides a set of minimum standards and practices for the safe and healthy operation of a laboratory at Kwantlen. Following the requirements set out in this manual will help meet the requirements of the British Columbia – Occupational Health and Safety Act, WHMIS legislation in Canada, and Kwantlen Polytechnic University Policy No G.22 Safety & Health Program (refer to Appendix F). It is required reading for all employees working in research and teaching laboratories at Kwantlen Polytechnic University.

This manual was developed by PharmEng Technology[®], in consultation with faculty and employees in the Departments of Biology, Chemistry, Physics and Environmental Protection Technology (EPT) at the Surrey and Richmond BC campuses. It is intended to cover laboratory safety in all science laboratories on all campuses.

Revisions and updates may continue to be made to this manual as teaching programs evolve. Contact Manager/Director, Occupational Health and Safety at Kwantlen, with any comments or suggestions or updates you may have about the manual.

This manual is intended to:

- Define health and safety responsibilities within the Kwantlen Polytechnic University community;
- Explain basic emergency procedures;
- Provide information and standards for the healthy and safe operation of a laboratory;

- Outline any policies that are specific to particular laboratories in Biology, Chemistry, Physics and Environmental Protection Technology at the Surrey and Richmond BC campuses.

Each of the Departments listed above may have additional procedures that apply to their own situations and work. If there are concerns about assignment of responsibility or resolving disputes, the Manager/Director, Occupational Health and Safety should be contacted. Refer to Section 2 of this manual for specific details of each individual laboratory/dept. In all cases the laboratory instructor is ultimately responsible for teaching safe work practices and must insist upon the use of proper procedures to eliminate unnecessary hazards.

This manual attempts to be all-encompassing for laboratory safety. However, it should be kept in mind that not every possible emergency scenario can be predicted or foreseen ahead of time. Laboratory safety requires constant due diligence and exercise of common sense by each individual working in such facilities.

1.3 GENERAL HEALTH AND SAFETY PRINCIPLES

There is a number of general health and safety principles that apply to working in any laboratory, which Kwantlen employees and students should always keep in mind.

- Do not eat, drink, smoke, or apply cosmetics in the laboratory. Confine long hair and loose clothing.
- Contact lenses are not permitted.
- Use appropriate personal protective equipment) at all times. Ensure visitors to the laboratory are equipped with appropriate safety equipment.
- Do not use laboratory equipment for other than its designed purpose. Do not store food in the laboratory fridge or ice maker.

- Ensure that there is controlled access to a laboratory area and that there is no unsupervised/unauthorized access. Students should not be left unattended in a laboratory.
- Signs identifying hazards in the laboratory room and emergency contact information are posted on all entrances to the laboratory.
- When pipetting, use a proper pipetting device. Do not pipet by mouth.
- Avoid direct exposure to gases, vapors, aerosols and particulates by using a properly functioning laboratory fume hood or Biological Safety Cabinet (BSC), as applicable.
- Know the location of, and correct use of all available safety equipment including but not necessarily limited to: emergency showers, eyewash stations, fire blankets, fire alarm switches, PPE storage sites, emergency exits, and emergency contact info.
- Store all hazardous agents correctly and label according to Workplace Hazardous Materials Information Systems (WHMIS) requirements.
- Consult the Material Safety Data Sheets (MSDS) prior to using an unfamiliar chemical and follow the proper procedures when handling or manipulating all hazardous agents. MSDS's should not be older than 3 years before reviewing and updating.
- Prepare and maintain a chemical inventory list for the laboratory.
- Wipe, clean and disinfect laboratory countertops and other surfaces as soon as possible after completing laboratory work. Follow proper waste disposal procedures. Wash your hands before leaving a laboratory.
- Be conscientious about what you touch with gloved hands so as to not potentially contaminate surfaces.

- Keep all emergency exits and access to emergency equipment (fire extinguishers, emergency eye washes/showers) free of obstructions. Keep work places clean and free of unwanted chemicals, biological specimens, and idle equipment. Avoid leaving reagent bottles, empty or full, on the floor. All laboratories should be maintained in a neat, clean and orderly fashion.
- Review and enforce the rules regularly so that they become second nature.

1.4 BASIC SAFETY PROCEDURES

Before starting to work:

- Employees should ensure that they have received and understood all safety training, any relevant equipment operating instructions, and any other relevant safety information provided by Kwantlen.
- Employees are responsible for creating and providing students with all required safety information and procedures in their laboratory manuals. Students are responsible for reading and understanding the safety information and should be trained by the laboratory instructor.
- Employees should ensure that they understand the hazards of the materials in the lab, as well as appropriate safe handling, storage and emergency protocols. Read labels and MSDS before moving, handling or opening chemicals. Never use a product from an unlabeled container. Unlabeled containers containing contents of uncertain identity must be appropriately disposed of.
- Review the agents, processes and equipment in the laboratory. If you are unsure of any aspect of a procedure, verify before proceeding.
- Review the emergency spill response procedures for the materials you will handle.
- Know the emergency reporting procedures and telephone numbers.
- Know the designated and alternate escape routes for emergency evacuations

While working in the laboratory:

- There should be restricted laboratory access to authorized persons only.
- No smoking; eating; drinking; storing food, beverages or tobacco;

- No applying cosmetics or lip balm and handling contact lenses in the laboratory;
- Wear full sleeve lab coats (knee length), gloves and safety glasses, as applicable in the laboratory where there are chemicals, biohazards or radioisotopes.
- Do not wear open shoes, such as sandals, in the lab.
- Tie back or otherwise restrain long hair, loose clothing and dangling accessories when working with chemicals, biohazards, radioisotopes, or moving machinery.
- Walk; do not run, in the lab.
- Ensure that access to emergency equipment (eyewashes, safety showers and fire extinguishers) is not blocked.
- Ensure that any defective or damaged equipment are removed from use, labeled and arrange to have it repaired or replaced;
- Report all injuries, no matter how minor, to Manager/Director, Occupational Health and Safety. Inform students in the laboratory to report accidents and dangerous incidents (eg. "near-misses") promptly to Laboratory Instructors.
- Conduct procedures involving the release of volatile toxic or flammable materials in a chemical fume hood.
- Perform procedures that can release infectious bioaerosols in a biological safety cabinet (refer to Kwantlen Biosafety manual);

Working alone

Working alone is an unsafe practice that should be discouraged. If working alone is unavoidable, take precautionary measures to ensure that others are aware of your location and schedule. Ensure that there is a route for contact in case of emergency and that you are aware of the locations of all available safety resources.

At the end of laboratory work

Conduct a safety check at the end of each experiment and before leaving the lab.

Ensure that:

- all sources of gas, water, electricity, and vacuum lines have been shut off or disconnected as appropriate;
- unused materials, equipment and other supplies are returned to their proper storage locations;
- any equipment or work areas that may have been in contact with hazardous materials are decontaminated. Label, package and dispose of all waste material properly;
- all protective clothing (lab coats, gloves, etc.) are removed from the body before leaving the laboratory;
- hands are washed thoroughly before leaving the laboratory;
- the door to the laboratory is closed and locked if you are the last one to leave.

1.5 RISK ASSESSMENT

There are many categories of hazards that may be encountered in a laboratory setting, and situations can change frequently. Even after you have identified and controlled all current risks, it is critical that you remain open to the possibility that new unexpected dangers can arise. Prior to beginning a new laboratory procedure, employees should consider performing a safety risk assessment. This may include:

1. Identifying all hazardous materials (chemicals, biological agents, physical and mechanical hazards) to be used and the circumstances for their use;
2. Consulting relevant reference information sources for safety data (i.e. MSDS's);
3. Evaluating the potential for toxicity to the employees and students;
4. Considering possible routes of exposure;
5. Selecting appropriate procedures to minimize exposures
6. Preparing for contingencies;
7. Consider documenting the risk assessment analysis.

1.6 WORKPLACE HAZARDOUS MATERIALS SAFETY INFORMATION SYSTEM (WHMIS)

The Workplace Hazardous Materials Information System (WHMIS) is a Canada-wide system for providing information on the safe use of hazardous materials, referred to as *controlled products*, in the workplace. It is intended to protect the health and safety of workers by promoting access to information on hazardous materials; this information is provided by means of product labels, MSDS and education programs. *Controlled products* are products, materials, and substances that are regulated by WHMIS legislation, based on their hazardous properties and characteristics. The WHMIS legislation falls under the Canada Hazardous Products Act³.

WHMIS is governed by federal and provincial laws and regulations and any person supplying or using controlled products must comply with its requirements. At Kwantlen, WHMIS legislation applies to all employees who work in areas where controlled products are used. WHMIS divides hazardous materials into six main categories or classes based on their characteristics, refer to Appendix A. The main objectives of WHMIS are hazard identification and product classification. WHMIS achieves this goal through three main components: Labeling, MSDS and Training.

1.6.1 Labeling

Labels alert users to the dangers of the chemical product and basic safety precautions. It is imperative that all containers in laboratories be clearly identified.

WHMIS legislation dictates what information is required on a workplace label. Any controlled products, whether in transit, storage, or use, must be labeled. A label may be a mark, sign, stamp, device, sticker, ticket, tag, or wrapper and

³ http://www.ccohs.ca/oshanswers/legisl/intro_whmis.html

must be attached to, imprinted, stenciled, or embossed on the container of the controlled product. There are 2 types of labels prescribed under WHMIS regulation: supplier labels and workplace labels.

Supplier's Labels

Suppliers are responsible for labeling WHMIS-controlled products. A supplier label must contain the following information:

- product identifier (name of product);
- supplier identifier (name of company that sold it);
- hazard symbols (WHMIS classification symbols)⁴;
- risk phrases (words that describe the main hazards of the product);
- precautionary statements (how to work with the product safely);
- first aid measures (what to do in an emergency);
- reference to the MSDS;
- be written in both official languages.

Workplace Labels

A workplace label must appear on all WHMIS-controlled products when:

- controlled products are produced, manufactured or prepared (e.g., stock solutions) in the laboratory;
- the controlled product is transferred from the original container into another container; and
- the original supplier label becomes illegible or damaged or when it is removed;
- A workplace label must contain the following information:

⁴ Refer to Appendix A for listing of official WHMIS symbols for different chemical classes.

1. product identifier (product name);
2. information for the safe handling of the product;
3. reference to the MSDS;
4. may contain the WHMIS hazard symbols or other pictograms.

Laboratory Sample Labels

Laboratory samples are samples intended solely to be tested in a laboratory or used for educational or demonstration purposes. Laboratory samples do not include WHMIS-controlled products that are used by the laboratory for testing other products, materials or substances (e.g., buffer solutions).

The requirements for laboratory samples that are intended to be used in a laboratory immediately (same day) and solely by that person who prepared them include:

- Clear and unambiguous label on the sample;
- a description of sample's contents must be readily available (e.g., noted in a lab book); and
- MSDS for the sample must be readily available.
- Laboratory samples to be transported outside of a laboratory (e.g., sent elsewhere for analysis), including within Kwantlen Campus must have a label affixed to it that contains the following information:
 - product identifier (product name)
 - owner's name (name of Principal Investigator who prepared the sample)
 - lab number
 - contact telephone number of owner or Principal Investigator

1.6.2 Material Safety Data Sheets (MSDS)

Material Safety Data Sheets (MSDS) provide more details than labels. They are technical bulletins that provide chemical, physical, and toxicological information about each controlled product, as well as information on precautionary and emergency procedures.

All containers of controlled products should be labeled with WHMIS compliant labels and be classified under MSDS. Refer to Kwantlen Policy No. G13 Workplace Hazardous Material Information System (WHMIS) for more information.

Each laboratory should have its own MSDS database for controlled products used in the laboratory. These MSDS should be easily accessible in the laboratory and the database should be reviewed annually for completeness. The Facilities department should also receive a copy of the current MSDS. Refer to the facility floor plan for each of the individual laboratories in Section 2 for the MSDS storage location.

Supplier's Responsibilities

Suppliers of WHMIS-controlled products are required to make available MSDS to the purchaser. The MSDS must be available in both official languages. Should any new information arise about a product, the Supplier is required to revise the MSDS.

Laboratory's Responsibilities

WHMIS legislation requires that a MSDS be readily accessible to anyone who works with, or who may be exposed to controlled products. Each laboratory is responsible for ensuring that their MSDS Collection:

- location is communicated to all employees working on site;
- contains the MSDS for all WHMIS-controlled products in the laboratory;
- contains MSDS that are all less than 3 years old;

- is updated when new information becomes available.

MSDS Collections may be stored in several ways: a filing cabinet, binders, on a personal computer, or by any other means of storage. At the very least, there must be a hard copy collection of all MSDS's and all employees must be informed and aware of its location, and have unrestricted access to the data sheets at any time.

In order to simplify MSDS management, multiple departments utilizing a common laboratory space, or which are in close proximity to each other (ie. in the same building), can share a central MSDS collection. All lab employees, must have 24/7 access to the MSDS Collection area. If the room is sometimes locked, all employees must have a key. Students are to have supervised, limited access to MSDS's.

1.6.3 Training

WHMIS training is a major component of the WHMIS legislation and therefore is mandatory for all employees at Kwantlen working with controlled products. Kwantlen is required to provide initial WHMIS training and it is encouraged that employees take a refresher course every 2 years.

1.7 INVENTORY MANAGEMENT IN LABORATORIES

Management of Inventory is an important aspect of safety in the research and teaching laboratory. Over time, a laboratory space can easily accumulate materials, supplies, and hazardous agents and become cluttered and over-crowded. Some of the chemical materials themselves can become a danger if left unchecked/unsupervised for long periods of time. The following points should be followed for inventory management in a laboratory:

- It is the responsibility of laboratory technicians to oversee and maintain laboratory inventory.
- All newly received containers of laboratory chemicals at Kwantlen must be date-marked to indicate time of receipt.
- First in First out (FIFO) principle should be applied to all laboratory supplies. Stock should be rotated with the oldest stock always being used first.
- In the laboratory, all media and stock solutions should be clearly labeled as per WHMIS requirements outlined in Section 1.6.1 above and Kwantlen Policy No. G13 Workplace Hazardous Material Information System (WHMIS).
- All drawer and cupboards should be clearly labeled. Inventory lists should be reviewed and updated regularly.
- Keep inventory records of chemicals, and update annually.

1.7.1 Chemical Storage Guidelines

The following guidelines are applicable to chemical storage in the laboratory and in storage bunker rooms at Kwantlen.

- Ensure all containers of hazardous chemicals are properly labeled as per WHMIS requirements outlined in Section 1.6.1 above and Kwantlen Policy No. G13 Workplace Hazardous Material Information System (WHMIS).
- Store hazardous chemicals in an area that is accessible only to authorized laboratory employees;

- Only daily-use quantities should be kept in the laboratory;
- Do not store chemicals in aisles, under sinks or on floors, desks or bench tops;
- Store chemicals away from sources of heat (e.g., ovens or steam pipes) and direct sunlight. Water-sensitive chemicals must be stored to prevent contact with water;
- Never stack bottles on top of each other;
- Do not store chemicals above eye level/shoulder height;
- Store larger containers on lower shelves;
- When applicable, store liquids inside chemically-resistant secondary containers (such as trays or tubs) that are large enough to hold spills;
- When applicable, store chemicals inside closable cabinets or on sturdy shelving that has edge guards to prevent containers from falling;
- Ensure that chemicals cannot fall off the rear of shelves;
- When applicable, store acids in a dedicated acid cabinet. Nitric acid may be stored there also but only if it is kept isolated from all other acids;
- Chemicals must be stored in tightly closed containers;
- Chemicals must not be dispensed within the chemical bunker
- Store chemicals according to compatibility, do not store chemicals alphabetically except within a grouping of compatible chemicals (refer to Appendix B for further guidance);
- When applicable, store highly toxic or controlled materials in a locked, dedicated poison cabinet;
- Designate specific storage areas for each class of chemical, and return reagents to those locations after each use;

- Store volatile toxic and odorous chemicals in a way that prevents release of vapors (e.g., inside closed secondary containers, ventilated cabinets, paraffin sealing);
- Store flammables requiring refrigeration in explosion-safe or lab-safe refrigerators;
- Label reactive or unstable chemicals (e.g., ethers and other peroxide-forming chemicals) with the date of receipt, the date opened and an expiry date, if applicable. Should also indicate date of peroxide testing and required frequency;
- Inspect chemicals weekly for signs of deterioration and for label integrity;
- Dispose of unwanted chemicals promptly according to the Hazardous Waste Disposal program in Section 1.8;
- Compressed gas cylinders must be anchored securely;
- Keep all stored chemicals, especially flammable liquids, away from heat and direct sunlight.

1.7.2 Flammable liquid storage cabinets

Flammable chemicals should be stored inside flammable liquid storage cabinets. Only those flammables in use for the day should be outside the cabinet.

Guidelines for cabinet use include:

- Use NFPA or UL approved flammable liquid storage cabinets⁵;
- Keep cabinet doors closed and latched;
- Do not store other materials in these cabinets.
- Cabinets must be ventilated, refer to Section 1.9 for further information.

⁵ NFPA-National Fire Protection Agency; UL-Underwriters Laboratories

1.7.3 Packing and Moving Chemicals

General Procedures

1. Review chemical spill clean-up procedures before packing and moving;
2. Do not allow third party moving companies or other non-laboratory employees with no experience in working with chemicals, to box or handle chemicals;
3. Consider discarding chemicals which have not been used for a long period of time;
4. Review inventory of chemicals for especially dangerous ones, i.e. peroxide formers like isopropyl ether, butadiene, potassium metal, sodium amide, etc. Handle with extra caution;
5. Wear appropriate PPE (lab coat, gloves, and eyewear) and be familiar with chemical(s) MSDS's before beginning work;
6. Segregate and box chemicals into the following groups: organics, inorganics, acids, bases, oxidizers, reducers, and flammables;
7. Damaged bottles that are open and exposed should be treated as hazardous waste and properly disposed of;
8. Separate glass bottles and jars in a box with cardboard or vermiculite to prevent breakage during transportation;
9. Large 4L bottles of liquid chemicals/solvents should be transported in rubber carrying cases with handles.
10. Cap gas cylinders and move using a cylinder truck;
11. Ensure that all chemicals are accounted for and no chemicals are left behind;

Transportation between Laboratory and Shipping/Receiving

The receiving, storage and transport of chemicals and other hazardous materials to and from the Shipping and Receiving dept at Kwantlen must be properly controlled

to minimize chances of accidents, chemical spills, and exposure of personnel to hazardous agents.

A general principle that guides all safety aspects of transportation is ensuring that personnel are present to receive and inspect transported agents. Transported materials must never be dropped off without an intended recipient present to receive the materials. Based on this general principle, the following guidelines should be followed for shipping and receiving of hazardous materials at Kwantlen:

- Received goods must always be inspected for packaging integrity and damage. Only undamaged goods should be accepted for receiving and transport within Kwantlen;
- Goods received that have time, temperature or other storage sensitivity restrictions must be handled immediately as appropriate, by the receiver;
- Received goods must not be allowed to sit unattended for extended periods of time.
- Goods must be transported in a safe and appropriate manner to minimize chances of damage and breakage of packaging integrity. Large shipments on skids must be transported using a fork lift. Heavy boxes and containers must be transported using aids such as dolly's and carts.
- The labels on all received goods should be reviewed for any safety requirements/restrictions and instructions followed.
- Shipping & Receiving personnel should undergo training and refresher courses every two years in Transportation of Dangerous Goods.

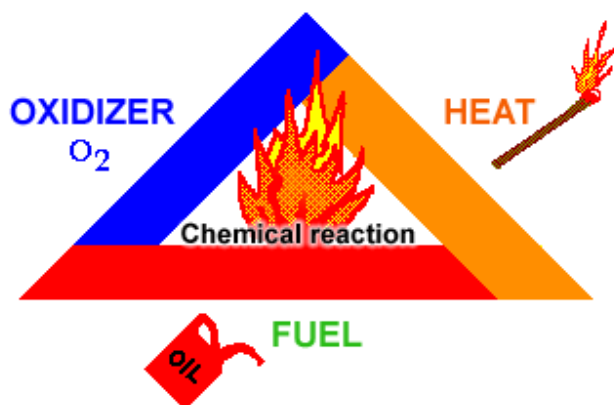
FIRE SAFETY

Laboratory fires can be caused by Bunsen burners, runaway chemical reactions, electrical heating units, failure of unattended or defective equipment, or overloaded electrical circuits. Kwantlen employees must be aware of how and where these potential dangers exist in their laboratory rooms.

Kwantlen employees must also familiarize themselves with the operation of the fire extinguishers, location of pull stations, fire blankets, emergency exits and evacuation routes. The evacuation procedure for Kwantlen is outlined on signage placards located beside all building exit doors and elevators. In the event that the general alarm is sounded, use the evacuation routes established for your area and follow the instructions on the signage.

1.7.4 The fire triangle

Fire cannot occur without an ignition source, fuel and an oxidizing atmosphere (usually air). These three components comprise what is called the "fire triangle":



Fire will not be initiated if any one of these elements is absent, and will not be sustained if one of these elements is removed. This concept is useful in understanding prevention and control of fires. For example, the coexistence of flammable vapors and ignition sources should be avoided, but when flammable vapors cannot be controlled, elimination of ignition sources is essential.

Kwantlen employees should have an understanding of the fire triangle and how best to work in the laboratory such that they are minimizing the potential of any or all of the three components of the triangle to be simultaneously present.

General guidelines for working safely and minimizing chances of fire:

- a) Avoid using open flames if possible, otherwise, use an open flame only as long as necessary and extinguish it when done.
- b) Do not use an open flame to heat flammable or combustible materials.
- c) Remove all flammable and combustible materials from the work area before lighting a flame.
- d) Notify all others in the lab and note any procedure using flammable and combustible gases and liquids before lighting a flame.
- e) Store all flammable and combustible materials properly as specified in Section 1.7.1.
- f) use non-spark generating equipment and have adequate ventilation if a flammable atmosphere may be present,
- g) in the event of fire, immediately locate and shut off the master supply valve for gas to the laboratory
- h) handle flammable and combustible chemicals inside of a fume hood

1.7.5 Classes of fire

The National Fire Protection Association (NFPA) has defined four classes of fire, according to the type of fuel involved. These are:

Class A fires involve combustibles such as paper, wood, cloth, rubber and many plastics.

Class B fires entail burning of liquid fuels like oil-based paints, greases, solvents, oil and gasoline.

Class C fires are of electrical origin (fuse boxes, electric motors, wiring).

Class D fires encompass combustible metals such as magnesium, sodium, potassium and phosphorus.

Kwantlen must have Fire Extinguishers on hand in each laboratory that is appropriate for the classes of fuels that are present. At present, Class ABC fire extinguishers are suitable for Kwantlen's needs. These extinguishers must be inspected, serviced, and maintained on a regular basis by an outside contractor.

1.8 HAZARDOUS WASTE DISPOSAL

In general, hazardous waste is to be appropriately contained and labeled and placed in a designated Hazardous Waste Disposal Area. This waste is to be handled either by Kwantlen Facilities Dept or outside contractors. For information regarding general waste management at Kwantlen Polytechnic University, refer to Kwantlen Polytechnic University Policy No. F13 Waste Management/Environment (see Appendix F).

For biological waste handling and disposal, refer to the Kwantlen Biosafety Manual.

1.8.1 Liquid and Solid Chemical Waste Disposal

Each laboratory facility at Kwantlen has slightly different procedures for handling chemical waste. In general, solvent waste must be collected and stored in suitable containers (ie. capped 4L glass bottles or similar) which are stored in a well-ventilated fume hood. Halogenated and non-halogenated organic solvent waste must be collected and stored in separate bottles. Storage bottles should be capped shut while being stored in a fume hood. When they are full, they are transported to a pickup location and taken away for processing and disposal by an outside contractor company. At the discretion of knowledgeable laboratory employees, some liquid chemical waste can be discarded down the drain.

Examples include but are not limited to aqueous buffers, dilute acids and bases.

In general, solid waste must be collected and stored in suitable containers (metal or plastic bottles or pails with sealable lid) and stored in a ventilated area (ie. chemical bunker). The containers must be labeled to indicate that they are being used to store solid chemical waste. Solid chemical waste may originate from a spill, in which case a dust pan and brush can be used to collect the waste, and transferred to the storage container. Knowledgeable laboratory employees must be wary of the compatibility or non- compatibility of combining certain classes of solid chemical waste together in the same container. When containers are ready for disposal, they are to be transported to a pickup location and taken away for processing and disposal by an outside contractor company.

1.8.2 Regular garbage

Regular garbage should not contain any hazardous waste. All regular-garbage bins are to be emptied daily (bags removed and replaced) by outside contractors.

1.8.3 Sharps and needles

They are to be disposed of in designated and specially designed bins. When bins are $\frac{3}{4}$ full, they are to be transported to a pickup location appropriate for each laboratory, for disposal by an outside contractor. Individual depts. are responsible for purchasing their own sharps containers.

1.8.4 Glass waste and broken glass

This waste is to be disposed of in designated metal garbage cans with a foot lever operated closing lid and rigid plastic liner (no bag). When full, bins are to be transported to appropriate pick-up locations for Kwantlen Facilities dept employees to pick, process and dispose. Individual depts. are responsible for purchasing their own glass waste cans.

Refer to Section 2 for further procedures that may be specific to each laboratory department.

1.9 LABORATORY VENTILATION AND FUMEHOODS

General ventilation

General ventilation, also called dilution ventilation, involves dilution of inside air with fresh air. Its purpose is to:

- maintain comfortable environment of temperature, humidity and air movement for room occupants;
- dilute indoor air contaminants;
- balance out the removal of air by fume hoods and biological safety cabinets, from the general indoor atmosphere;

General ventilation systems comprise a balance of incoming air supply and outgoing air exhaust. The air may be supplied via a central HVAC (Heating, Ventilation and Air Conditioning) system. Laboratory air may be exhausted through either local exhaust devices or air returns connected to the HVAC system.

Kwantlen employees must be observant of any obvious deficiencies in air quality in the laboratory and report any problems to the Manager, Physical Plant in Kwantlen Facilities Dept. The Manager, Physical Plant or outside contractor should also routinely (recommend annually) inspect laboratory HVAC systems to ensure that they are functioning properly to maintain adequate ventilation and circulation of fresh air.

Chemical fume hoods and their safe use

Chemical fume hoods are fire and chemical resistant enclosure units with a sliding sash for opening or closing the hood. They are able to capture and exhaust even heavy vapors by means of air being drawn into the front opening and up into an exhaust system at relatively high velocity. They are preferred for all laboratory procedures that require manual handling of hazardous chemical materials.

General Procedure for Fume hood use:

1. Turn fume hood on; check for proper air movement.
2. Place work material at least 6" inside hood, behind the "plane" of the hood sash.
3. Lower glass shield to certification mark or lower.
4. Perform work slowly, entering "straight" into the hood; do not make large sweeping motions within the hood or upon exiting.
5. Remove materials from hood when work is completed; allow hood to run for 10-15 minutes before turning off.

When fume hoods are properly used and maintained, they will render substantial protection, provided the user is aware of its capabilities and limitations. Proper usage and maintenance encompasses the following⁶:

1. Controls for the operation of a fume hood and its services must be located outside the fume hood and must be immediately accessible to the laboratory worker, except that water taps may be located inside the cabinet if the main shutoff valve is in a safe location outside the cabinet.
2. A fume hood must be connected to a local exhaust ventilation system which will provide minimum air velocities over the operational face area of the hood of:
 - (a) an average of 0.5 m/s (100 fpm) but not less than 0.4 m/s (80 fpm) at any point across the face, and
 - (b) an average of 0.75 m/s (150 fpm) but not less than 0.65 m/s (125 fpm) at any point across the face if the fume hood is used for carcinogenic substances.

⁶ From: <http://www2.worksafebc.com/publications/OHSRegulation/Policies-Part30.asp>

3. A fume hood must be located to prevent cross drafts or other disruptive forces from lowering the air flow across the operational face to unacceptable levels.
4. A fume hood and its ductwork must be constructed from materials compatible with its use.
5. A fume hood must be clearly labeled with any applicable restrictions on its use.
6. A fume hood must not be used for storage of chemicals unless it is used exclusively for this purpose and is labeled with this limitation.
7. Air velocities over the operational face area of a fume hood must be measured and recorded at least annually and after any repair or maintenance which could affect the air flows.
8. Airflow in a fume hood used for very toxic or radioactive materials must be monitored continuously if there is risk to workers in the event of loss of airflow.
9. A fume hood with an adjustable sash must be marked to identify the maximum height the sash may be set at and still maintain the required air flows.
10. Fume hoods should be serviced and maintained on an annual basis either by Manager, Physical Plant in Kwantlen Facilities Dept, or an outside contractor. The record of annual maintenance should include use of a sticker affixed to somewhere on the front face of the fume hood. The sticker would, at a minimum, outlined the name of the servicing entity, date/time of last maintenance inspection and name or initials of the service technician.

To ensure that fume hoods provide the highest degree of protection, observe the following guidelines:

- Only materials being used in an ongoing experiment should be kept in the fume hood. Cluttering the hood will create air flow disturbances.

- When it is necessary to keep a large apparatus inside a hood, it should be placed upon blocks or legs to allow air to flow underneath.
- Operate the hood with the sash as low as is practical. Keep in mind that reducing the open face size will also increase the face velocity, possibly to unsafe levels.
- Work as far into the hood as possible. At least six inches is recommended.
- Do not lean into the hood. This disturbs the air flow, and also places your head into the contaminated air inside the hood.
- Do not make quick motions into or out of the hood, or create cross drafts by walking rapidly past the hood. Opening doors or windows can sometimes cause strong air currents which will disturb the air flow into the hood.
- Heating devices should be placed at the rear of the hood.
- Power cords must not hang down in front of the fume hood workspace.
- Do not use a hood for any function it was not specifically designed for.
- Keep hood door closed when fume hood is not being used.
- Remember that sinks inside fume hoods are not designed for disposing of any and all chemical wastes. Consult with user's manual or fume hood manufacturer to determine what chemical waste is appropriate for disposal.
- If chemical fumes can be detected by sense of smell to be emanating from a fume hood, immediately discontinue fume hood use and make arrangements with the fume hood servicing and maintenance contractor (indicated on maintenance sticker on fume hood), and/or fume hood manufacturer, as necessary, for the fume hood to be inspected and repaired.

1.10 COMPRESSED GASES AND CRYOGENICS

By nature of being contained in a high pressure vessel, compressed gases have potential to be very dangerous if not handled properly. Similarly, cryogenic materials are at such low temperatures that they can cause damage and injury to humans, if not handled properly.

1.10.1 Hazards of compressed gases

All compressed gases have potential health and safety hazards related to the chemical properties of the gas, as well as pressure hazards. Kwantlen employees must take precautions to protect employees and students from these potential hazards. The high pressure inside a gas cylinder can be extremely hazardous if disrupted. Knocking over an unsecured, uncapped cylinder of compressed gas can break the cylinder valve. The resulting rapid escape of high pressure gas can turn a cylinder into an uncontrolled projectile or pinwheel, causing serious injury and damage. Poorly controlled release of compressed gas in the laboratory can burst reaction vessels, cause leaks in equipment and hoses or result in runaway chemical reactions. 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 areas and causing asphyxiation.

Guidelines for safe handling, storage and transport of compressed gas cylinders:

- A sturdy cylinder cart should be used for transporting cylinders. Chain or strap the cylinder to the cart.
- When cylinders are not in use or are being transported, remove the regulator and attach the protective cap;
- All gas cylinders, full or empty, should be secured to a solid support such as a wall, using suitable racks, straps, chains or stands;

- Cylinders must be prevented from striking each other directly. This can be achieved by placing cylinders at a suitable distance from each other or by wrapping the upper part of cylinders with plastic webbing.
- Never bleed a cylinder completely empty; leave a residual pressure.
- Cylinders of flammable gases including hydrogen must be grounded; potential ignition sources such as open flames, sparks, and hot surfaces must be removed from the vicinity flammable gas cylinders;
- Toxic, odorless gases must be used with a venting system;
- Verify that the regulator is appropriate for the gas being used and the pressure being delivered. Do not rely upon the pressure gauge to indicate the maximum pressure ratings; check the regulator's specifications.
- Ensure the tubing and the apparatus downstream from the regulator are designed to withstand the pressures intended to be delivered. The tubing and other components should also be chemically resistant to the gas being used, tubing length should not be longer than is necessary and should be secured if necessary.
- Do not use adaptors or Teflon (PTFE) tape to attach regulators to gas cylinders. The recommendation of commercial gas suppliers is that regulator fittings in good condition do not require additional sealants.
- Do not lubricate an oxygen regulator.
- Compressed gas cylinders have a finite shelf life. Ensure cylinders are regularly inspected. Any cylinder that is corroded or has damaged valve components should be returned to the supplier. All cylinders older than five years should be returned to the manufacturer. Manufacturers of corrosive gases recommend that cylinders of corrosives be replaced every six months to guard against valve failure.
- Any cylinder that is found to be leaking must be returned to the vendor.

- Do not expose cylinders to temperatures extreme beyond the range of typical indoor and outdoor environmental temperatures.
- Always wear eye protection when working with compressed gases.
- Store incompatible classes of gases separately.

Guidelines for safe handling and usage of gas cylinder regulators:

- Only qualified, experienced, WHMIS-trained individuals are allowed to be handling and manipulating gas regulators. At a minimum, PPE such as lab coats and safety glasses must be worn before working with gas regulators.
- Confirm that the properly rated regulator is being used for the specific gas cylinder. Regulators should be labeled to identify the specific gas that they are designed for.
- Only use non-adjustable wrenches (no pliers or adjustable wrenches) for loosening and tightening brass nuts on regulators. Thread the cylinder connection brass nut on the regulator onto a gas cylinder valve by hand until snug, then use wrench to tighten. Thread the brass nut of the regulator outlet to the hose or pipe of the gas recipient equipment by hand until snug, then use wrench to tighten.
- Never use lubricants or Teflon tape on a connection thread.
- When connections are tightened, slowly open the master cylinder valve until the cylinder pressure gauge value stabilizes.
- Slowly turn the pressure adjustment knob counterclockwise to open the regulator valve. Turn until the desired delivery pressure is indicated on the delivery pressure gauge.
- Open the outlet valve and readjust the delivery pressure if required.

- It is recommended to have on hand, a leak-test solution such as SNOOP[®] to detect leaks in connections. Leak-test solution should be sprayed or otherwise applied to regulator connections to confirm that there are no leaks.

1.10.2 Cryogenic hazards

Cryogenics refers to very low temperature materials such as dry ice (solid CO₂) and liquefied air or gases like nitrogen and oxygen. The following potential hazards are associated with the use of cryogenics:

- asphyxiation due to displacement of oxygen (does not apply to liquid air and oxygen);
- materials becoming brittle and shattering from extreme cold;
- extreme frostbite;
- explosion due to pressure build up;
- condensation of oxygen and fuel (e.g. hydrogen and hydrocarbons) resulting in explosive mixtures.

Precautions for handling cryogenic materials and vessels:

- When handling cryogenic materials, always wear eye protection and insulated gloves to protect skin and eyes from contact;
- Use only low-pressure containers equipped with pressure-relief devices. Do not allow cryogenic preservation material to be stored in a sealed system;
- Use and store in well-ventilated areas;
- Keep away from sparks or flames, as appropriate;
- minimize and control ice build-up;
- Use materials resistant to low temperature brittling and shattering (e.g. latex rubber tubing);

- Watches, rings, bracelets or other jewelry that could trap fluids against flesh should not be worn when handling cryogenic liquids;
- To prevent thermal expansion of contents and rupture of the vessel, do not fill containers to more than 80% of capacity;
- If cryogenics must be transported by elevator, take adequate precautions to prevent possible injury. It is required to send cryogenic liquid tanks in elevators without any passengers and ensure that nobody gets on the elevator while the cryogen is being transported;
- Never use liquid nitrogen or liquid air as a cold trap to collect a flammable or combustible material mixed with air. Oxygen may condense from the air and lead to an explosion hazard;
- Dry ice/solvent cooling baths should be prepared carefully by the slow addition of small amounts of the solid dry ice to the solvent to avoid excessive frothing and overflow of the solvent;
- Never lower your head into a dry ice chest since a high level of CO₂ may accumulate there posing an asphyxiation hazard;

1.11 PHYSICAL HAZARDS AND ERGONOMICS

There are a number of common physical characteristics of laboratories that are of potential safety concern.

1.11.1 General Guidelines to Reduce Physical Hazards

- Do not block access to emergency safety equipment such as fire extinguishers, eyewashes, showers, first aid kits or utility controls such as breaker boxes or gas shut-off valves;
- Avoid blocking exits or normal paths of travel: keep hallways, walkways and stairs clear of chemicals, boxes, equipment and shelf projections;

- Ensure that the weight of stored material does not exceed the load-bearing capacity of shelves or cabinets;
- Ensure that wall-mounted shelving has heavy-duty brackets and supports and is attached to studs or solid blocking. Regularly inspect clamps, supports, shelf brackets and other shelving hardware;
- Arrange items so that they do not overhang or project beyond the edges of shelves or counter tops;
- Do not stack materials so high that stability is compromised;
- Leave a minimum of 18 inches (45.7 cm) of clearance between sprinkler heads and the top of storage;
- Use a safety step or stepladder to access higher items; never stand on a stool or a chair;
- Store frequently used items between knee and shoulder height;
- Store heavy objects on lower shelves;

1.11.2 Glassware

- Repair, replace or dispose of any damaged glassware. Follow proper disposal procedures for damaged glassware; refer to Section 1.8.4 for further details;
- Ensure that you are using gloves that provide adequate protection when working with glass tubing; at a minimum, latex gloves;
- Tape permanent vacuum glassware which presents an implosion risk with either electrical or duct tape or use appropriate shielding;
- Ensure that you are using gloves that provide adequate protection when picking up broken glass; at a minimum, latex gloves;
- When using and handling specialized glassware, ensure that you have had proper instruction and training on its safe and effective use;

- Specific procedures may apply for contaminated glassware. ie. glassware contaminated with biohazardous materials must be handled differently than chemical contamination. Refer to Kwantlen biosafety manual for details of handling glassware with biohazardous contamination.

1.11.3 Systems under pressure or vacuum

Never heat or carry out a reaction in a closed vessel unless it is designed or tested to withstand the expected pressure of the reaction. Pressurized equipment must have an appropriate pressure release valve. Pressurized equipment must be shielded, guarded, or designed to protect the operator against potential explosions.

The corollary applies to systems under vacuum. Never create a vacuum in a closed vessel that is not designed or tested to withstand the expected vacuum pressure of a reaction or process. Vacuum-pressure rated equipment must have an appropriate vacuum-release valve. Vacuum-pressure rated equipment must have a label with a vacuum pressure specification rating indicating the range of pressure that it has been designed to be implosion-proof for.

Compressed air sources on laboratory benches must be carefully utilized. When utilizing compressed air through connecting rubber hoses, ensure that all hose connections are snug and tight before opening valve. Compressed air valve handles should be opened slowly to prevent sudden increases in pressure of an enclosed system. Compressed air should never be directed towards a person and personnel are recommended to wear eye goggle protection when working with compressed air.

1.11.4 Backflow preventers

All gooseneck water faucets to which a hose is attached in a laboratory must be equipped with an appropriate backflow preventer. This prevents the contamination of the drinking water system.

1.11.5 Electrical Safety

Electrically powered equipment including but not limited to hot plates, stirrers, vacuum pumps, electrophoresis apparatus, lasers, heating mantles, ultrasonicators, power supplies, and microwave ovens are essential elements of many laboratories. These devices can pose a significant hazard to laboratory workers, particularly when mishandled or not maintained. Many laboratory electrical devices have high voltage or high power requirements, carrying even more risk.

The major hazards associated with electricity are electrical shock and fire. Electrical shock occurs when the body becomes part of the electric circuit, either when an individual comes in contact with both wires of an electrical circuit, one wire of an energized circuit and the ground, or a metallic part that has become energized by contact with an electrical conductor.

The severity and effects of an electrical shock depend on a number of factors, such as the pathway through the body, the amount of current, the length of time of the exposure, and whether the skin is wet or dry. Water is a great conductor of electricity, allowing current to flow more easily in wet conditions and through wet skin.

In addition to the electrical shock hazards, sparks from electrical equipment can serve as an ignition source for flammable or explosive vapors or combustible materials.

Loss of electrical power can create hazardous situations. Flammable or toxic vapors may be released as a chemical warms when a refrigerator or freezer fails. Fume hoods may cease to operate, allowing vapors to be released into the laboratory. If magnetic or mechanical stirrers fail to operate, safe mixing of reagents may be compromised.

Preventing Electrical Hazards

There are various ways of protecting people from the hazards caused by electricity, including insulation, guarding, grounding, and electrical protective

devices. Laboratory workers can significantly reduce electrical hazards by following some basic precautions:

- Inspect wiring of equipment before each use. Replace damaged or frayed electrical cords immediately.
- Use safe work practices every time electrical equipment is used.
- Know the location and how to operate shut-off switches and/or circuit breaker panels. Use these devices to shut off equipment in the event of a fire or electrocution.
- Limit the use of extension cords. Use only for temporary operations and then only for short periods of time. In all other cases, request installation of a new electrical outlet.
- Multi-plug adapters must have circuit breakers or fuses.
- Place exposed electrical conductors (such as those sometimes used with electrophoresis devices) behind shields.
- Minimize the potential for water or chemical spills on or near electrical equipment.

Insulation

All electrical cords should have sufficient insulation to prevent direct contact with wires. In a laboratory, it is particularly important to check all cords before each use, since corrosive chemicals or solvents may erode the insulation.

Damaged cords should be repaired or taken out of service immediately, especially in wet environments such as cold rooms and near water baths.

Guarding

Live parts of electric equipment operating at 50 volts or more (i.e., electrophoresis devices) must be guarded against accidental contact. Plexiglas shields may be used to protect against exposed live parts.

Grounding

Only equipment with three-prong plugs should be used in the laboratory. The third prong provides a path to ground for internal electrical short circuits, thereby protecting the user from a potential electrical shock.

Circuit Protection Devices

Circuit protection devices are designed to automatically limit or shut off the flow of electricity in the event of a ground-fault, overload or short circuit in the wiring system. Ground-fault circuit interrupters, circuit breakers and fuses are three well-known examples of such devices.

Fuses and circuit breakers prevent over-heating of wires and components that might otherwise create fire hazards. They disconnect the circuit when it becomes overloaded. This overload protection is very useful for equipment that is left on for extended periods of time, such as stirrers, vacuum pumps, drying ovens, Variacs and other electrical equipment.

The ground-fault circuit interrupter, or GFCI, is designed to shutoff electric power if a ground fault is detected, protecting the user from a potential electrical shock. The GFCI is particularly useful near sinks and wet locations. Since GFCIs can cause equipment to shutdown unexpectedly, they may not be appropriate for certain apparatus. Portable GFCI adapters (available in most safety supply catalogs) may be used with a non-GFCI outlet.

Motors

In laboratories where volatile flammable materials are used, motor-driven electrical equipment should be equipped with non-sparking induction motors or air motors.

Avoid series-wound motors, such as those generally found in some vacuum pumps, rotary evaporators and stirrers. Series-wound motors are also usually found in household appliances such as blenders, mixers, vacuum cleaners and

power drills. These appliances should not be used unless flammable vapors are adequately controlled.

Although some newer equipment has spark-free induction motors, the on-off switches and speed controls may be able to produce a spark when they are adjusted because they have exposed contacts. One solution is to remove any switches located on the device and insert a switch on the cord near the plug end.

Safe Work Practices

The following practices may reduce risk of injury or fire when working with electrical equipment:

- Avoid contact with energized electrical circuits.
- Use guarding around exposed circuits and sources of live electricity.
- Disconnect the power source before servicing or repairing electrical equipment.
- When it is necessary to handle equipment that is plugged in, be sure hands are dry and, when possible, wear nonconductive gloves and shoes with insulated soles.
- If it is safe to do so, work with only one hand, keeping the other hand at your side or in your pocket, away from all conductive material. This precaution reduces the likelihood of accidents that result in current passing through the chest cavity.
- Minimize the use of electrical equipment in cold rooms or other areas where condensation is likely. If equipment must be used in such areas, mount the equipment on a wall or vertical panel.
- If water or a chemical is spilled onto equipment, shut off power at the main switch or circuit breaker and unplug the equipment.

- If an individual comes in contact with a live electrical conductor, do not touch the equipment, cord or person. Disconnect the power source from the circuit breaker or pull out the plug using a leather belt.
- All electrical installations must conform to the provisions of the BC electrical code⁷;
- All electrical equipment must be CSA approved⁸;
- Extension cords should not be used for permanent installations. Contact Kwantlen Facilities Dept to install or relocate outlets in close proximity to the equipment;
- Use ground fault circuit interrupters where there is a risk of an operator coming in simultaneous contact with water and electrical equipment;
- Only trained, qualified employees may repair or modify electrical or electronic equipment;
- Power bars should not be located beneath work benches where chemicals are handled.

1.11.6 Ergonomics

Ergonomics is concerned with how the workplace "fits" the worker. Performing certain work tasks without regard for ergonomic principles can result in:

- Fatigue;
- repetitive motion injuries;
- strains, aches and injuries from biomechanical stresses;

⁷ http://www.bclaws.ca/Recon/document/freeside/--%20S%20--/Safety%20Standards%20Act%20%20SBC%202003%20%20c.%2039/05_Regulations/12_100_2004.xml#section20

⁸ <http://www.csa.ca/cm/ca/en/about-csa>

- eyestrain from video display terminals (VDTs);
- decreased worker morale.

Factors that can increase the risk of musculoskeletal injury are:

- awkward positions or movements;
- repetitive movements;
- application of force.

General guidelines for maximizing ergonomic comfort for Kwantlen laboratory workers include:

- maintaining suitable heights of laboratory workbenches for all employees;
- Laboratory chairs are on wheels or castors, are sturdy (5-legged), and are position-adjustable for seat height, angle, and backrest height;
- Computer monitor screens are positioned at or slightly below eye level, and are positioned so as to avoid glare from lights or windows;
- Computer keyboards and pointing devices are positioned so that wrists are kept in a neutral position and forearms are horizontal;
- Color, lettering size and contrast of images on the computer monitors should be optimized/customized by the operator through the operating system control panel and/or monitor adjustment knobs, for comfort and minimal eye strain;
- Work station design does not necessitate excessive bending, reaching, stretching or twisting;
- Vibration-producing equipment, such as vortex mixers and pump-type pipettors are not used for extended periods of time;
- Buttons and knobs on equipment are accessible and of a good size;

- Aids such as carts and dolly's are available for transport of heavy and/or bulky items;
- Employees are informed on proper techniques for lifting or moving heavy materials (ie. utilizing upper legs, and not the lower back to bear the weight);
- Indoor air quality parameters, such as temperature, humidity and air supply are maintained at comfortable set-points (suggested conditions: 21-23°C, 30-60%Relative Humidity⁹, 4-12 air changes/hr¹⁰);
- Floors are slip-resistant;
- Noise levels are not excessive and constant to the point of causing worker discomfort.

1.12 EQUIPMENT SAFETY

When procuring and purchasing new lab equipment at Kwantlen, 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;
- have no sharp edges or burrs.

All efforts should be made to prevent equipment from becoming contaminated and spreading contamination. To reduce the likelihood of equipment malfunction that could result in leakage, spill or unnecessary generation of aerosolized contaminants:

⁹ http://www.ccohs.ca/oshanswers/phys_agents/thermal_comfort.html

¹⁰ OSHA Part 1910–Occupational Safety and Health Standards

- Review the equipment manufacturer's documentation. Keep for future reference;
- Use and service equipment according to the manufacturer's instructions;
- Ensure that anyone who uses a specific instrument or piece of equipment is properly trained in setup, use and cleaning of the item;
- Ensure that equipment leaving the laboratory for servicing or disposal is appropriately decontaminated.

Some larger pieces of equipment that utilize electricity to operate also require down time for regular scheduled maintenance and/or repair. A specific Kwantlen lockout procedure must be followed to ensure the safety of the maintenance/repair person¹¹. The procedure in brief includes:

- All locks/keys for the lock-out system will be supplied by Kwantlen to employees. No other lock and keys are permitted.
- Every person must use their own lock and not work under another person's lock.
- Facility Manager is to be notified of work to be done.
- Isolate equipment and lock-out by attaching your personal lock to the isolation point and place lock-out tag at that location.
- On electrical equipment, employees have the lock-out isolation checked by an electrician if there is any doubt that equipment is turned off.
- Do not work on equipment unless you are absolutely sure it is locked off with your lock and cannot be started.

¹¹ Lockout procedure from Kwantlen Facilities Training Manual, p.96 of 111, April 26-2006.

- Upon completion of work, inspect to ensure equipment is safe to use before removing locks.

The following sections outline some of the precautions and procedures to be observed with some commonly used laboratory equipment.

1.12.1 Centrifuges

Improperly used or maintained centrifuges can present significant hazards to users. Failed mechanical parts can result in release of flying objects, hazardous chemicals and biohazardous aerosols. The high speed spins generated by centrifuges can create large amounts of aerosol if a spill, leak or tube breakage occurs. To avoid contaminating your centrifuge:

- Check glass and plastic centrifuge tubes for stress lines, hairline cracks and chipped rims before use. Use unbreakable tubes whenever possible;
- Avoid filling tubes to the rim;
- Use caps or stoppers on centrifuge tubes. Avoid using lightweight materials such as aluminum foil as caps;
- Use sealed centrifuge buckets (safety cups) or rotors that can be loaded and unloaded in a biological safety cabinet. If necessary, clean and decontaminate the outside of the cups or buckets before and after centrifugation. Inspect o-rings regularly and replace if cracked or dry;
- Ensure that the centrifuge is properly balanced;
- Do not open the lid until the rotor head has come to a complete stop.
- Do not attempt to stop a spinning rotor by hand or with an object, or interfere with the interlock safety device;
- Decant supernatants carefully and avoid vigorous shaking when resuspending;

When using high-speed or ultra centrifuges, additional practices should include:

- Connect the vacuum pump exhaust to a trap;
- Record each run in a logbook: keep a record of speed and run time for each rotor;
- Install a HEPA filter between the centrifuge and the vacuum pump when working with biohazardous material;
- Never exceed the specified speed limitations of the rotor.

1.12.2 Heated water baths/circulating baths, ultrasonic baths

Heated water baths and circulating water baths keep immersed materials immersed at a constant temperature. They may be filled with a variety of materials, depending on the bath temperature required; they may contain water, mineral oil, glycerin, paraffin or silicone oils, with bath temperatures ranging up to 300°C. The following precautions are appropriate for heating baths:

- set up baths on a stable surface, away from flammable and combustible materials including wood and paper;
- relocate only after the liquid inside has cooled;
- ensure baths are equipped with redundant heat controls or automatic cutoffs that will turn off the power if the temperature exceeds a preset limit;
- use with the thermostat set well below the flash point of the heating liquid in use;
- use a thermometer to allow a visual check of the bath temperature.

The most common heating bath and/or circulating bath used in laboratories are the water bath. When using a water bath:

-
- Do not overfill bath beyond design specifications;

- clean regularly; a disinfectant, such as a phenolic detergent, can be added to the water;
- avoid using sodium azide to prevent growth of microorganisms; sodium azide forms explosive compounds with some metals;
- raise the temperature to 90°C or higher, if applicable for 30 minutes once a week for decontamination purposes;
- unplug the unit before filling or emptying, and have the continuity-to-ground checked regularly;

Ultrasonic baths present unique hazards to laboratory employees if not handled properly¹². The purpose such equipment is to expose the work-piece to vibratory energy of sufficient intensity to bring about a permanent physical change. The main hazard to the user is from accidental contact exposure to the ultrasonic wave. However, many industrial and commercial uses of ultrasound also incidentally generate and propagate high sound-pressure levels in the air in the sonic and ultrasonic range. When this happens, a hazard may also arise from the ear's reception of the airborne ultrasound.

Contact exposure to high-power ultrasonic energy sources must be avoided at all times.

The following precautions are recommended to ensure the safe use of ultrasonic baths:

1. Limited surrounding exposure -only operators familiar with the safe use of high-power ultrasonic bath equipment should be allowed within the boundaries of the controlled area while the equipment is operating. Exposure to others in the surrounding area is easily preventable.

¹² From: http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/safety-code_24-securite/guidelines-principes-eng.php

2. Use of PPE -Personnel using high-power ultrasonic baths should be knowledgeable about the possible harmful effects of ultrasonic energy and take preventative measure such as wearing protective hearing devices (disposable ear plugs) and gloves while operating equipment.
3. Use of signage -a warning sign for ultrasonic energy sources in a laboratory is recommended for use, see below. Warning signs should be placed at or near the vicinity of the high power energy source. Accompanying each warning sign there should also be a statement indicating the precautionary measures to be taken while the ultrasound power is on (ie. Wear hearing protection). Labels should be placed on all ultrasonic cleaning tanks cautioning nearby personnel not to immerse hands or other parts of the body in the tank while it is operating.

1.12.3 Ovens and Hot Plates

Laboratory ovens are useful for baking or curing material, off-gassing, dehydrating samples and drying glassware.

- Ensure that oven design prevents contact between flammable vapors and heating elements or spark-producing components
- Discontinue use of oven if the backup thermostat, pilot light or temperature controller has failed
- Avoid heating toxic materials in an oven unless it is vented outdoors (via a canopy hood, for example)
- Never use laboratory ovens for preparation of food for human consumption
- Ensure that glassware placed in an oven is designed to handle the high temperatures.
- Glassware that has been rinsed with an organic solvent should be rinsed with distilled water before it is placed in a drying oven

Hot plates in a laboratory setting also present potential hazards. Personnel using hot plates should be aware of the following:

- A typical hotplate will not appear to be obviously hot, especially shortly after it has been shut off. Personnel should have a sign and/or verbally communicate to other persons in the laboratory that a hot plate is in use.
- Glassware that is placed on a hotplate must be rated to withstand the temperature of a hotplate and must not be cracked. Otherwise, there is risk of shattering and spillage of contents.
- Never allow contents in glassware to heat to dryness on a hotplate as this may lead to cracking or breakage of glassware.
- Glassware and other containers placed on a hotplate should be handled with appropriate gloves to prevent burning and scalding

1.12.4 Shakers, Blenders and Sonicators

When used with infectious biological agents, mixing equipment such as shakers, blenders, sonicators, grinders and homogenizers can release significant amounts of hazardous aerosols, and should be operated inside a biological safety cabinet whenever possible. Equipment such as blenders and stirrers can also produce large amounts of flammable vapors. The hazards associated with this type of equipment can be minimized by:

- selecting and purchasing equipment with safety features that minimize leaking;
- selecting and purchasing mixing apparatus with non-sparking motors;
- checking integrity of gaskets, caps and bottles before using and replacing damaged components;
- allowing for any potential aerosols to settle for at least one minute before opening containers;

- for blending of potentially biohazardous materials, cover the top of blenders with a disinfectant-soaked towel during operation and conduct blending operation in biosafety cabinet if possible;
- when using a sonicator, immersing the tip deeply enough into the solution to avoid creation of aerosols;

1.12.5 Microwave Ovens

Microwave ovens are potentially dangerous because of potential for exposure to microwave radiation. The following safety tips apply for operation and maintenance of microwave ovens in laboratories¹³:

- Do not operate oven when empty.
- Exercise extreme caution if you have a pacemaker implant. Microwave radiation may cause pacemaker interference. Persons with pacemaker implants should not be near a microwave oven unless they are sure that it is in good operating condition and there is no leakage of microwave radiation.
- After each use, check to ensure that door seal and inside surfaces of door and oven cavity are clean.
- Do not put face close to door window when oven is operating.
- Ensure that the microwave is unplugged or disconnected from electrical power before reaching into any accessible openings or attempting any repairs.
- Ensure that the adjustment of applied voltages, replacement of the microwave power generating component, dismantling of the oven

¹³ Microwave safety from Canadian OHS Centre:

http://www.ccohs.ca/oshanswers/phys_agents/microwave_ovens.html#_1_7

components, and refitting of waveguides are undertaken **only** by qualified persons. The services of a qualified repairman should be sought when any malfunction is suspected.

- Do not bypass the door interlocks.
- Do not test a microwave power generating component without an appropriate load connected to its output. The power generated must never be allowed to radiate freely into occupied areas.

1.12.6 Safe use of Analytical equipment

The following are general guidelines for safe use of analytical equipment; refer to Section 2 for each Kwantlen laboratory for specific analytical equipment:

- Ensure that installation, modification and repairs of analytical equipment are carried out by authorized service employees;
- Read and understand the manufacturer's instructions before using this equipment;
- Make sure that preventive maintenance procedures are performed as required;
- Do not attempt to defeat safety interlocks;
- Wear safety glasses and lab coats (and other appropriate PPE as specified) for all procedures.

1.12.7 Glassware safety

- Use a dustpan and brush, not your hands, to pick up broken glass;
- Discard broken glass in a rigid container separate from regular garbage and label it appropriately (refer to Section 1.8.4 for glass waste);
- Protect glass that is subject to high pressure or vacuum. Wrapping glass vessels with cloth tape will minimize the possibility of projectiles;

- Glass is weakened by everyday stresses such as heating and bumping. Handle used glassware with extra care;
- Discard or repair all damaged glassware, as chipped, cracked or star-cracked vessels cannot be expected to endure stress from normal use.

When handling glass rods or tubes:

- fire polish the ends,
- lubricate with water or glycerin when inserting through stopper,
- ensure stopper holes are properly sized, and not too small,
- insert carefully, with a slight twisting motion, keeping hands close together along the side, never over the end of the rod or tube, and
- use gloves or a cloth towel to protect your hands

Glass Thermometers and Barometers Containing Mercury

These instruments must be handled with care to avoid breakage and release of mercury droplets.

- Store instruments in a manner that minimizes chances of being accidentally smashed, dropped or otherwise broken.
- Wear gloves when handling instruments
- Do not expose instruments to temperature or pressure extremes, to avoid breakage.
- If these instruments are broken, carefully clean area of broken glass and dispose of as described in Section 1.8.4. For directions on cleanup and disposal of mercury waste, refer to Appendix D.

Types of Glass

Laboratory Glassware is made from many different variations and formulations. The following Table outlines brief definitions of some glass types and

descriptions of their characteristics¹⁴. This information is to be used as a guideline only—all materials should be tested under actual conditions before used in specific applications.

Glass type/Trade name	Characteristics and Properties
Corning® Pyrex® 7740	A borosilicate, low expansion Type I glass designed for use in all products requiring very high resistance to strong acids or alkalis and in products intended for use in heat applications such as autoclaves, hot plates, and open flame. Examples include Pyrex® beakers, burettes, centrifuge tubes, cylinders, desiccators, dishes, flasks, fritted ware, funnels, and jars.
Corning® Vycor® 7913	This material is formed as a borosilicate type glass. It is then subjected to a chemical treatment that removes most of the elements in the glass except silica (SiO ₂). Glass is then reheated to eliminate the microscopic holes caused by the chemical treatment. Only quartz has higher silica content. It is designed for use in all products that must withstand very high temperatures or thermal shock. Since Corning is the only company that makes VYCOR® there are no federal or ASTM standards. Examples include evaporating dishes 34587-20 and -22.
Corning® PyrexPlus®	This laboratory glassware is Pyrex® brand borosilicate glass labware which has been coated with a tough, transparent plastic vinyl. The coating, which is applied to the outside of the vessel, helps prevent exterior surface abrasion. It also helps minimize the loss of contents and helps contain glass fragments if the glass vessel is broken. The recommended temperature range for PyrexPlus® labware is 10 deg C to 80 deg C.
Wheaton 180	An exceptionally clear borosilicate glass of high chemical durability which has been especially formulated for the lowest background count while still at a reasonable cost. Great care has been taken to select only those ingredients for the batch that would not cause

¹⁴ From Cole Parmer Technical Library:

http://www.coleparmer.ca/techinfo/techinfo.asp?htmlfile=Properties_Glass.htm&ID=608

	unwanted background count or color. Potassium as a separate element has been excluded from the batch to minimize K40. Special controls ensure high quality and batch to batch uniformity.
Wheaton 200	Also referred to as Wheaton-33® low extractable borosilicate glass, is a borosilicate glass with exceptional thermal endurance that meets the requirements of Federal specification DD-G-541b, glass (laboratory), for both USP and ASTM Type I, borosilicate glass Class A. This glass meets all sterilization requirements. Examples include sample bottles 08913-15, -25, -45 and -55, and large sample vials 08918-22, -23 and -24.
Wheaton 400	Also known as No-Sol-Vit, is a borosilicate glass that falls well within the limits for USP Type I chemically resistant borosilicate glass, as specified in the XXIII revision of the U.S. Pharmacopoeia. Examples include safety-coated wide-mouth bottles 34501-20, -50 and -70.
Wheaton 800	a superior soda-lime flint glass that meets requirements for USP Type III soda-lime glass as specified in the XXIII Revision of the U.S. Pharmacopoeia. Examples include clear safety-coated bottles 08922-50 and -60.
Wheaton 900	Similar in formulation to Wheaton 800 glass except it is amber colored which provides light sensitivity. Examples include amber safety-coated bottles 08922-55 and -65.

1.13 PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) is designed to protect parts of the body. It should act as a primary barrier between the hazard and the worker. It does not reduce the hazard itself, but reduces chances of exposure to it. PPE must be chosen that is appropriate to the hazards that are present.

All Kwantlen laboratories must be stocked with adequate supplies of PPE and Kwantlen employees must understand what PPE to use for different types of hazards. It is the responsibility of Kwantlen employees to ensure that students use PPE and use it properly.

1.13.1 Laboratory Coats or gowns

Appropriate protective clothing (e.g., lab coats, aprons, and coveralls) is required in all experimental areas where hazardous materials are handled.

Guidelines for selection and use of protective laboratory clothing:

- select full sleeve, knee-length lab coats with button or snap closures and full sleeves;
- wear a solid-front lab coat or gown with back closures and knitted cuffs when working with highly toxic or infectious agents;
- wear protective aprons for special procedures such as transferring large volumes of corrosive material;
- remove protective clothing when leaving the laboratory;
- remove protective clothing in the event of visible or suspected contamination;
- Clothing should provide maximum coverage of skin in accordance with the risk of exposure. Kwantlen employees must determine the specific requirements in each lab.

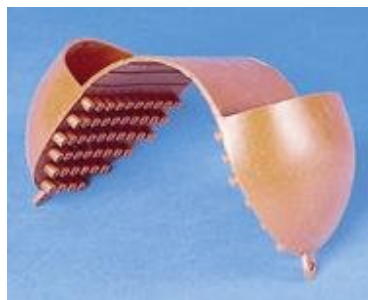
- When lab coats are used they should be removed and hung up prior to employees leaving the lab. They should be kept clean and laundered separately from regular clothing, buttoned closed when worn. In the event that highly corrosive or reactive materials are handled, rubber aprons should be worn.

1.13.2 Gloves

Gloves are used in the laboratory for protection from a variety of hazards including radiation sources, chemical products, biohazardous material and physical hazards (abrasion, tearing, puncture, sharp edges, and exposure to temperature extremes). There are different types of protective gloves available and they should be chosen to offer the best protection for specific procedures, chemical hazards and physical hazards.

Heavily fortified cloth material gloves such as autoclave gloves or industrial oven mitts must be available for handling extremely hot items that may originate from an autoclave, or extremely cold items from freezer storage.

Rubber grippers such as “Hot Hands Protector Mitts” must be available for handling and transporting containers of hot liquids (ie. containers of molten agarose gel from a microwave oven)¹⁵.



¹⁵ Available from: <http://www.2spi.com/catalog/safety/hot-hands.shtml>

If applicable, cloth gloves with rubber coatings for extra gripping power, must be available for handling any items that require solid gripping to avoid dropping and breakage.

Refer to Appendix C for more detailed reference guide to glove selection for different physical hazards.

Disposable Plastic Gloves

Disposable plastic latex gloves are the most commonly used types of gloves and is the most widely used form of PPE in the laboratory setting. Disposable gloves are made from a variety of materials including but not limited to: rubber (latex), neoprene, and nitrile. In microbiological laboratories where biohazardous materials exist, surgical gloves of rubber (latex) or vinyl are generally the preferred choice. Refer to the Kwantlen biosafety manual for further information. When working with chemical hazards, disposable gloves made of appropriate polymer material must be chosen such that they provide protection to the user, and are not reactive with the material being handled. Refer to Table C2 in Appendix C for a detailed guide to selection of disposable glove material type for different classes of chemical hazards.

Guidelines for disposable glove usage:

- choose a glove that provides adequate protection from the specific hazard(s);
- be aware that some glove materials may cause adverse skin reactions in some individuals and investigate alternatives;
- inspect gloves for leakage before using; test rubber and synthetic gloves by inflating them;
- make sure that the gloves fit properly;
- ensure that the gloves are long enough to cover the skin between the top of the glove and the sleeve of the lab coat;
- discard worn or torn gloves;

- discard disposable gloves that are, or may have become, contaminated;
- avoid contaminating "clean" equipment: remove gloves and wash hands before carrying out tasks such as using the telephone;
- always wash your hands after removing gloves, even if they appear not to be contaminated;
- minimize the practice of reusing disposable gloves;
- follow the manufacturer's instructions for cleaning and maintenance of reusable gloves;
- before using gloves, learn how to remove them without touching the contaminated outer surface with your hands;

There are also oven mitts for handling very hot items and rubber "hot hands" for handling beaker sized containers of hot liquid such as molten agar. These types of glove PPE should be available in Kwantlen laboratories if such samples are handled.

1.13.3 Eye and Face Protection

All Kwantlen employees, students and visitors must wear appropriate eye and/or facial protection in:

- All areas where hazardous materials, or substances of an unknown nature, are stored, used or handled;
- All areas where the possibility of splash, flying objects, moving particles and/or rupture exist;
- All areas where there are other eye hazards, e.g. UV or laser light

Guidelines for selection and use of protective eyewear:

- Light-to-moderate work: CSA approved¹⁶ safety glasses with side shields are the minimum requirement for working in a laboratory.
- Goggles should be utilized when working under significant risk of splash of chemicals, or projectiles.
- A full face shield, plus goggles should be utilized when working under significant risk of splashing on the face, or possible explosion.
- If safety glasses with correction lenses are needed, first consult with an optometrist or ophthalmologist.
- All PPE eyewear should be inspected regularly as is appropriate, for proper functionality, cleanliness and contamination. Dirty or contaminated eyewear can be cleaned with standard eyeglass pump sprays and/or a water/bleach solution for decontamination.

Approved safety glasses with side shields are the minimum protection required in a laboratory. Goggles and face shields may also be required for certain procedures, as determined by the instructor.

1.13.4 Respiratory Protection

Under normal circumstances at Kwantlen laboratories, the use of fume hoods should generally eliminate respiratory hazards, and the use of dust masks may also be adequate. Extreme equipment such as respirator masks and self-contained breathing (SCBA) regulators should not be required for laboratory situations. If such equipment is ever required, the selection should be based on the CSA Standard: Selection, Use and Care of Respirators CSA – Z94.4-93¹⁷. It is essential the wearer be properly instructed for safe and fit use of a respirator.

¹⁶ CSA Standard for Eye and Face Protectors (CSA-Z94.3-99)

¹⁷ WorkSafeBC guideline for respiratory protection:
<http://www2.worksafebc.com/Publications/OHSRegulation/GuidelinePart8.asp?reportID=24511>

1.13.5 Hearing Protection

Hearing protection is not likely required in Kwantlen laboratories but in British Columbia, hearing protection is required for noise levels above 85 decibels¹⁸. In the event that such noise levels are encountered, Kwantlen must have hearing protection aids available for employees and students in the form of disposable sponge ear plugs.

1.13.6 Foot Protection

As a general rule, people must not be allowed to wear opened-toed shoes such as sandals when entering and working in a laboratory.

Safety footwear is designed to protect feet against a variety of injuries. Impact, compression, chemical splashes and puncture are the most common types of injuries. This hazard is not likely significant in Kwantlen laboratories, however if safety footwear is required in the future, it should be chosen according to the hazard and should be properly rated. (Protective Footwear CSA-Z195-M92)

For PPE considerations for working with biohazardous materials, refer to Kwantlen Polytechnic University Biosafety Manual.

1.13.7 Emergency Showers and Eyewash Stations

Kwantlen Polytechnic University must have emergency showers and eyewash stations available for any laboratories that handle solid and liquid chemicals. These equipment must be readily accessible, in working order, be routinely inspected and maintained.

¹⁸ Sound thresholds for work environment safety: <http://www.workrights.ca/content.php?doc=149>

Emergency Showers

Monthly Flush Test

- **Visual inspection of the unit.** Look for leaks, pipe damage, and proper placement of protective covers. This should be done prior to testing in order to avoid further damage to the unit and risk of injury to users and yourself. Ensure that the unit is free of any obstructions.
- **Activate unit.** Ensure that the water flow is continuous, evaluate that the unit can maintain flow for 15 minutes.
- Valve actuator must stay on unless manually turned off and must activate water flow in one second or less.
- Controlled flow of flushing fluid must be provided to both eyes simultaneously.
- The unit must be capable of delivering not less than 20 gallons per minute of flushing fluid.
- **Sanitize water supply through *monthly* flushing.** In order to relieve the unit of any rust and other pipe build-up, flush the unit until the water runs clear.
- **Document test with dates and initials on unit tag.** Facilities Management is responsible to ensure an appropriate tag is on all units.

Annual Flow Test

- **Flow rate of the device will be conducted *annually*.** Let the water run for one minute to collect at least 75.7 liters (20 gallons) of water.
- **Document test with dates and initials on unit tag.** Facilities Management is responsible to ensure an appropriate tag is on all units.

Eyewash and Eye/Face wash units

Monthly Flush Test

- **Visual inspection of the unit.** Look for leaks or pipe damage and proper placement of protective covers. This should be done prior to testing in order to avoid further damage to the unit and risk of injury to users. Ensure that the unit is free of any obstructions.
- **Activate unit.** Ensure that the water flow is continuous, evaluate that the unit can maintain flow for 15 minutes, and is not injurious to the user's eye or face. Valve actuator must activate water flow in one second or less.
- Valve actuator must stay on unless manually turned off and must activate water flow in one second or less.
- Controlled flow of flushing fluid must be provided to both eyes simultaneously.
- The unit must be capable of delivering not less than 0.4 gallons per minute of flushing fluid for 15 minutes.
- **Sanitize water supply through *monthly* flushing.** In order to relieve the unit of any rust and other pipe build-up, flush the unit until the water runs clear.
- **Document test with dates and initials on unit tag.** Facilities Management is responsible to ensure an appropriate tag is on all units.
- Annual Flow Test
- **Flow rate of the device will be conducted *annually*.** Following established procedures let the water run for one minute to collect at least 1.5 liters (0.4 gallon) of water for eyewash alone and 11.4 liters (3.0 gallons) for an eye/face wash unit.

- **Document test with dates and initials on unit tag.** Facilities Management is responsible to ensure an appropriate tag is on all units.

1.14 EMERGENCY RESPONSE PROCEDURES

1.14.1 Emergency Response to Chemical Spills

In the event of a chemical spill in a Kwantlen laboratory, Employees are responsible for prompt and proper clean-up of the spill. Employees are also responsible for ensuring that they have spill kits stocked with adequate and appropriate spill control materials. Employees must also have suitable PPE on hand that is readily available and appropriate for the chemicals being handled.

The following are emergency response procedures to be followed for cleanup of significant chemical spills (>500ml).^{19,20}

1. Immediately alert all occupants present in the room and evacuate the area, if necessary.
2. If there is a fire, contact 9-9-1-1, if there is need for medical attention, contact Kwantlen First Aid at 604-599-2676 (Richmond) or 604-599-2076 (Surrey).
3. Attend to any people who may have become exposed and contaminated with hazardous chemical material. Help to immediately escort them to a running safety shower. When in the shower, remove clothing immediately and let the victim's skin be flushed with water for at least fifteen minutes.

¹⁹ For spills <500ml, the emergency response procedures outlined above may be followed, it is up to the discretion of Kwantlen laboratory employees to determine if outside help is required, and/or if the spill can be cleaned up without using the resources in a spill kit.

²⁰ For spills >500ml, if there has been a release to the environment or if there is no one knowledgeable about spill clean-up available, contact Kwantlen Facilities Dept. for immediate assistance and situation management.

Clothing must be laundered before consideration to reuse. Refer to Section 1.14.3 for First Aid for Chemical Exposure for more information.

4. If a volatile, flammable material has been spilled, immediately warn everyone in vicinity to evacuate, remove any sources of ignition such as a lit flame and ventilate the area as much as possible by opening windows, if available.
5. If acid or base has been spilled, neutralize with the appropriate agent from the spill kit.
6. If the spill is of unknown composition, or potentially dangerous (explosive, toxic vapors), alert everyone present and evacuate the room. If the spill cannot be safely handled using the equipment and employees present, call the emergency telephone number. Refer to Appendix D for guidelines on specific types of chemical spills.
7. Put on PPE, as appropriate for the hazard (e.g., face masks, gloves, smocks, protective clothing, etc.). Refer to the Material Safety Data Sheet or other references for specific information on the chemical hazard that has spilled. If unsure how to proceed, or if you do not have the necessary protective equipment, do not attempt to clean up the spill without external dept assistance.
8. Consider the need for respiratory protection (refer to Section 1.13.3). If respiratory protection is required, contact Kwantlen Facilities dept and defer subsequent clean-up activities to them.
9. Utilize the Kwantlen laboratory spill kit contents to contain and clean-up the spill. Loose spill control materials should be distributed over the entire spill area, working from the outside, circling to the inside. This reduces the chance of splash or spread of the spilled chemical.

10. Protect floor drains from spread of chemical spill into the environment.
Spill socks and absorbents may be placed around drains, as needed.
11. When spilled materials have been absorbed, use brush and scoop to pick up the spent adsorbent materials into a sturdy container such as a metal garbage can, or plastic waste basket.
12. Label containers to indicate hazardous materials content for disposal.
Contact Kwantlen Facilities Dept or outside contractor, as the case may be for a particular laboratory, for specific disposal instructions.
13. Decontaminate the surface where the spill occurred using a mild detergent and water, when appropriate.
14. Collect all cleanup materials for proper disposal including contaminated tools and clothing.
15. In all cases of chemical spills, whether external assistance is required or not for cleanup, report all incidences to Kwantlen Facilities dept.
16. After use of the spill kit, ensure restocking of spill kit contents.

Chemical Spill Kit Design

Each laboratory has a unique composition of hazardous and non-hazardous chemicals in different. As a result, the spill kit requirements of each laboratory are also unique.

There are general guidelines to follow when deciding how to appropriately stock a spill kit. Few labs are properly equipped without supplementing the basic spill kit with items that meet the specific needs of that laboratory. These specific needs can only be determined by assessing the types and quantities of chemicals in the laboratory, and by consulting MSDS's.

The following are the recommended components of a basic spill kit:

	Component	Details for consideration
1.	Polypropylene or high-density polyethylene bucket with top – (5 gallon or larger)	<p>Purpose of bucket is to serve as a receptacle for chemical resistant bag liners during a spill clean-up and as a storage container for the spill kit components.</p> <p>Other considerations: The bucket or container should be well labeled (with list of contents) and easily accessible. All Kwantlen employees and students working in the lab must know where the spill kit is located. The size of the bucket can be variable, depending on need.</p>
2.	Personal protective equipment (PPE)	<p>A. Safety eyewear: Spare safety glasses and/or goggles.</p> <p>B. Gloves: highly chemical resistant is recommended. No gloves are 100% chemical proof, however, some are resistant to more chemicals than others, for example: Nitrile, neoprene, and butyl rubber gloves.</p> <p>Latex gloves are limitedly resistant to many laboratory chemicals and should not be chosen for use in a spill kit.</p> <p>C. Body coverings including, but not limited to: aprons, shoe covers, knee protectors, lab coats/smocks, gas masks and dust masks.</p> <p>Reading the MSDSs is the best way to ensure that all of the requirements for PPE have been fulfilled.</p>
3.	Clean-up Tools	Clean-up tools such as dustpan, scoop and brush, etc. should be chemical-resistant and non-sparking (plastic). A variety of polypropylene tools are available.

4.	Inert, non-combustible absorbent materials to soak up and neutralize chemical spills	<p>Every spill kit should contain non-combustible absorbent materials. Examples of such materials include:</p> <p>A. Vermiculite: soft, monoclinic, hydrous silicate minerals resulting from alterations of mica and occurring in tiny, leafy scales that expand greatly when heated; used for insulation, water adsorption, etc.</p> <p>B. Other inert “loose bulk” such as clay, sand, or kitten litter. When spread over a spilled liquid, these loose bulk materials will effectively absorb and prevent the spill from spreading.</p> <p>Many of the inert, non-combustible absorbents are available as socks, pillows, pads, diking tubes, etc. A spill kit should contain a combination of loose bulk absorbents, as well as encased absorbents (socks, pads, pillows, etc.)</p> <p>It should be noted that paper towels, rags, and sawdust are not inert, non-combustible materials and are not recommended for inclusion as spill kit absorbent material</p>
5.	Absorbents for specific chemicals/classes of chemicals	<p>A spill kit should contain inert absorbent that is designed specifically for the types of chemicals present that may spill.</p> <p>A. Acids Spills: Sodium bicarbonate and sodium carbonate are designed for neutralizing and absorbing many acid spills. Some of the commercial kits have color indicators to show when a spill has been neutralized.</p> <p>B. Alkali Spills: Citric acid and sodium bisulfate are designed for neutralizing and absorbing many alkali or caustic spills. Some of the commercial kits have</p>

		<p>color indicators to show when a spill has been neutralized.</p> <p>C. Solvent Spills: Commercial solvent treatment materials may be used to reduce vaporization and raise the flash points of some solvents.</p> <p>D. Other considerations: There are other chemical-specific materials that may be necessary to safely and effectively neutralize or treat some chemical spills. Some chemicals require special precautions and all absorbents have limitations.</p>
6.	Chemical resistant bags	All spill residue and spill clean-up materials need to be placed in a high density polyethylene or polypropylene bag with attached hazardous waste tag.
7.	Hazardous waste tags	Tags are required to adequately label and identify bags of hazardous waste cleanup debris for subsequent treatment/disposal.

In addition to the core components outlined above for a basic spill kit, the quantities of each of the components to be stocked in each Kwantlen laboratory spill kit must be determined based on quantities of hazardous chemicals that are present.

Commercial spill kits that are purchased as a starting point may also include information/instruction pamphlets and guidelines for quantity of absorbent materials to use.

Once the required contents and quantities for a spill kit have been determined, each Kwantlen laboratory must establish a checklist of spill kit components and quantities. A record of this checklist should be kept on file and also posted on the outside of the spill kit container.

The chemical spill kit and PPE must be stored in a readily accessible location within or immediately adjacent to the laboratory. Refer to floor plan drawings of each laboratory in Section 2, for the spill kit location in each particular laboratory dept at Kwantlen.

Spill response plans must be discussed with all Kwantlen employees working in the laboratory. Employees are responsible for being properly trained to know how to use each of the components in a spill kit. Spill response is a component of WHMIS safety training, refer to Section 1.15.

1.14.2 Emergency Response to Fire

If a fire is discovered or accidentally started:

- **Alert** people in the area of the need to evacuate
- **Activate** the nearest fire alarm
- **Call** Emergency 911 and notify Facilities Dept at 604-599-3276, or 8-1-1
- **Smother** the fire with a fire blanket or use a fire extinguisher. A fire extinguisher can result in additional risk for injury if not used properly. Kwantlen employees must be trained to properly operate a fire extinguisher. Aim the extinguisher at the base of the fire. Small fires can be extinguished without evacuation, but one must constantly evaluate and be ready to evacuate if the fire cannot be controlled.

If a building fire alarm is sounding or you receive notification of a fire emergency, immediately evacuate the laboratory and building and follow the official Kwantlen emergency response policy F.4 Emergency Response Plan and Policy No. F4a Emergency Response/Communication Plan (refer to Appendix F).

1.14.3 Emergency Response to Chemical Exposure

The following procedures should be followed by Kwantlen laboratory employees in the event of chemical exposure. All cases of chemical exposure, regardless of severity, must be reported to First Aid attendant at Kwantlen Facilities Dept.

Chemicals on Skin or Clothing

1. For exposure to skin only, immediately flush affected area(s) with water for at least 15 minute. For larger spills onto clothing, the safety shower should be used.
2. While rinsing under the safety shower, quickly remove all contaminated clothing or jewelry. **Seconds count.**
3. Use caution when removing pullover shirts or sweaters to prevent contamination of the eyes.
4. Check the MSDS to determine if any delayed effects of exposure may be expected.
5. Discard contaminated clothing or launder them separately from other clothing if it is decided that the clothing can be kept. Leather garments or accessories cannot be decontaminated and should be discarded.

Do not use solvents to wash skin. They remove the natural protective oils from the skin and can cause irritation and inflammation. In some cases, washing with a solvent may facilitate absorption of a toxic chemical.

For flammable solids on skin, first brush off as much of the solid as possible, then proceed as described above.

For hydrofluoric acid, rinse with water for 5 minutes and apply calcium gluconate gel, then get immediate medical attention. If no gel is available, rinse for 15 minutes and get immediate First Aid attention from Kwantlen Facilities Dept.

For phenol concentrations more than 10%, flush with water for 15 minutes or until the affected area turns from white to pink. Apply polyethylene glycol, if available. Do not use ethanol. Proceed from Step 2 as described above.

Chemicals in Eyes

Immediately flush eye(s) with water for at least fifteen minutes²¹. The eyes must be forcibly held open to wash, and the eyeballs must be rotated so all surface area is rinsed. The use of an eye wash fountain is desirable so hands are free to hold the eyes open. If an eyewash station is not available, pour water on the eye, rinsing from the nose outward to avoid contamination of the unaffected eye.

Remove contact lenses while rinsing. **Do not lose time removing contact lenses before rinsing.** Do not attempt to rinse and reinsert contact lenses.

Seek medical attention and First Aid from Kwantlen Facilities dept, regardless of the severity or apparent lack of severity.

Chemical Inhalation

Close containers, open windows or otherwise increase ventilation, and move to area with fresh air.

If symptoms, such as headaches, nose or throat irritation, dizziness, or drowsiness persist, seek medical attention and First Aid by contacting Kwantlen Facilities Dept and explaining what chemicals were inhaled.

Review the MSDS to determine what health effects are expected, including delayed effects.

²¹ Kwantlen laboratory eyewash stations are to be maintained regularly by the Facilities dept, refer to Section 1.13.7. Portable eyewash bottles are to be emptied and refilled weekly or monthly with fresh water. Records must be kept beside each safety shower station indicating the date of last flushing.

Accidental Ingestion of Chemicals

Immediately contact Kwantlen First Aid and 911 for emergency response instructions. **Do not induce vomiting in the victim**, unless directed to do so by a health care provider.

In general, affected laboratory students or workers should seek medical attention. For extreme emergencies, call 9-1-1 directly. Kwantlen First Aid attendant

1.14.4 Emergency Response to Exposure to Infectious Agents²²

Intact Skin

- Remove contaminated clothing.
- Vigorously wash contaminated skin for 1 minute with soap and water.

Broken, cut or damaged skin or puncture wound

Remove contaminated clothing.

- Vigorously wash contaminated skin for 5 minutes with soap and water.
- If necessary, seek medical attention from Kwantlen First Aid.

Eye(s)

Immediately flush eyes for at least 15 minutes with water, preferably using an eyewash station. If no eyewash station is available, pour water on the eye(s) for 15 minutes, rinsing from the nose outward to avoid contamination of the unaffected eye.

Hold eyelids away from your eyeball and rotate your eyes so that all surfaces may be washed thoroughly.

²² Also refer to Section 4.2 in the Kwantlen Biosafety manual.

Seek immediate medical attention from Kwantlen First Aid and follow similar instructions for chemical exposure to eyes in Section 1.14.3.

1.15 EMPLOYEE AND STUDENT SAFETY TRAINING

Employees

All Kwantlen laboratory employees must undergo WHMIS Chemical Safety training and read and understand this laboratory safety manual.

All Kwantlen employees working in laboratories that handle biological agents should undergo Biosafety training. Refer to Section 1.4 of the Kwantlen Biosafety Manual, Version 1.0.

Radiation Safety Training

Kwantlen employees should take refresher training course for lab safety and/or biological safety every 2 years.

Kwantlen employees must ensure that there are formally written safety procedures, as applicable to students, in all student laboratory manuals that are handed out as course materials. Employees must ensure that students read and understand these procedures prior to engaging in the laboratory activities for the school term.

SAFETY PROGRAM SITE-SPECIFIC INFORMATION

2. PHYSICS DEPT AT SURREY CAMPUS

2.1.1 Key Contacts for Safety Issues

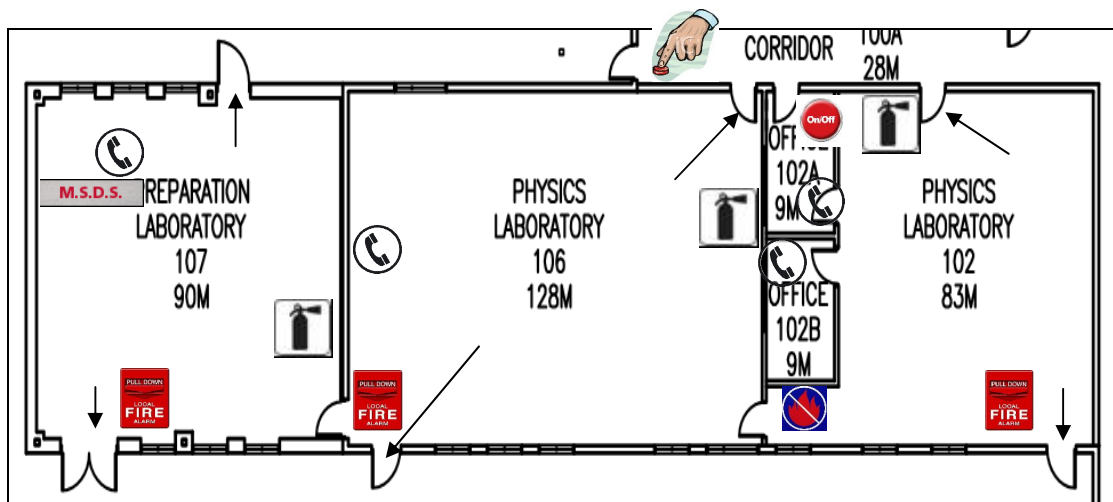
Lab Technician - Physics

Phone: 604-599-2476

Voice Mail: 9673

2.1.2 Floor plan of Physics Laboratory

The Physics Dept at Surrey campus spans rooms #107, 106, 102A, 102B, and 102. These rooms are outlined in the map below. The locations of various safety features in this laboratory facility are also shown.



Fire Extinguisher



Emergency Exit



Breaker Panel



Emergency Gas Shut-off



MSDS database



Emergency push-button contact



Telephone



Fire Alarm Pull Station

2.1.3 General Laboratory Safety Guidelines

The Surrey Physics laboratory contains minimal issues of concern with regards to safety risk. There are minimum additional safety considerations to apply to the Surrey Physics Laboratory, beyond what is already encompassed in this safety manual. One radioisotope, Cobalt 60 is handled in this laboratory. This radioisotope is encased in a plastic shell material and there is no risk associated with spillage, leakage or any other manner of direct exposure to the radiation source. The safety considerations for this isotope is discussed in Sections below. The laboratory also contains low energy lasers and a high voltage generator, which are also discussed below.

2.1.4 Handling of Specific Classes of Hazardous Materials

Refer to Sections 1.6 to 1.14 in this manual for guidelines and details of handling potentially hazardous materials in the laboratory.

In addition, the Surrey Physics Laboratory stores and handles minute samples of Cobalt 60 isotope, which upon radioactive decay emits beta particles and gamma particles. Cobalt 60 is minimally hazardous when encased and requires minimal precautions with respect to radioisotope handling, storage and disposal. It is not considered a significant safety risk²³.

Individual Cobalt 60 radioisotope samples are packaged in plastic disc containers and should be stored in a clearly marked box within a secured room.

²³ Refer to: <http://www.cnsccsn.gc.ca/eng/pdfs/Co-60.pdf>. In particular, it is stated that "No protective clothing is necessary for work with sealed sources."

Cobalt 60 should be handled with the same basic care and attention described in this safety manual for all other hazardous materials found in Kwantlen laboratories.

Disposal of Cobalt 60 requires only destroying the plastic storage disc by breaking into pieces and then disposing directly into bins with regular garbage.

2.1.5 Use of Personal Protective Equipment

Other than PPE measures described in Section 1.13, there are no additional measures required for the Surrey Physics laboratory. Everyone is required to utilize tweezers or tongs to handle and manipulate the tiny chip of Cobalt radioisotope material. Otherwise, handling of Cobalt 60 does not require use of any PPE²⁴.

2.1.6 General Procedures for Radiation Safety

Below is a list of general safety precautions for handling radioactivity at Kwantlen Polytechnic University. The safety precautions listed below apply only to Cobalt 60 radioisotope. If in the future, Kwantlen is to handle higher energy isotopes, the safety precautions listed below may need to be reviewed and revised:

1. All employees and students who work with radioactive materials must be conscientious of their activities and actions.
2. All users of radioactive materials must be either an “authorized user” (persons with an extensive knowledge of radioactivity and safe working procedures) or work under the direction of an approved “authorized user”.

²⁴ Kwantlen's radiation license is from the Canadian Nuclear Safety Commission. There is no PPE required and because of the very low emissions from the radiation sources used at Kwantlen The license submission did not require listing of any procedures because of the very low dose of the sources.

3. All laboratories using radioactive materials must have a “Caution - Radioactive Materials” door sign.
4. Use tongs or tweezers to handle individual plastic discs containing radioactive isotope.
5. Perform procedures quickly, efficiently, and precisely.
6. Store all radioactive materials within clearly labeled and shielded containers.

Physical Security of Radioactive Materials

1. All laboratories using radioactive materials should have lockable doors. Laboratories without lockable doors may not be used for work or storage of radioactive materials.
2. All laboratories using radioactive materials must be locked at all times when unoccupied.
3. Laboratories where radioactive materials are stored may be unlocked if an authorized person is present at all times.
4. Radioactive materials must be stored in an appropriately secured fashion to prevent unauthorized users to access the materials.

2.1.7 Procedures for Clean Up of Chemical Spills

At present, chemical spills in Surrey Physics dept have a very low probability of occurrence because there is essentially no use of any chemicals in the laboratory teaching area. There is no spill kit located in Surrey Physics laboratory rooms, and until such time that chemicals are handled in these rooms, one is not required.

2.1.8 Procedures for Waste Management

The majority of waste generated by the Physics Dept is regular waste that is handled and disposed of by traditional means. There is essentially no sharps/needles waste and no liquid solvent waste. On occasion when an Exacto Knife blade piece is broken off for disposal, it should be discarded in an appropriate sharps container located in the Surrey Chemistry laboratory Dept, Room 108 or 110A.

In the rare event of broken glass and glass waste, debris should be appropriately swept up and disposed of in the glass waste container in Surrey Chemistry dept, Room 108 or 110A.

As described in Section 2.1.4, disposal of Cobalt 60 requires only destroying the plastic storage disc by breaking into pieces and then disposing directly into bins with regular garbage.

2.1.9 Procedures for Emergency Response and First Aid

According to Kwantlen Policy F.4 Emergency Response Plan, the Kwantlen Facilities Dept is to be contacted for all events requiring emergency response and first aid. The placard displaying all emergency contact numbers is located at the exit doorway of the Physics laboratory rooms E102, E106, and E107. Exit doors in these rooms should be freely accessible and not blocked by equipment or other obstacles.

2.1.10 Equipment with Potential Safety Concerns

The Surrey Physics laboratory contains a Van de Graaf Generator for demonstration purposes only, by Kwantlen employees to students. It can generate very high voltage (up to 30,000V), although at very low current. When properly used, there is minimal safety risk.

The laboratory also contains low power, dispersed laser beam generators. Kwantlen employees must warn students to not look directly into the path of the laser light beam.

Kwantlen employees in the Physics laboratory is required to read and follow all instruction manuals associated with the above equipment to ensure that they fully understand the procedure for proper and safe usage. Employees are also responsible for communicating these procedures to students, as appropriate.

2.1.11 Regular Scheduled Maintenance of Equipment

Laboratory equipment must be inspected and maintained by a qualified person. The degree of inspection and maintenance to be implemented is to be dictated by equipment-specific requirements. The frequency of the inspection depends on the hazard posed by the equipment, the manufacturer's instructions, or as required by regulations. Kwantlen employees are required to be aware of any regular scheduled maintenance that is required in their laboratory. Employees should also maintain records of all equipment maintenance activities. These records/files should be secured by the employee and be available at all times.

2.2 BIOLOGY DEPT AT RICHMOND CAMPUS

2.2.1 Key Contacts for Safety Issues

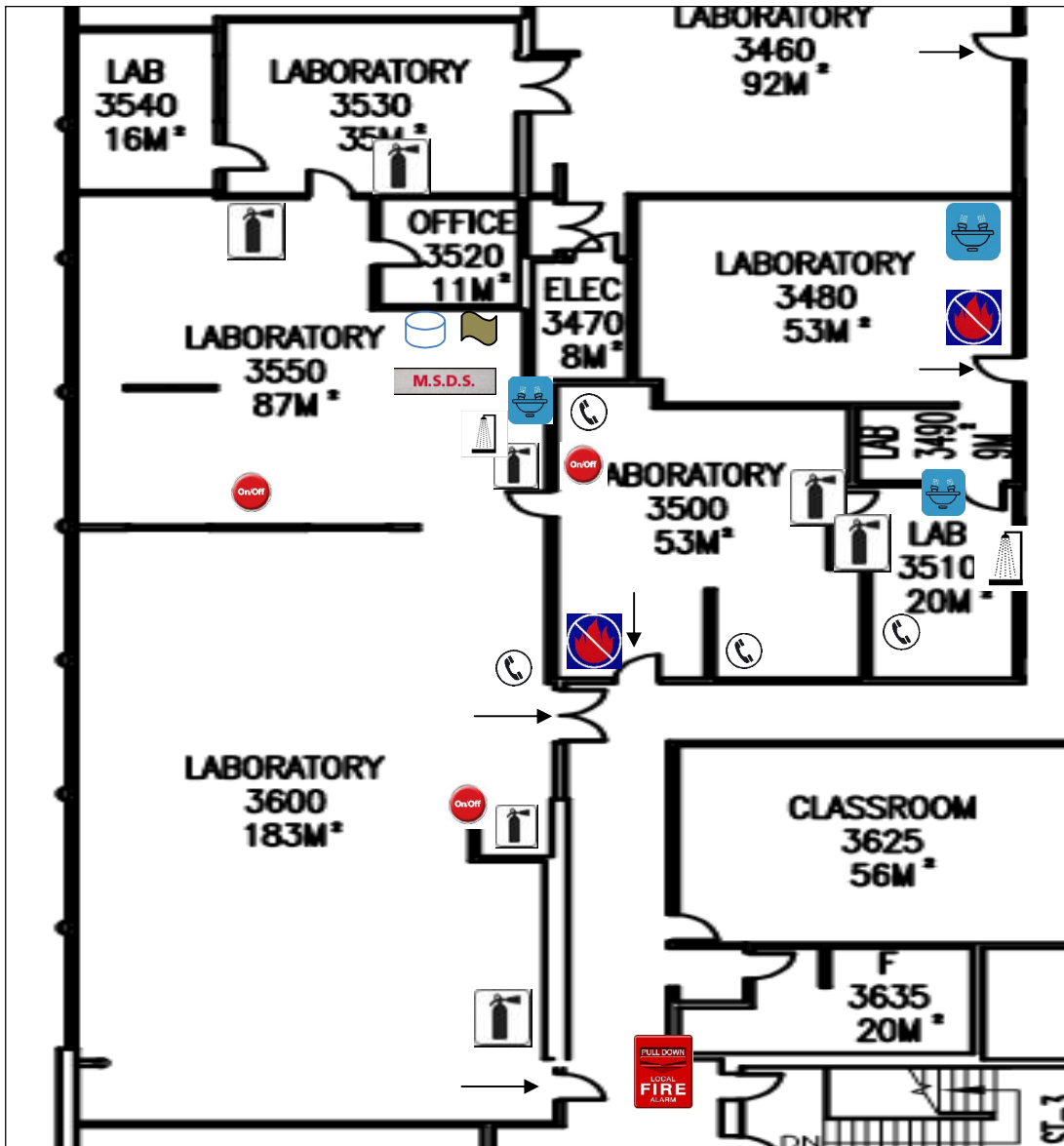
Lab Technician – Biology, Microbiology

Phone: 604-599-2711, -2214, -9142, -2617

Voice Mail: 9142

2.2.2 Floor plan of Biology Laboratory

The Biology dept at Richmond campus spans rooms #3600, 3550, 3530, 3540, 3480, 3490 and 3500. These rooms are outlined in the map below. The locations of various safety features in this laboratory facility are also shown.



-Eyewash station



Emergency Exit



-Emergency Shower



Emergency Gas Shut-off



-Fire Blanket



Emergency push-button contact



Spill Kit



MSDS database



Fire Extinguisher



Telephone



Breaker Panel



Fire Alarm Pull Station

2.2.3 List of General Laboratory Safety Guidelines

Refer to the general safety guidelines outlined in Section 1.2 and 1.3 as they directly apply to the Richmond Biology Laboratory rooms.

2.2.4 Handling of Specific Classes of Hazardous Materials

Refer to Sections 1.6 to 1.14 in this manual for guidelines and details of handling all potentially hazardous materials in the laboratory.

2.2.5 Use of Personal Protective Equipment

Standard PPE including gloves, eye goggles and lab coats are available and provided in the Richmond Biology laboratory. There is no additional PPE required beyond what is described in Section 1.13 of this manual.

2.2.6 Procedures for Equipment Operation

Chemical Fume Hoods

For proper operation of chemical fume hoods in the Surrey biology laboratory, refer to Section 1.9.

Biological Safety Cabinets

For proper operation of Biological Safety Cabinets (BSC's), refer to Section 2.7.2 of the Kwantlen Biosafety Manual.

2.2.7 Procedures for Clean Up of Chemical Spills

Refer to Section 1.14.1 for handling of chemical spills.

2.2.8 Procedures for Waste Management

All biohazardous waste including solid waste containing biohazardous components must be autoclaved prior to disposal. Refer to Section 2.6.2 of the Kwantlen biosafety manual for procedures to process biohazardous waste in an autoclave.

Solvent waste must be collected in suitable containers (ie. capped 4L glass bottles or similar) and stored in a well-ventilated fume hood until disposal. If applicable, halogenated and non-halogenated organic solvent waste must be segregated in different storage bottles. Accumulated solvent waste is to be removed from Kwantlen campus and disposed of by an external contractor company, such as Newalta Corp.

Sharps waste from the Biology laboratory is to be collected in designated sharps containers purchased by the Surrey Biology dept. Filled sharps containers are to be removed, treated and disposed of by Enviro-Smart Waste Management.

Broken glass is to be collected in designated glass waste cardboard boxes. Filled glass waste boxes are to be removed, treated and disposed of by Kwantlen Facilities dept.

Liquid aqueous waste (with any biohazardous agents having been neutralized) that is poured down the drain must be diluted with running tap water while it is being poured out.

2.2.9 Procedures for Emergency Response and First Aid

According to Kwantlen Policy F.4 Emergency Response Plan, the Kwantlen Facilities Dept is to be contacted for all events requiring emergency response and first aid. The placard displaying all emergency contact numbers is located at the exit doorway of the Richmond Biology laboratory rooms 3600, 3500 and 3480. Exit doors in these rooms should be freely accessible and not blocked by equipment or other obstacles.

2.2.10 List of Critical Equipment with Potential Safety Concerns

The Richmond Biology and Microbiology laboratory rooms contain the following pieces of equipment with particular safety concerns:

Microtome in histology room

Microtomes are especially dangerous pieces of equipment because they utilize very sharp knives. If not operated properly, the equipment may cause serious injury. Users must be adequately trained before operating a microtome. The training must be documented.

Microtome's must be visually inspected before each use and damaged units reported to the laboratory manager / instructor. Damaged units must not be used until they have been examined by a qualified person.

The usage, handling and storage of microtome knives is very important and the following guidelines should be followed²⁵:

- Always carry the blade in its case to the microtome. Microtome blades must be stored in a safe manner with the blade edge guarded.²⁶
- Microtome units should be fitted with a guard that protects the projecting portion of the blade when the unit is in use.
- When not in use the blade should be removed and stored in a designated case.
- Do not leave blades in unattended microtomes.
- Do not leave blades on workbenches, in sinks, in beakers or in any location where inadvertent contact can be made with them.

²⁵ Safe usage of microtome knives. Adapted from: ehs.unl.edu/sop/s-microtomes.pdf

²⁶ From WorkSafe BC, Part 30 Laboratories, Section 30.28
(<http://www2.worksafebc.com/publications/OHSRegulation/Part30.asp#SectionNumber:30.28>)

- Never manipulate a blade unless it has a handle securely fastened to it. If the handle has been removed during use replace it before removing the blade from the microtome.
- Where possible microtome blades should be sharpened by machine. If manual sharpening is required then a written risk assessment for the task must be undertaken.
- Microtome blades should be disposed off in an appropriate manner using designated sharps bins. Cleaning of blades must be undertaken with due care with the blade held by the handle at all times. Blades should be carefully dried and returned to storage cases immediately. Do not leave blades to dry on draining boards or laboratory benches.

Worker ergonomics are also important to consider for the safe operation of a microtome²⁷.

- The equipment and/or bench top height should be adjusted for appropriate height for the user, whether standing or sitting.
- Allow adequate clearance for legs and thighs. Use adjustable stool/chair with built-in foot rest and arm rests.
- Use less force when turning the hand wheel.
- Take frequent breaks, every 20 minutes, from microtome work.
- Protect wrists and forearms from contact pressure, pad sharp edges.

UV lamp box

This equipment is used for viewing prepared microscope slides. To minimize exposure of the eyes to UV radiation, operators of the UV viewing lamp must

²⁷ Adapted from: http://www.uos.harvard.edu/ehs/ih/labergo_microtome.shtml

wear eye goggles or equivalent. Operators should wear gloves and also minimize the time that hands are kept underneath the lamp while viewing samples.

Autoclave for biological decontamination

Operators must be careful and wary of the extreme high temperatures and pressure of steam and the stainless steel surfaces of the equipment. Operators must also be aware of the penetrating properties of live steam. Refer to Section 2.6 in the Kwantlen Biosafety Manual for further information about operating an autoclave.

Kwantlen employees in the Biology laboratory is required to read and follow all instruction manuals associated with the above equipment to ensure that they fully understand the procedure for proper and safe usage. Employees are also responsible for communicating these procedures to students, as appropriate.

2.2.11 Regular Scheduled Maintenance of Critical Equipment

Laboratory equipment must be inspected and maintained by a qualified person. The frequency of the inspection depends on the hazard posed by the equipment, the manufacturer's instructions, or as required by regulations. Kwantlen employees must be aware of any regular scheduled maintenance that is required in their laboratory. Employees should also maintain records of all equipment maintenance activities. These records/files should be secured and be available at all times.

Autoclave Maintenance

The laboratory technician should confirm cycle effectiveness on a monthly basis by running empty chamber and/or full load cycles and using biological indicators strips. A formal protocol should be developed, followed, and data recorded.

The autoclave should be placed on an annual inspection/certification schedule. Employees are responsible for establishing the maintenance schedule and ensuring that it is followed. Refer to Section 2.6 of the Kwantlen Biosafety manual for details of Autoclave usage to sterilize biological waste.

Fume hood Maintenance

Fume hoods must be maintained on a regular schedule, refer to Section 1.9.

Biosafety Cabinet Maintenance

BSCs must be maintained on a regular schedule, refer to Section 2.7.3 of Kwantlen Biosafety manual for details.

Eyewash Stations and Emergency Showers

Portable eyewash stations should be emptied and refilled with fresh water weekly or monthly. Emergency showers and permanent eyewash stations should be flushed and maintained according to Section 1.13.7. Records must be kept beside each eyewash and emergency shower station indicating the date of service.

2.3 CHEMISTRY DEPT AT SURREY CAMPUS

2.3.1 Key Contacts for Safety Issues

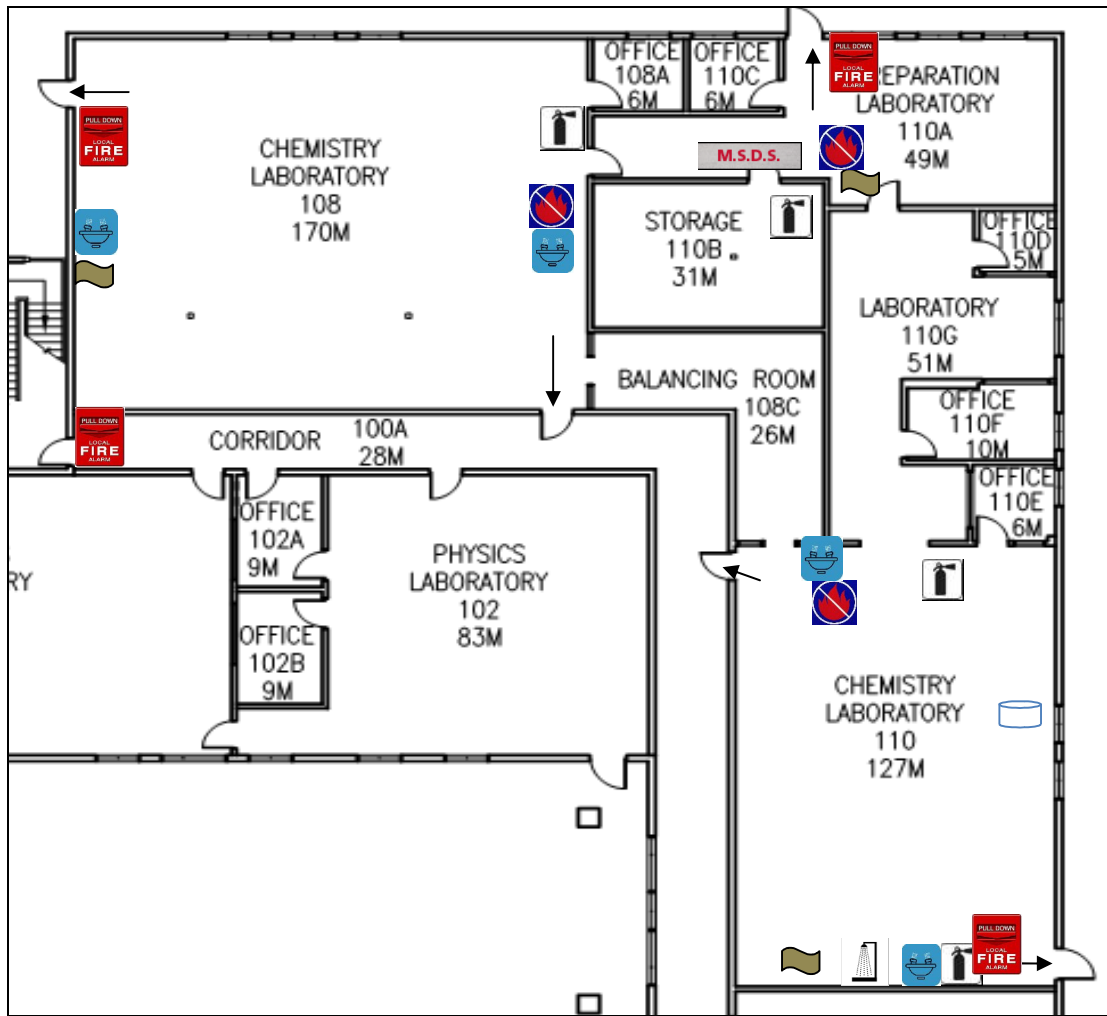
Lab Technician - Chemistry

Phone: 604-599-2209

Voice Mail: 2209

2.3.2 Floor plan of Chemistry Laboratory

The Chemistry Dept at Surrey campus spans rooms #108, 108A, 110C, 110A, 110B, 110F, 110E, 110G, 108C, and 110. These rooms are outlined in the map below. The locations of various safety features in this laboratory facility are also shown.



-Eyewash station



Emergency Exit



-Emergency Shower



Emergency Gas Shut-off



-Fire Blanket



Emergency push-button contact



Spill Kit -*absorbent only



M.S.D.S. MSDS database



Fire Extinguisher



Telephone

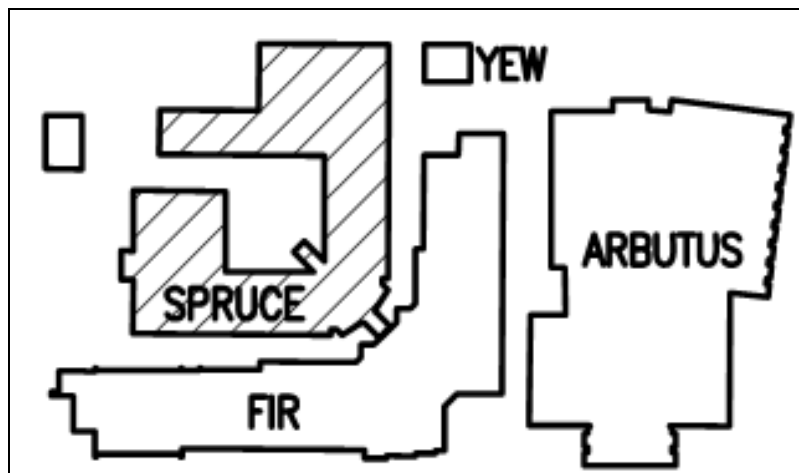


Breaker Panel

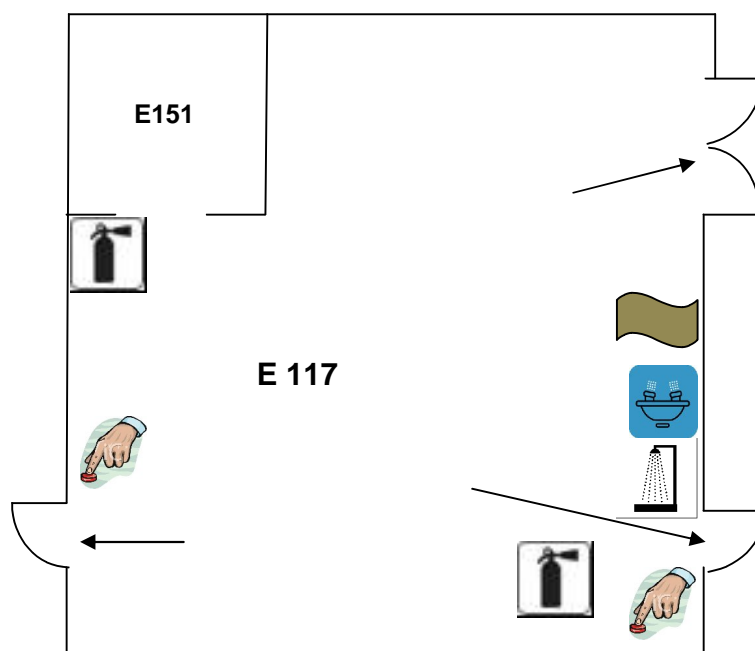


Fire Alarm Pull Station

There is also a chemical bunker storage location on the Surrey campus that is used primarily by the Chemistry dept, it is called the Yew Building, refer to diagram below. The Chemistry laboratory rooms are located in the Spruce building and the relative location to the chemical bunker building can be seen.



A schematic drawing of the Yew building storage bunker with safety features is outlined below



-Eyewash station



Emergency Exit



-Emergency Shower



Fire Extinguisher



-Fire Blanket



Emergency push-button contact



Fire Alarm Pull Station

2.3.3 List of General Laboratory Safety Guidelines

Refer to the general safety guidelines outlined in Section 1.2 and 1.3 as they directly apply to the Surrey Chemistry Laboratory rooms.

There are no materials and practices in the Surrey Chemistry dept requiring safety measures over and above beyond those described in Section 1.4 – 1.14.

The Chemical bunker in the Yew building contains hazardous chemicals and the safety principles outlined in Sections 1.5 – 1.8, 1.13 – 1.14 this manual should be applied to the bunker.

2.3.4 Handling of Specific Classes of Hazardous Materials

Refer to Sections 1.6 to 1.14 in this manual for guidelines and details of handling all potentially hazardous materials in the laboratory.

2.3.5 Use of Personal Protective Equipment

Other than PPE measures described in Section 1.13, there are no additional measures required for the Surrey Chemistry laboratory.

2.3.6 Procedures for Equipment Operation

Chemical Fume Hoods

For proper operation of chemical fume hoods in the Surrey Chemistry laboratory, refer to Section 1.9

2.3.7 Procedures for Clean Up of Chemical Spills

Refer to Section 1.14.1 for handling of chemical spills.

2.3.8 Procedures for Waste Management

Solvent waste must be collected in suitable containers (ie. capped 4L glass bottles or similar) and stored in a well-ventilated fume hood until disposal. If applicable, halogenated and non-halogenated organic solvent waste must be segregated in different storage bottles. Accumulated solvent waste along with any chemical solids waste is to be removed from Kwantlen campus and disposed of by an external contractor company, such as Newalta Corp.

Broken glass is to be collected in designated glass waste cardboard boxes. Filled glass waste boxes are to be removed, treated and disposed of by Kwantlen Facilities dept.

Liquid aqueous waste that is poured down the drain must be diluted with running tap water while it is being poured out.

Sharps waste is to be collected in designated sharps containers purchased by the Surrey Chemistry dept. Filled sharps containers are to be removed, treated

and disposed of by an external contractor such as Enviro-Smart Waste Management.

2.3.9 Procedures for Emergency Response and First Aid

According to Kwantlen Policy F.4 Emergency Response Plan, the Kwantlen Facilities Dept is to be contacted for all events requiring emergency response and first aid. The placard displaying all emergency contact numbers is located at the exit doorway of the Surrey Chemistry laboratory rooms. Exit doors in these rooms should be freely accessible and not blocked by equipment or other obstacles.

2.3.10 List of Equipment with Potential Safety Concerns

There are several pieces of equipment in the Surrey Chemistry laboratory with unique safety concerns.

Atomic absorption (AA) spectrometers

Sample preparation for atomic absorption procedures often requires handling of flammable, toxic and corrosive products. Familiarize yourself with the physical, chemical and toxicological properties of these materials and follow the recommended safety precautions. Atomic absorption equipment must be adequately vented, as toxic gases, fumes and vapors are emitted during operation. Other recommendations to follow when carrying out atomic absorption analysis are:

- Wear safety glasses for mechanical protection.
- Check the integrity of the burner, drain and gas systems before use.
- Inspect the drain system regularly; empty the drain bottle frequently when running organic solvents.
- Allow the burner head to cool to room temperature before handling.

- Never leave the flame unattended. A fire extinguisher should be located nearby.
- Never change gas pressure or shut off gas while flame is burning.
- Avoid viewing the flame or furnace during atomization unless wearing protective UV eyewear.
- Hollow cathode lamps are under negative pressure and should be handled with care to minimize implosion risks. Lamps should be disposed of according to manufacturer's instructions.

Gas Chromatograph

Gas chromatography requires handling compressed gas (helium), and flammable and toxic chemicals. Consult product MSDS before using such hazardous products. Specific precautions for working with gas chromatographs include:

- Perform periodic visual inspections and pressure leak tests of the sampling system plumbing, fittings and valves.
- Follow the manufacturer's instructions when installing columns. Glass or fused capillary columns are fragile: handle them with care and wear safety glasses to protect eyes from flying particles while handling, cutting or installing capillary columns.
- Turn off and allow heated areas such as the oven, inlet and detector, as well as connected hardware, to cool down before touching them.
- To avoid electrical shock, turn off the instrument and disconnect the power cord at its receptacle whenever the access panel is removed.

2.3.11 Regular Scheduled Maintenance of Critical Equipment

Laboratory equipment must be inspected and maintained by a qualified person. The frequency of the inspection depends on the hazard posed by the equipment, the manufacturer's instructions, or as required by regulations. Kwantlen employees must be aware of any regular scheduled maintenance that is required

in their laboratory. Employees should also maintain records of all equipment maintenance activities. These records/files should be secured and be available at all times.

Fume hood Maintenance

Fume hoods must be maintained on a regular schedule, refer to Section 1.9.

Eyewash Stations and Emergency Showers

Portable eyewash stations should be emptied and refilled with fresh water weekly or monthly. Emergency showers and permanent eyewash stations should be flushed and maintained according to Section 1.13.7. Records must be kept beside each eyewash and emergency shower station indicating the date of service.

2.4 BIOLOGY DEPT AT SURREY CAMPUS

2.4.1 Key Contacts for Safety Issues

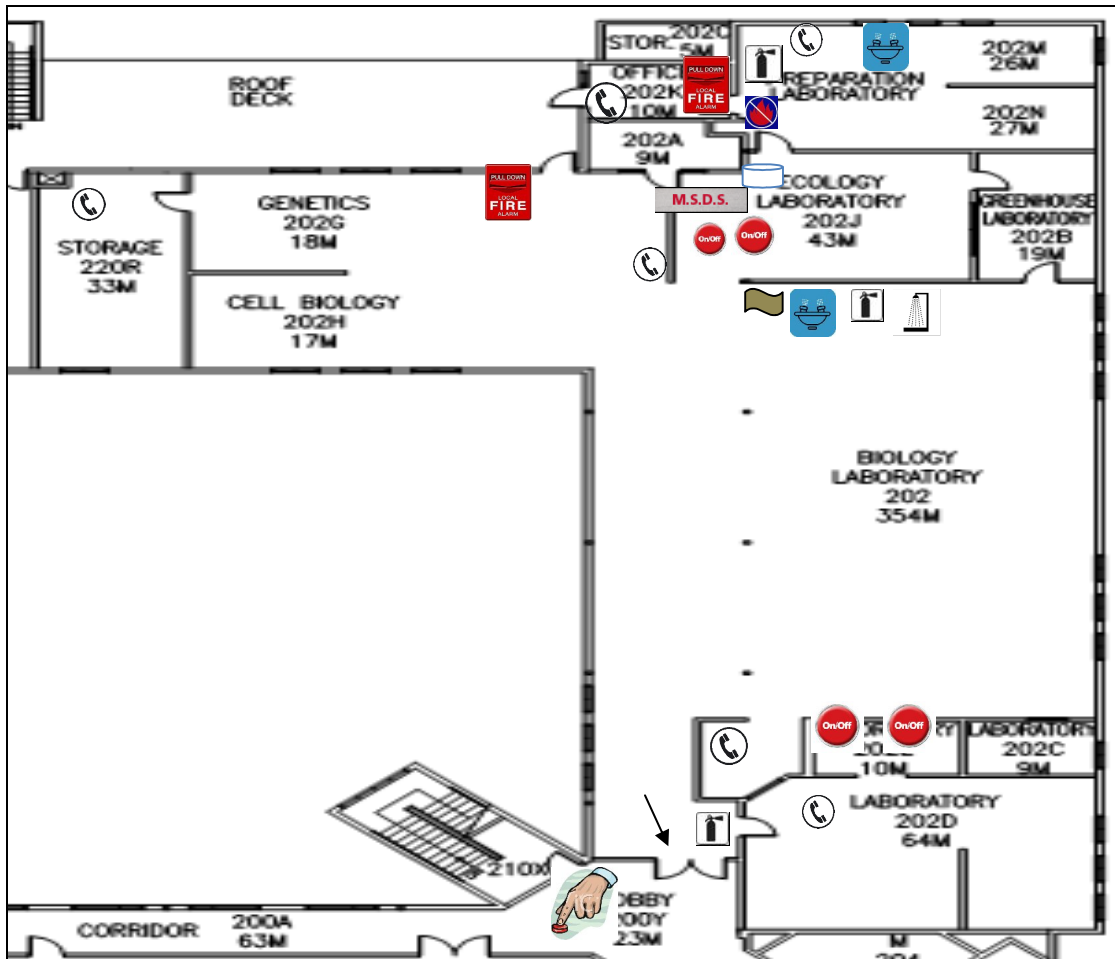
Lab Technician - Biology

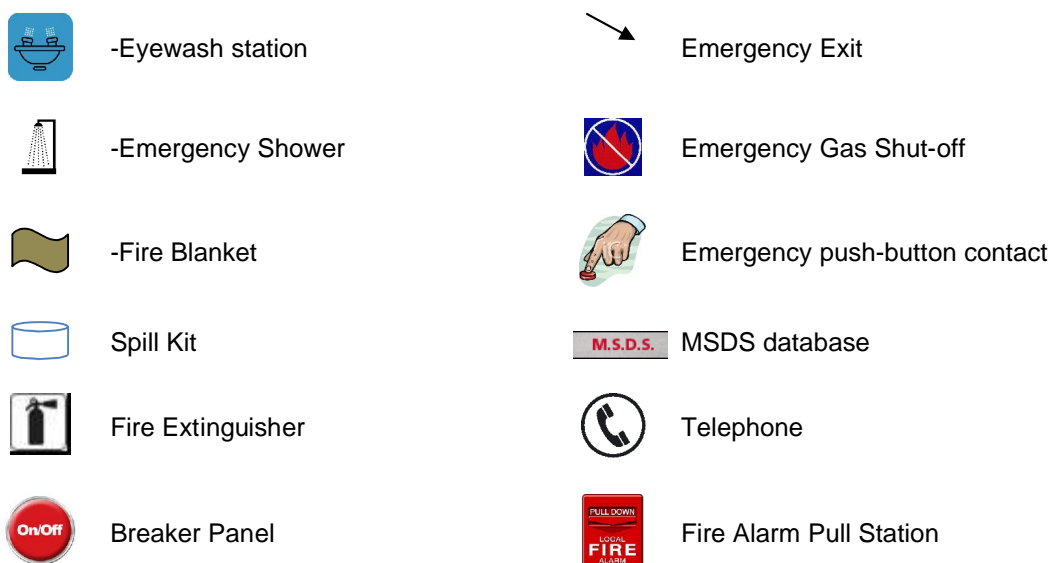
Phone: 604-599-2214

Voice Mail: 2214

2.4.2 Floor plan of Biology Laboratory

The Biology Dept at Surrey campus spans rooms # E202, E202G, E202H, E202A, E202K, E202O, E202M, E202N, E202J, E202B, E202D, E202E, E202C, and E202R. These rooms are outlined in the map below. The locations of various safety features in this laboratory facility are also shown.





2.4.3 List of General Laboratory Safety Guidelines

Refer to the general safety guidelines outlined in Section 1.2 and 1.3 as they directly apply to the Surrey Biology Laboratory rooms.

2.4.4 Handling of Specific Classes of Hazardous Materials

Refer to sections 1.6 to 1.14 in this manual for guidelines and details of handling all potentially hazardous materials in the laboratory.

2.4.5 Use of Personal Protective Equipment

Standard PPE including gloves, eye goggles and lab coats are available and provided in the Surrey Biology laboratory. There is no additional PPE required beyond what is described in Section 1.13 of this manual.

2.4.6 Procedures for Equipment Operation

Chemical Fume Hoods

For proper operation of chemical fume hoods in the Surrey biology laboratory, refer to Section 1.9

Biological Safety Cabinets

For proper operation of Biological Safety Cabinets (BSC's), refer to Section 2.7.2 of the Kwantlen Biosafety Manual.

2.4.7 Procedures for Clean Up of Chemical Spills

Refer to Section 1.14.1 for handling of chemical spills.

2.4.8 Procedures for Waste Management

All biohazardous waste including solid waste containing biohazardous components must be autoclaved prior to disposal. Refer to Section 2.6.2 of the Kwantlen biosafety manual for procedures to process biohazardous waste in an autoclave.

Solvent waste must be collected in suitable containers (ie. capped 4L glass bottles or similar) and stored in a well-ventilated fume hood. If applicable, halogenated and non-halogenated organic solvent waste must be segregated in different storage bottles. Accumulated solvent waste is to be removed from Kwantlen campus and disposed of by an external contractor company, such as Newalta Corp.

Sharps waste is to be collected in designated sharps containers purchased by the Surrey Biology dept. Filled sharps containers are to be removed, treated and disposed of by an external contractor such as Enviro-Smart Waste Management.

Broken glass is to be collected in designated glass waste cardboard boxes. Filled glass waste boxes are to be removed, treated and disposed of by Kwantlen Facilities dept.

Liquid aqueous waste (with any biohazardous agents having been neutralized) that is poured down the drain must be diluted with running tap water while it is being poured out.

2.4.9 Procedures for Emergency Response and First Aid

According to Kwantlen Policy F.4 Emergency Response Plan, the Kwantlen Facilities Dept is to be contacted for all events requiring emergency response and first aid. The placard displaying all emergency contact numbers is located at the exit doorway of the Surrey Biology laboratory rooms 202, 202G and 202K. Exit doors in these rooms should be freely accessible and not blocked by equipment or other obstacles.

2.4.10 List of Critical Equipment with Potential Safety Concerns

The Surrey Biology and Microbiology laboratory rooms contain the following pieces of equipment with particular safety concerns:

Microtome in histology room

Microtomes are especially dangerous pieces of equipment because they utilize very sharp knives. If not operated properly, the equipment may cause serious injury. Users must be adequately trained before operating a microtome. The training must be documented.

Microtome's must be visually inspected before each use and damaged units reported to the laboratory manager / instructor. Damaged units must not be used until they have been examined by a qualified person.

The usage, handling and storage of microtome knives is very important and the following guidelines should be followed²⁸:

²⁸ Safe usage of microtome knives. Adapted from: ehs.unl.edu/sop/s-microtomes.pdf

- Always carry the blade in its case to the microtome. Microtome blades must be stored in a safe manner with the blade edge guarded.²⁹
- Microtome units should be fitted with a guard that protects the projecting portion of the blade when the unit is in use.
- When not in use the blade should be removed and stored in a designated case.
- Do not leave blades in unattended microtomes.
- Do not leave blades on workbenches, in sinks, in beakers or in any location where inadvertent contact can be made with them.
- Never manipulate a blade unless it has a handle securely fastened to it. If the handle has been removed during use replace it before removing the blade from the microtome.
- Where possible microtome blades should be sharpened by machine. If manual sharpening is required then a written risk assessment for the task must be undertaken.
- Microtome blades should be disposed off in an appropriate manner using designated sharps bins. Cleaning of blades must be undertaken with due care with the blade held by the handle at all times. Blades should be carefully dried and returned to storage cases immediately. Do not leave blades to dry on draining boards or laboratory benches.

Worker ergonomics are also important to consider for the safe operation of a microtome³⁰.

- The equipment and/or bench top height should be adjusted for appropriate height for the user, whether standing or sitting.

²⁹ From WorkSafe BC, Part 30 Laboratories, Section 30.28
(<http://www2.worksafebc.com/publications/OHSRegulation/Part30.asp#SectionNumber:30.28>)

³⁰ Adapted from: http://www.uos.harvard.edu/ehs/ih/labergo_microtome.shtml

- Allow adequate clearance for legs and thighs. Use adjustable stool/chair with built-in foot rest and arm rests.
- Use less force when turning the hand wheel.
- Take frequent breaks, every 20 minutes, from microtome work.
- Protect wrists and forearms from contact pressure, pad sharp edges.

UV lamp box

Used for viewing prepared microscope slides. To minimize exposure of the eyes to UV radiation, operators of the UV viewing lamp must wear appropriate eye goggles or equivalent. Operators should also wear gloves and minimize the time that hands are kept underneath the lamp while viewing samples.

Autoclave

Used for biological decontamination. Operators must be careful and wary of the extreme high temperatures and pressures of steam and the stainless steel surfaces of the equipment. Operators must also be aware of the penetrating properties of live steam.

Tabletop centrifuge

There is also a tabletop centrifuge, heat block and Oven in the Surrey Biology laboratory. Refer to Section 1.12 for safety considerations for these types of equipment.

2.4.11 Regular Scheduled Maintenance of Critical Equipment

Laboratory equipment must be inspected and maintained by a qualified person. The frequency of the inspection depends on the hazard posed by the equipment, the manufacturer's instructions, or as required by regulations. Kwantlen employees must be aware of any regular scheduled maintenance that is required in their laboratory. Employees should also maintain records of all equipment

maintenance activities. These records/files should be secured and be available at all times.

Autoclave Maintenance

The laboratory technician should confirm cycle effectiveness on a monthly basis by running empty chamber and/or full load cycles and using biological indicators strips. A formal protocol should be developed, followed, and data recorded.

The autoclave should be placed on an annual inspection/certification schedule. The laboratory employees are responsible for establishing the maintenance schedule and ensuring that it is followed. Refer to the Kwantlen Biosafety manual for details of Autoclave usage to sterilize biological waste.

Fume hood Maintenance

Fume hoods must be maintained on a regular schedule, refer to Section 1.9.

Biosafety Cabinet Maintenance

BSCs must be maintained on a regular schedule, refer to Section 2.7.3 of Kwantlen Biosafety manual for details.

Eyewash Stations and Emergency Showers

Portable eyewash stations should be emptied and refilled with fresh water weekly or monthly. Emergency showers and permanent eyewash stations should be flushed and maintained according to Section 1.13.7. Records must be kept beside each eyewash and emergency shower station indicating the date of service.

2.5 ENVIRONMENTAL PROTECTION TECHNOLOGY (EPT) DEPT AT RICHMOND CAMPUS

2.5.1 Key Contacts for Safety Issues

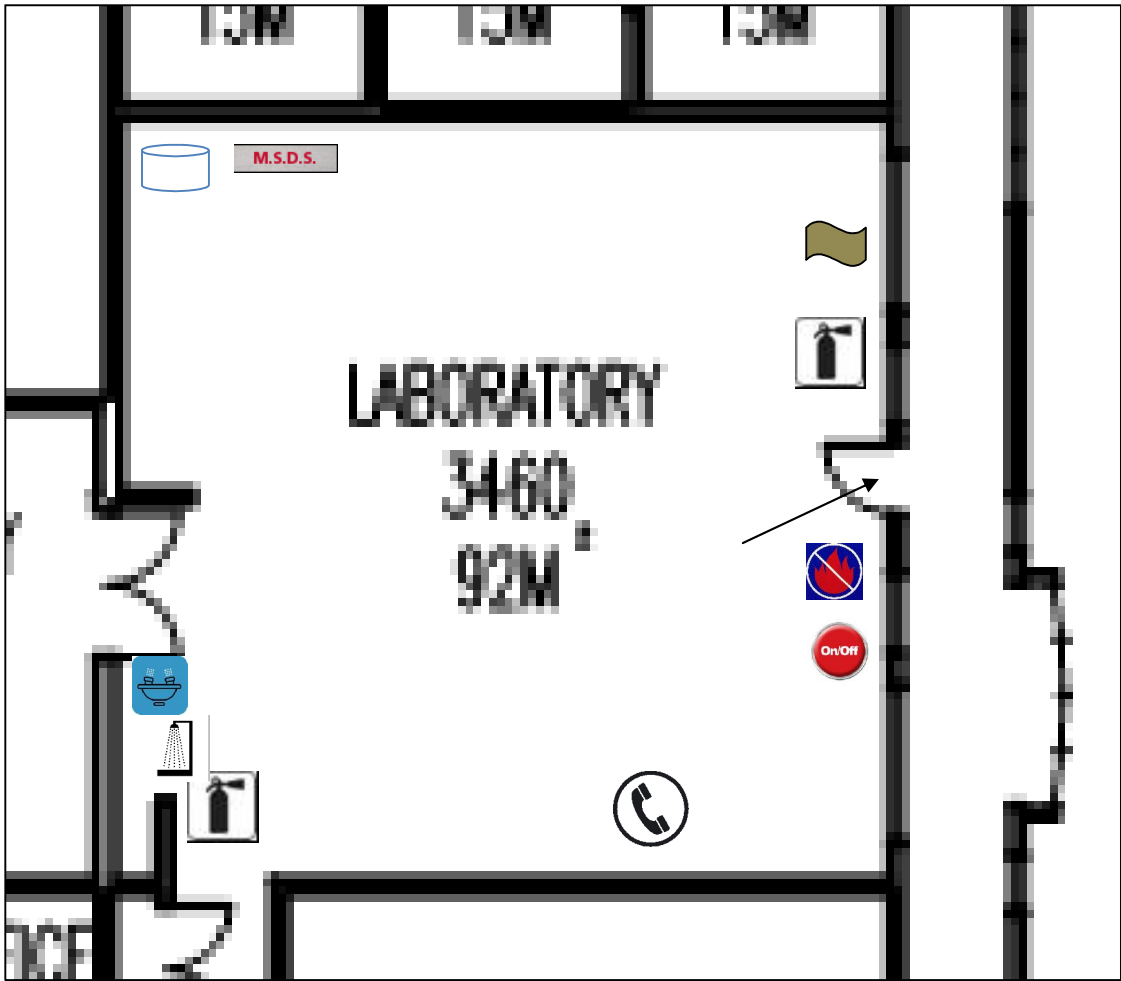
Lab Instructor for EPT

Phone: 604-599-2583

Voice Mail: 2583

2.5.2 Floor plan of EPT Laboratory

The Environmental Protection Technology Dept at Richmond campus is located in room #3460. This room is outlined in the map below. The locations of various safety features in this laboratory facility are also shown.



Eyewash station



Emergency Shower



Fire Blanket



Spill Kit



Fire Extinguisher



Emergency Exit



Emergency Gas Shut-off



Breaker Panel



M.S.D.S. MSDS database



Telephone

2.5.3 List of General Laboratory Safety Guidelines

Refer to the general safety guidelines outlined in Section 1.2 and 1.3 as they directly apply to the Richmond EPT Laboratory rooms.

2.5.4 Handling of Specific Classes of Hazardous Materials

Refer to sections 1.6 to 1.14 in this manual for guidelines and details of handling all potentially hazardous materials in the laboratory.

Sulfur dioxide and iodine are two specialty chemicals utilized in the EPT laboratory. They are both stored in the chemical bunker outside of the EPT lab, in the Richmond Chemistry dept (Room 3390); refer floor plan in Section 2.6.2.

These two chemicals are to be handled in a fume hood and with appropriate PPE including gloves, lab coat and eye protection.

2.5.5 Use of Personal Protective Equipment

Other than PPE measures described in Section 1.13, there are no additional measures required for the Richmond EPT laboratory.

2.5.6 Procedures for Equipment Operation

Chemical Fume Hoods

For proper operation of chemical fume hoods in the Surrey biology laboratory, refer to Section 1.9.

2.5.7 Procedures for Clean Up of Chemical Spills

Refer to Section 1.14.1 for handling of chemical spills.

2.5.8 Procedures for Waste Management

Solvent waste must be collected in suitable containers (ie. capped 4L glass bottles or similar) and stored in a well-ventilated fume hood. If applicable, halogenated and non-halogenated organic solvent waste must be segregated in different storage bottles. Accumulated solvent waste along with any chemical

solids waste is to be removed from Kwantlen campus and disposed of by an external contractor company, such as Newalta Corp.

Broken glass is to be collected in designated glass waste cardboard boxes. Filled glass waste boxes are to be removed, treated and disposed of by Kwantlen Facilities dept.

Liquid aqueous waste that is poured down the drain must be diluted with running tap water while it is being poured out.

Sharps and needles are not utilized in the EPT Laboratory.

2.5.9 Procedures for Emergency Response and First Aid

According to Kwantlen Policy F.4 Emergency Response Plan, the Kwantlen Facilities Dept is to be contacted for all events requiring emergency response and first aid. The placard displaying all emergency contact numbers is located at the exit doorway of the Richmond EPT laboratory room 3460. Exit doors in these rooms should be freely accessible and not blocked by equipment or other obstacles.

2.5.10 List of Equipment with Potential Safety Concerns

At present, there is no critical equipment in the EPT laboratory that is of safety concern.

2.5.11 Regular Scheduled Maintenance of Equipment

Laboratory equipment must be inspected and maintained by a qualified person. The frequency of the inspection depends on the hazard posed by the equipment, the manufacturer's instructions, or as required by regulations. Kwantlen employees must be aware of any regular scheduled maintenance that is required in their laboratory. Employees should also maintain records of all equipment maintenance activities. These records/files should be secured and be available at all times.

Fume hood Maintenance

Fume hoods must be maintained on a regular schedule, refer to Section 1.9.

Eyewash Stations and Emergency Showers

Portable eyewash stations should be emptied and refilled with fresh water weekly or monthly. Emergency showers and permanent eyewash stations should be flushed and maintained according to Section 1.13.7. Records must be kept beside each eyewash and emergency shower station indicating the date of service.

2.6 CHEMISTRY DEPT AT RICHMOND CAMPUS

2.6.1 Key Contacts for Safety Issues

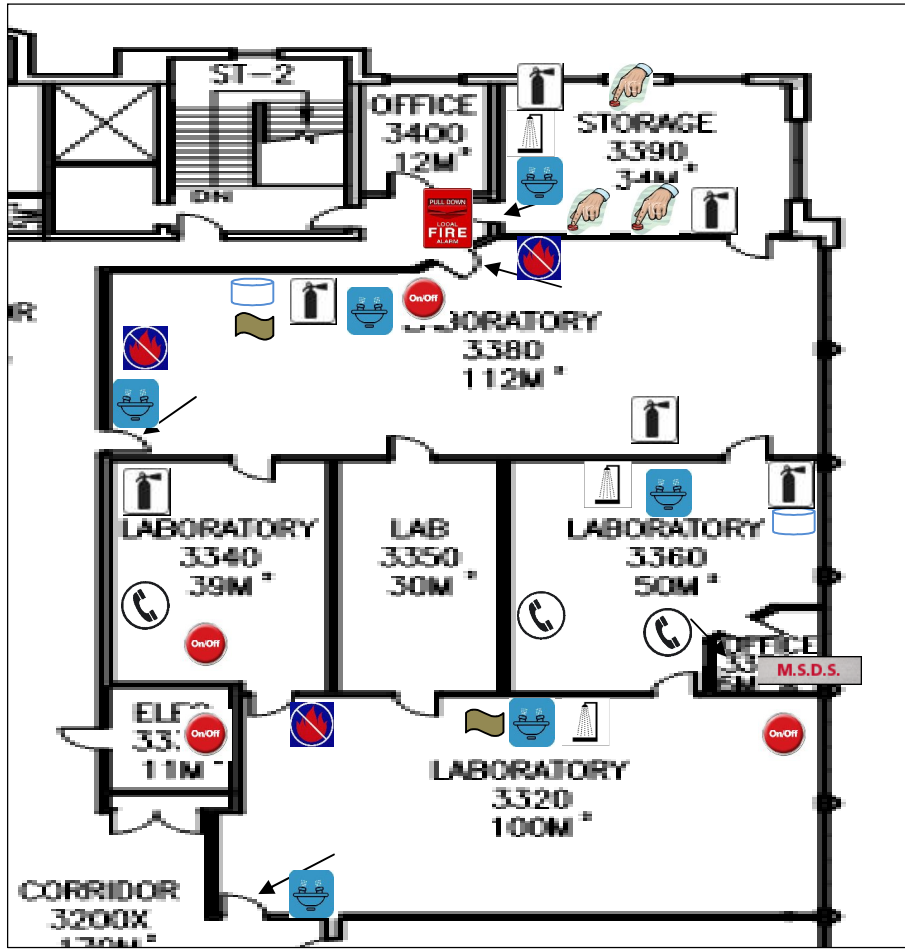
Lab Technician - Chemistry


Phone: 604-599-2558

Voice Mail: 2558


2.6.2 Floor plan of Chemistry Laboratory


The Chemistry Dept at Richmond campus spans rooms #3320, 3340, 3350, 3360, 3380, 3400, 3390, and 3370. These rooms are outlined in the map below. The locations of various safety features in this laboratory facility are also shown.




- 


-Eyewash station




Emergency Exit
- 


-Emergency Shower




Emergency Gas Shut-off
- 


-Fire Blanket




Emergency push-button contact
- 

Spill Kit



M.S.D.S. MSDS database
- 

Fire Extinguisher



Telephone



Breaker Panel



Fire Alarm Pull Station

2.6.3 List of General Laboratory Safety Guidelines

Refer to the general safety guidelines outlined in Section 1.2 and 1.3 as they directly apply to the Richmond Chemistry Laboratory rooms.

There are no materials and practices in the Richmond Chemistry dept requiring safety measures over and above beyond those described in Section 1.2 and 1.3 and the remainder of Section 1 in this manual.

2.6.4 Handling of Specific Classes of Hazardous Materials

Refer to Sections 1.6 to 1.14 in this manual for guidelines and details of handling all potentially hazardous materials in the laboratory.

2.6.5 Use of Personal Protective Equipment

Other than PPE measures described in Section 1.13, there are no additional measures required for the Richmond Chemistry laboratory.

2.6.6 Procedures for Equipment Operation

Chemical Fume Hoods

For proper operation of chemical fume hoods in the Surrey biology laboratory, refer to Section 1.9.

2.6.7 Procedures for Clean Up of Chemical Spills

Refer to Section 1.14.1 for handling of chemical spills.

2.6.8 Procedures for Waste Management

Solvent waste must be collected in suitable containers (ie. capped 4L glass bottles or similar) and stored in a well-ventilated fume hood. If applicable,

halogenated and non-halogenated organic solvent waste must be segregated in different storage bottles. Accumulated solvent waste along with any chemical solids waste is to be removed from Kwantlen campus and disposed of by an external contractor company, such as Newalta Corp.

Broken glass is to be collected in designated glass waste cardboard boxes. Filled glass waste boxes are to be removed, treated and disposed of by Kwantlen Facilities dept.

Liquid aqueous waste that is poured down the drain must be diluted with running tap water while it is being poured out.

Sharps and needles are not utilized in the Richmond Chemistry Laboratory.

2.6.9 Procedures for Emergency Response and First Aid

According to Kwantlen Policy F.4 Emergency Response Plan, the Kwantlen Facilities Dept is to be contacted for all events requiring emergency response and first aid. The placard displaying all emergency contact numbers is located at the exit doorway of the Richmond Chemistry laboratory rooms 3390, 3380 and 3320. Exit doors in these rooms should be freely accessible and not blocked by equipment or other obstacles.

2.6.10 List of Equipment with Potential Safety Concerns

There are several pieces of equipment in the Richmond Chemistry laboratory with unique safety concerns.

Gas Chromatograph

Gas chromatography requires handling compressed gases (nitrogen, hydrogen, argon, helium), and flammable and toxic chemicals. Consult product MSDSs before using such hazardous products. Specific precautions for working with gas chromatographs include:

- Perform periodic visual inspections and pressure leak tests of the sampling system plumbing, fittings and valves.
- Follow the manufacturer's instructions when installing columns. Glass or fused capillary columns are fragile: handle them with care and wear safety glasses to protect eyes from flying particles while handling, cutting or installing capillary columns.
- Turn off and allow heated areas such as the oven, inlet and detector, as well as connected hardware, to cool down before touching them.
- To avoid electrical shock, turn off the instrument and disconnect the power cord at its receptacle whenever the access panel is removed.

2.6.11 Regular Scheduled Maintenance of Equipment

Laboratory equipment must be inspected and maintained by a qualified person. The frequency of the inspection depends on the hazard posed by the equipment, the manufacturer's instructions, or as required by regulations. Kwantlen employees must be aware of any regular scheduled maintenance that is required in their laboratory. Employees should also maintain records of all equipment maintenance activities. These records/files should be secured and be available at all times.

Fume hood Maintenance

Fume hoods must be maintained on a regular schedule, refer to Section 1.9.

Eyewash Stations and Emergency Showers

Portable eyewash stations should be emptied and refilled with fresh water weekly or monthly. Emergency showers and permanent eyewash stations should be flushed and maintained according to Section 1.13.7. Records must be kept beside each eyewash and emergency shower station indicating the date of service.

2.7 PHYSICS DEPT AT RICHMOND CAMPUS

2.7.1 Key Contacts for Safety Issues

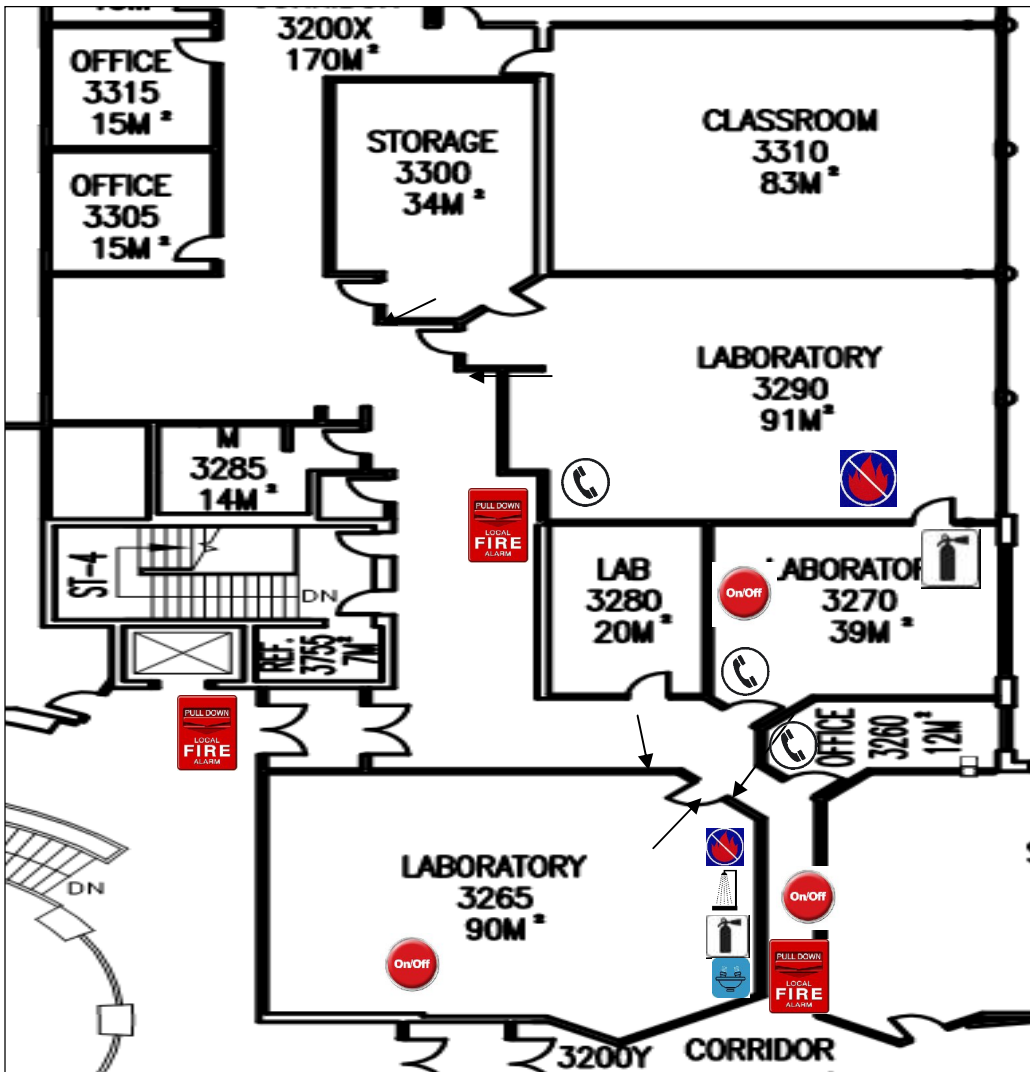
Physics - Lab Technician and Kwantlen Radiation Safety Officer









Phone: 604-599-2615

Voice Mail: 9695

2.7.2 Floor plan of Physics Laboratory

The Physics Dept at Richmond campus spans rooms #3300, 3265, 3270, 3280, and 3290. These rooms are outlined in the map below. The locations of various safety features in this laboratory facility are also shown.



- | | | | |
|---|-------------------|---|-------------------------|
|  | -Eyewash station |  | Emergency Exit |
|  | -Emergency Shower |  | Emergency Gas Shut-off |
|  | Fire Extinguisher |  | Fire Alarm Pull Station |
|  | Breaker Panel |  | Telephone |

2.7.3 List of General Laboratory Safety Guidelines

The Richmond Physics laboratory contains minimal issues of concern with regards to safety risk. There are minimum additional safety considerations to apply to the Surrey Physics Laboratory, beyond what is already encompassed in this safety manual. Three radioisotopes are handled and stored in this laboratory, Cobalt 60, Strontium 90, and Polonium 210. All three radioisotopes are separately encased in a plastic shell material and there is no risk associated with spillage, leakage or any other manner of direct exposure to the radiation source. The safety considerations for these isotopes are discussed in Sections below. The laboratory also contains low energy lasers and a high voltage generator, which are also discussed below.

2.7.4 Handling of Specific Classes of Hazardous Materials

Refer to sections 1.6 to 1.14 in this manual for guidelines and details of handling all potentially hazardous materials in the laboratory.

In addition, the Richmond Physics Laboratory stores and handles minute samples of Cobalt 60, Strontium 90, and Polonium 210 isotopes, each which upon radioactive decay emit either beta particles, gamma particles, or alpha particles. These isotopes are minimally hazardous when encased in a plastic shell, as they are at Kwantlen. As a result, these isotopes are not considered a significant safety risk³¹.

Individual Cobalt 60, Strontium 90, and Polonium 210 radioisotope samples are packaged in sealed plastic disc containers and should be stored in a clearly marked box within a secured room.

³¹ Refer to: <http://www.cnsccsn.gc.ca/eng/pdfs/Co-60.pdf>, Canadian Nuclear Safety Commission –Radiation Safety Data Sheet for Po210, and Canadian Nuclear Safety Commission –Radiation Safety Data Sheet for Sr90. In particular for all three isotope data sheets, it is stated that “No protective clothing is necessary for work with sealed sources.” For Sr90 in stuarthunt.com/Downloads/RMSDS/Sr90.pdf, it is that “sealed sources pose no internal radiation hazard”.

Cobalt 60, Strontium 90, and Polonium 210 should be handled with common sense care and attention even though it is packaged in sealed plastic disc containers.

Disposal of Cobalt 60, Strontium 90, and Polonium 210 requires only destroying the plastic storage disc by breaking into pieces and then disposing directly into bins with regular garbage.

2.7.5 Use of Personal Protective Equipment

Other than PPE measures described in Section 1.13, there are no additional measures required for the Richmond Physics laboratory. All Students and employees are required to utilize tweezers or tongs to handle and manipulate the tiny chip of radioisotope material. Otherwise, handling of Cobalt 60, Strontium 90, and Polonium 210 radioisotope samples does not require use of any PPE³².

2.7.6 General Procedures for Radiation Safety

Below is a list of general safety precautions for handling radioactivity at Kwantlen Polytechnic University. The safety precautions listed below apply only to Cobalt 60, Strontium 90, and Polonium 210 isotopes. If in the future, Kwantlen is to handle higher energy isotopes, the safety precautions listed below may need to be reviewed and revised:

1. All employees and students who work with radioactive materials must be conscientious of their activities and actions.
2. All users of radioactive materials must be either an “authorized user” (persons with an extensive knowledge of radioactivity and safe working procedures) or work under the direction of an approved “authorized user”.

³² Kwantlen's radiation license is from the Canadian Nuclear Safety Commission. There is no PPE required because of the very low emissions from the radiation sources used at Kwantlen. The license submission did not require listing of any procedures because of the very low dose of the sources.

3. All laboratories using radioactive materials must have a “Caution - Radioactive Materials” door sign.
4. Use tongs or tweezers to handle individual plastic discs containing radioactive isotope.
4. Perform procedures quickly, efficiently, and precisely.
5. Store all radioactive materials within clearly labeled and shielded containers.

Physical Security of Radioactive Materials

1. All laboratories using radioactive materials should have lockable doors. Laboratories without lockable doors may not be used for work or storage of radioactive materials.
2. All laboratories using radioactive materials must be locked at all times when unoccupied.
3. Laboratories where radioactive materials are stored may be unlocked if an authorized person is present at all times.
4. Radioactive materials must be stored in an appropriately secured fashion to prevent unauthorized users to access the materials.

2.7.7 Procedures for Clean Up of Chemical Spills

At present, chemical spills in Richmond Physics dept have a very low probability of occurrence because there is essentially no use of any chemicals in the laboratory teaching area. There is no spill kit located in Richmond Physics laboratory rooms, and until such time that chemicals are handled in these rooms, one is not required.

2.7.8 Procedures for Waste Management

The majority of waste generated by the Physics Dept is regular waste that is handled and disposed of by traditional means. There is essentially no

sharps/needles waste and no liquid solvent waste. On occasion when an Exacto Knife blade piece is broken off for disposal, it should be placed in a designated container in the Physics prep room and when full, the container is to be emptied in an appropriate sharps container located in the Richmond Chemistry laboratory Dept, Room 3380.

In the rare event of broken glass and glass waste, debris should be appropriately swept up and placed in a designated container in the Physics prep room and when full, the container is to be emptied in an appropriate sharps container located in the Richmond Chemistry laboratory Dept, Room 3380. of in the glass waste container in Richmond Chemistry dept, Room 3380.

As described in Section 2.7.4, disposal of Cobalt 60 requires only destroying the plastic storage disc by breaking into pieces and then disposing directly into bins with regular garbage.

2.7.9 Procedures for Emergency Response and First Aid

According to Kwantlen Policy F.4 Emergency Response Plan, the Kwantlen Facilities Dept is to be contacted for all events requiring emergency response and first aid. The placard displaying all emergency contact numbers is located at the exit doorway of the Richmond Physics laboratory rooms 3310, 3265, 3270, 3280 and 3290. Exit doors in these rooms should be freely accessible and not blocked by equipment or other obstacles.

2.7.10 Equipment With Potential Safety Concerns

The Richmond Physics laboratory contains a Van de Graaf Generator for demonstration purposes only, by Kwantlen employees to students. It can generate very high voltage (up to 30,000V), although at very low current. When properly used, there is minimal safety risk.

The laboratory also contains low powered lasers. Kwantlen employees must warn students to not look directly into the path of the laser light beam.

The Laboratory also contains two low-power microwave benches and 10 soldering iron stations.

Kwantlen employees in the Physics laboratory are required to read and follow all instruction manuals associated with the above equipment to ensure that they fully understand the procedure for proper and safe usage. Employees are also responsible for communicating these procedures to students, as appropriate.

2.7.11 Regular Scheduled Maintenance of Equipment

Laboratory equipment must be inspected and maintained by a qualified person. The degree of inspection and maintenance to be implemented is to be dictated by equipment-specific requirements. The frequency of the inspection depends on the hazard posed by the equipment, the manufacturer's instructions, or as required by regulations. Kwantlen employees are required to be aware of any regular scheduled maintenance that is required in their laboratory. Employees should also maintain records of all equipment maintenance activities. These records/files should be secured and be available at all times.

Eyewash Stations and Emergency Showers

Portable eyewash stations should be emptied and refilled with fresh water weekly or monthly. Emergency showers and permanent eyewash stations should be flushed and maintained according to Section 1.13.7. Records must be kept beside each eyewash and emergency shower station indicating the date of service.




APPENDICES

APPENDIX A: WHMIS SYMBOLS AND HAZARD WARNING INFORMATION SYSTEM	129
APPENDIX B: CHEMICAL STORAGE GUIDELINES AND COMPATIBILITY	132
APPENDIX C: GLOVE PPE SELECTION GUIDE	142
APPENDIX D: GUIDELINES FOR SPECIFIC TYPES OF CHEMICAL SPILLS	146
APPENDIX E: REFERENCES	149
APPENDIX F: KWANTLEN POLYTECHNIC UNIVERSITY POLICIES	152
INDEX	ERROR! BOOKMARK NOT DEFINED.





Appendix A: WHMIS symbols and hazard warning information system


The classes of controlled chemical products and their corresponding symbols or pictograms, as well as general characteristics and handling precautions are outlined in Table A1.

Table A1 - Safe handling of controlled products; summary of general characteristics and procedures for handling and storage of WHMIS-controlled products.³³

Class and Symbol	Characteristics	Precautions
Class A Compressed Gas 	<ul style="list-style-type: none"> Gas inside cylinder is under pressure The cylinder may explode if heated or damaged Sudden release of high pressure gas streams may puncture skin and cause fatal embolism 	<ul style="list-style-type: none"> Transport and handle with care Make sure cylinders are properly secured Store away from sources of heat or fire Use proper regulator
Class B Flammable and Combustible Material 	<ul style="list-style-type: none"> May burn or explode when exposed to heat, sparks or flames Flammable: burns readily at room temperature Combustible: burns when heated 	<ul style="list-style-type: none"> Store away from Class C (oxidizing materials) Store away from sources of heat, sparks and flame Do not smoke near these materials
Class C Oxidizing Material 	<ul style="list-style-type: none"> Can cause other materials to burn or explode by providing oxygen May burn skin and eyes on contact 	<ul style="list-style-type: none"> Store away from Class B (flammable and combustible) materials Store away from sources of heat and ignition Wear the recommended protective equipment and clothing

³³ Reference: http://www.ccohs.ca/oshanswers/legisl/whmis_classifi.html

<p>Class D Poisonous and Infectious Material</p>  <p>Division 1: Materials Causing Immediate and Serious Toxic Effects</p>	<ul style="list-style-type: none"> • May cause immediate death or serious injury if inhaled, swallowed, or absorbed through the skin 	<ul style="list-style-type: none"> • Avoid inhaling gas or vapors • Avoid skin and eye contact • Wear the recommended protective equipment and clothing • Do not eat, drink or smoke near these materials • Wash hands after handling
<p>Class D Poisonous and Infectious Material</p>  <p>Division 2: Materials Causing Other Toxic Effects</p>	<ul style="list-style-type: none"> • May cause death or permanent injury following repeated or long-term exposure • May irritate eyes, skin and breathing passages: may lead to chronic lung problems and skin sensitivity • May cause liver or kidney damage, cancer, birth defects or sterility 	<ul style="list-style-type: none"> • Avoid inhaling gas or vapors • Avoid skin and eye contact • Wear the recommended protective equipment and clothing • Do not eat, drink or smoke near these materials • Wash hands after handling
<p>Class D Poisonous and Infectious Material</p>  <p>Division 3: Biohazardous Infectious Materials</p>	<ul style="list-style-type: none"> • Contact with microbiological agents (e.g., bacteria, viruses, fungi and their toxins) may cause illness or death 	<ul style="list-style-type: none"> • Wear the recommended protective equipment and clothing • Work with these materials in designated areas • Disinfect area after handling • Wash hands after handling
<p>Class E Corrosive Material</p> 	<ul style="list-style-type: none"> • Will burn eyes and skin on contact • Will burn tissues of respiratory tract if inhaled 	<ul style="list-style-type: none"> • Store acids and bases in separate areas • Avoid inhaling these materials • Avoid contact with skin and eyes • Wear the recommended

		protective equipment and clothing
Class F Dangerously Reactive Material 	<ul style="list-style-type: none"> • May be unstable, reacting dangerously to jarring, compression, heat or exposure to light • May burn, explode or produce dangerous gases when mixed with incompatible materials 	<ul style="list-style-type: none"> • Store away from heat • Avoid shock and friction • Wear the recommended protective equipment and clothing

Appendix B: Chemical Storage Guidelines and Compatibility

Safe chemical handling requires routine inspections of chemical storage areas and maintenance of stringent inventory control. The inherent hazards of chemicals can be reduced by minimizing the quantity of chemicals on hand. However, when chemicals must be used, proper storage and handling can reduce or eliminate associated risks. All chemical storage areas and cabinets should be inspected at least annually and any unwanted or expired chemicals should be removed.

Typical storage considerations may include temperature, ignition control, ventilation, segregation and identification. Proper segregation is necessary to prevent incompatible materials from inadvertently coming into contact. A physical barrier and/or distance are effective for proper segregation.

Proper storage information can usually be obtained from the Material Safety Data Sheet (MSDS), label, or other chemical reference material. As required by WHMIS legislation, an MSDS must be on hand for every hazardous chemical in your workplace. MSDSs must be provided by the manufacturer or distributor of chemicals purchased.

Examples of Incompatible Chemicals

The following list is not a complete listing of incompatible materials. It contains some of the more common incompatible materials. Always research materials you work with in order to work safely in the lab.

Table B1. Chemicals listed in Column A should not be stored with or used near items in Column B.

Column A	Column B
Acetic acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetic anhydride	Hydroxyl-containing compounds such as ethylene glycol, perchloric acid
Acetone	Concentrated nitric and sulfuric acid mixtures, hydrogen peroxide
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Alkali and alkaline earth metals such as powdered magnesium, sodium, potassium	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens
Ammonia (anhydrous)	Mercury, halogens, calcium hypochlorite, hydrofluoric acid
Ammonium nitrate	Acids, metal powders, flammable liquids, chlorates, nitrites, sulfur, finely divided organic or combustible materials
Aniline	Nitric acid, hydrogen peroxide
Arsenical materials	Any reducing agent
Azides	Acids, heavy metals and their salts, oxidizing agents
Calcium oxide	Water
Carbon, activated	All oxidizing agents, calcium hypochlorite
Carbon tetrachloride	Sodium
Chlorates	Ammonium salts, acids, metal powders, sulfur, finely divided organic or combustible material

Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulfide
Chromic acid and chromium trioxide	Acetic acid, alcohol, camphor, glycerol, naphthalene, flammable liquids in general
Copper	Acetylene, hydrogen peroxide
Cumene hydroperoxide	Acids (organic or inorganic)
Cyanides	Acids
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens, other oxidizing agents
Fluorine	All other chemicals
Hydrides	Water
Hydrocarbons (e.g., butane, propane, benzene)	Fluorine, chlorine, bromine, chromic acid, peroxides
Hydrocyanic acid	Nitric acid, alkalis
Hydrofluoric acid (anhydrous)	Ammonia (aqueous or anhydrous)
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, any flammable liquid (i.e., alcohols, acetone), combustible materials, aniline, nitromethane
Hydrogen sulfide	Fuming nitric acid, oxidizing gases
Hypochlorites	Acids, activated carbon
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Mercury	Acetylene, fulminic acid, ammonia
Metal hydrides	Acids, water
Nitrates	Acids
Nitric acid (concentrated)	Acetic acid, acetone, alcohol, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids,

	flammable gases, copper, brass, any heavy metals
Nitrites	Acids
Nitroparaffins	Inorganic bases, amines
Oxalic acid	Mercury and silver and their salts
Oxygen	Oils, grease, hydrogen; flammable liquids, solids, or gases
Perchloric acid	Acetic anhydride, alcohol, bismuth, paper, wood, grease, oils
Permanganates	Concentrated sulfuric acid, glycerol, ethylene glycol, benzaldehyde
Peroxides, organic	Acids (organic or mineral), avoid friction, store cold
Phosphorus, white	Air, oxygen, alkalis, reducing agents
Potassium	Carbon tetrachloride, carbon dioxide, water
Potassium chlorate	Sulfuric and other acids, ammonium salts, metal powders, sulfur, finely divided organics, combustibles
Potassium perchlorate (see also chlorates)	Sulfuric and other acids
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, sulfuric acid
Silver and silver salts	Acetylene, oxalic acid, tartaric acid, ammonium compounds, fulminic acid
Sodium	Carbon tetrachloride, carbon dioxide, other chlorinated hydrocarbons, water
Sodium nitrate	Ammonium nitrate and other ammonium salts
Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulfides	Acids

Sulfuric acid	Chlorates, perchlorates, permanganates
---------------	--

Adapted from *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals*, National Research Council, 1995, with additions from OHS.

Table B2. Basic Chemical Segregation

The following Table provides guidelines for storage compatibilities of different chemical classes.

Hazard Class of Chemical	Recommended Storage Method	Examples	Incompatibilities
Compressed gases - Flammable	Store in a cool, dry area, away from oxidizing gases. Securely strap or chain cylinders to a wall or bench.	Methane Hydrogen Acetylene Propane	Oxidizing and toxic compressed gases, oxidizing solids.
Compressed gases - Oxidizing	Store in a cool, dry area, away from flammable gases and liquids. Securely strap or chain cylinders to a wall or bench.	Oxygen Chlorine Bromine	Flammable gases
Compressed gases - Poisonous	Store in a cool, dry area, away from flammable gases and liquids. Securely strap or chain cylinders to a wall or bench.	Carbon monoxide Hydrogen sulfide Nitrogen dioxide	Flammable and/or oxidizing gases.

Corrosives - Acids	Store separately in acid storage cabinet. Segregate oxidizing acids (i.e., Chromic, nitric, sulfuric, and perchloric acids) from organic acids	Acetic acid Phenol Sulfuric acid Chromerge Nitric acid Perchloric acid Chromic acid Hydrochloric acid	Flammable liquids, flammable solids, bases, oxidizers
Corrosives - Bases	Store in separate corrosive storage cabinet. Store solutions of inorganic hydroxides in labeled polyethylene containers.	Ammonium hydroxide Sodium hydroxide Calcium hydroxide	Flammable liquids, oxidizers, poisons, and acids
Flammable Liquids	Store in flammable storage cabinet and away from sources of ignition. Store highly volatile flammable liquids in an explosion-proof refrigerator.	Acetone Benzene Diethyl ether Methanol Ethanol Toluene Glacial acetic acid	Acids, bases, oxidizers, and poisons
Flammable Solids	Store in a separate dry, cool area away from oxidizers, corrosives, flammable liquids	Phosphorus, yellow Calcium carbide Picric acid	Acids, bases, oxidizers, and poisons

		Benzoyl peroxide	
General Chemicals - Non-reactive	Store on general laboratory benches or shelving preferably behind glass doors and below eye level.	Agar Sodium chloride Sodium bicarbonate Most non- reactive salts	See specific MSDS.
Oxidizers	Store in a spill tray inside a chemical storage cabinet. Separate from flammable and combustible materials.	Ammonium persulfate Ferric chloride Iodine Sodium hypochlorite Benzoyl peroxide Potassium permanganate Potassium dichromate The following are generally considered oxidizing substances: Peroxides, perchlorates, chlorates, nitrates,	Separate from reducing agents, flammables, and combustibles.

		bromates, and superoxides.	
Poisons/Toxic Compounds	Store separately in vented, cool, dry area, in unbreakable chemically-resistant secondary containers and in accordance with the hazardous nature of the chemical.	Aniline Carbon tetrachloride Chloroform Cyanides Heavy metals compounds, i.e., cadmium, mercury, osmium Oxalic acid Phenol Formic acid	Flammable liquids, acids, bases, and oxidizers. See specific MSDS.
Water-Reactive Chemicals	Store in dry, cool location, protect from water fire sprinkler.	Sodium metal Potassium metal Lithium metal Lithium aluminum	Separate from all aqueous solutions and oxidizers.

		hydride	
Carcinogens	Label all containers as "Cancer Suspect Agents". Store according to the hazardous nature of the chemical, using appropriate security when necessary.	Benzidine Beta-naphthylamine Benzene Methylene chloride Beta-propiolactone	See specific MSDS.
Teratogens	Label all containers as "Suspect Reproductive Hazard". Store according to the hazardous nature of the chemical, using appropriate security when necessary.	Lead and mercury compounds Benzene Aniline	See specific MSDS.
Peroxide-Forming Chemicals	Store in air-tight containers in a dark, cool, dry area. See Table 3 for recommended storage time limits.	Diethyl ether Acetaldehyde Acrylonitrile	See specific MSDS.
Strong Reducing Agents	Store in cool, dry, well-ventilated location. Water reactive. Segregate from all other chemicals.	Acetyl chloride Thionyl chloride Maleic anhydride Ferrous sulfide	See specific MSDS.

Appendix C: Glove PPE Selection Guide

Table C1. Guide to Selection of Glove Type for Skin Protection³⁴

Hazard	Degree of Hazard	Protective Material
Abrasion	Severe	Reinforced heavy rubber, staple-reinforced heavy leather
	Less severe	Rubber, plastic, leather, polyester, nylon, cotton
Sharp edges	Severe	Metal mesh, staple-reinforced heavy leather, Kevlar™ aramid-steel mesh
	Less severe	Leather, terry cloth (aramid fiber)
	Mild with delicate work	Lightweight leather, polyester, nylon, cotton
Chemicals and fluids	Risk varies according to the chemical, its concentration, and time of contact among other factors. Refer to the manufacturer, or product MSDS.	Dependant on chemical. Examples include: Natural rubber, neoprene, nitrile rubber, butyl rubber, PTFE (polytetrafluoroethylene), Teflon™, Viton™, polyvinyl chloride, polyvinyl alcohol, Saranex™, 4H™, Barricade™, Chemrel™, Responder™, Trelchem™
Cold	-	Leather, insulated plastic or rubber, wool, cotton
Heat	High temperatures (over 350°C)	Asbestos, Zetex™
	Medium high (up to 350°C)	Nomex™, Kevlar™, neoprene-coated asbestos, heat-resistant leather with linings

³⁴ From: The Canadian Centre for Occupational Health and Safety:
<http://www.ccohs.ca/oshanswers/prevention/ppe/gloves.html>

	Warm (up to 200°C)	Nomex™, Kevlar™, heat-resistant leather, terry cloth (aramid fiber)
	Less warm (up to 100°C)	Chrome-tanned leather, terry cloth
General Duty	-	Cotton, terry cloth, leather
Product Contamination	-	Thin-film plastic, lightweight leather, cotton, polyester, nylon
Radiation	-	Lead-lined rubber, plastic or leather

Note: The mention of trade name products in the above table is not intended as a recommendation or endorsement of any particular product. Refer to <http://www.ccohs.ca/oshanswers/prevention/ppe/gloves.html> for further information.

Table C2. Guide to Selection of Disposable Glove Material Type Compatible with Different Classes of Chemical Hazards³⁵

Compatibility Ratings

A Very Good or Excellent

B Good

C Fair

D Not recommended

— No data available

Glove material	Latex	Chloroprene	Nitrile*
Chemical	Compatibility rating		
Acetic Acid	A	A	A
Acetone	A	B	D
Acetonitrile	—	A	—
Ammonium Hydroxide	A	A	A
Carbon Tetrachloride	D	C	B
Chloroform	D	B	D
Ethanol	A	A	A
Ethyl Ether	B	A	B
Formaldehyde	A	A	A
Hexane	D	C	B

³⁵ From Cole Parmer:

<http://www.coleparmer.com/techinfo/techinfo.asp?htmlfile=ChartDisposGloves.htm&ID=56>

Hydrochloric Acid	B	A	B
Isopropanol	—	A	—
Kerosene	C	—	A
Methanol	A	A	A
Nitric Acid; 10%	D	B	C
Phosphoric Acid	B	A	A
Potassium Hydroxide	A	A	A
Sodium Hydroxide	A	A	A
Sulfuric Acid; 47% Battery Acid	A	B	B

*Nitron One® brand from Cole Parmer

The information in the above chart was supplied to Cole-Parmer by other reputable sources and is to be used **ONLY** as a guide in selecting gloves for chemical compatibility testing. Variability in material thickness, chemical concentration, temperature, and length of exposure to chemicals will affect specific performance.

Appendix D: Guidelines for Specific Types of Chemical Spills

This Section describes how to clean up some of the chemical spills that may occur in the laboratory at Kwantlen. Refer to Section 1.8 for details on how to dispose of the absorbed chemical.

Flammable and toxic liquids

If you can do so without putting yourself at risk, immediately shut off all potential ignition sources.

If fire occurs, alert everyone present and extinguish all flames using a fire extinguisher. If the fire cannot be controlled immediately pull the nearest fire alarm.

If no flames are evident, pour absorbent around the perimeter of the spill and then cover the rest of the material. Wear an appropriate respirator if toxic vapors are involved.

Wear gloves resistant to the chemical being handled. Using a plastic utensil (to avoid creating sparks), scoop up the absorbed spill, place it in a plastic bag, seal it, and place in a labeled container.

Corrosive liquids

Alert everyone present. If vapors are being released, evacuate people from the area.

Do not attempt to wipe up a corrosive liquid unless it is very dilute.

Protective gloves, boots, apron and eye protection must be used when neutralizing an extensive corrosive spill. Respiratory protection is required if the liquid releases corrosive vapor or gas.

Pour the required neutralizing or absorbing material around the perimeter of the spill, and then carefully add water and more neutralizing material to the contained area. Carefully agitate to promote neutralization.

Use pH paper to verify that all contaminated areas are neutralized and safe to wipe up.

If an absorbent (eg. spill control pillows) is used instead of a neutralizer, scoop up the absorbed spill, place it in a plastic bag, seal it, and then place in a labeled box. If neutralized material contains no toxic heavy metals (e.g. chromium), flush down the drain with plenty of water.

Corrosive solids

Small spills can be cleaned up mechanically with a dustpan and brush. Larger spills should be cleaned up using a HEPA (high-efficiency particulate) filter vacuum. For spills containing fine dusts, an air-purifying respirator with dust filters is recommended, as are gloves, protective goggles, and a lab coat.

Toxic solids

Avoid disturbing such solids (e.g. asbestos) which may release toxic dusts. Wet the material thoroughly, then place it in a plastic bag and label it appropriately. If wet removal is not possible, a vacuum equipped with a HEPA (High Efficiency Particulate Air) filter is required.

Gases

In the event of the release of a hazardous gas, there is no practical means of absorbing or neutralizing a gas - the leak must be corrected at the source and the room ventilated as much as possible, as quickly as possible.

Mercury

If a small amount of mercury is spilled (e.g. from a broken thermometer), use an aspirator bulb or a mercury sponge to pick up droplets, place the mercury in a glass container, cover mercury with water, seal and label the container.

To clean up any residual micro-droplets that may have worked into cracks and other hard-to-clean areas, sprinkle sulphur powder or other commercially available product for mercury decontamination. Leave the material for several

hours and sweep up solids into a plastic bag. Seal and label the bag and dispose of as hazardous chemical waste.

Contact the Kwantlen Facilities Dept for monitoring of mercury air concentrations.

If a large spill of mercury is involved, the area should be closed off, and a mercury respirator worn during the clean-up process.

Appendix E: References

1. **Radiation Safety Data Sheet for Cobalt 60**, from Canadian Nuclear Safety Commission, 1994. <http://www.cnsccsn.gc.ca/eng/pdfs/Co-60.pdf>
2. **Radiation Safety Data Sheet for Po210**, from Canadian Nuclear Safety Commission.
3. **Radiation Safety Data Sheet for Sr90**, from Canadian Nuclear Safety Commission.
4. **CRC Handbook of Laboratory Safety**, Fifth Edition, 2000., p.243-245
5. **Electrical Safety in the Laboratory:**
<http://web.princeton.edu/sites/ehs/labsafetymanual/sec7g.htm#Preventing>
6. **Fume hood usage from OHS regulatory perspective:**
<http://www2.worksafebc.com/publications/OHSRegulation/Policies-Part30.asp>
7. **Hazardous Products Act of Canada:**
http://www.ccohs.ca/oshanswers/legisl/intro_whmis.html
8. **Kwantlen Biological safety manual**, Version 1.0, 2007.
9. **Kwantlen Safety Committee:** <http://www.kwantlen.ca/hr/ohs/procedures.html>
and <http://www.kwantlen.ca/hr/ohs/committee.html> and
<http://www.kwantlen.bc.ca/hr/ohs/committee/members.html>
10. **Laboratory glass types, from Cole Parmer Technical Library:**
http://www.coleparmer.ca/techinfo/techinfo.asp?htmlfile=Properties_Glass.htm&ID=608
11. **Laboratory glove types:**
<http://www.ccohs.ca/oshanswers/prevention/ppe/gloves.html> and
<http://www.coleparmer.com/techinfo/techinfo.asp?htmlfile=ChartDisposGloves.htm&ID=56>

12. **Lockout procedure from Kwantlen Facilities Training Manual**, p.96 of 111, April 26-2006.
13. **Microtome safety**. From WorkSafe BC, Part 30 Laboratories, Section 30.28 (<http://www2.worksafebc.com/publications/OHSRegulation/Part30.asp#SectionNumber:30.28>).
14. **Microtome ergonomics:**
http://www.uos.harvard.edu/ehs/ih/labergo_microtome.shtml
15. **Microtome knives –safe usage**. Adapted from: ehs.unl.edu/sop/s-microtomes.pdf
16. **Microwave safety from Canadian OHS Centre:**
http://www.ccohs.ca/oshanswers/phys_agents/microwave_ovens.html#_1_7
17. **Prudent Practices in the Laboratory: Handling and Disposal of Chemicals**, National Research Council, 1995, p. 63-78.
18. **Sound thresholds for work environment safety:**
<http://www.workrights.ca/content.php?doc=149>
19. **Strontium 90 safety profile:** stuarthunt.com/Downloads/RMSDS/Sr90.pdf
20. **Ultrasonic bath safety guidelines from Health Canada:** http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/safety-code_24-securite/guidelines-principes-eng.php
21. **WHMIS legislation in Canada:** <http://www.hc-sc.gc.ca/ewh-semt/occup-travail/whmis-simdut/index-eng.php>
22. **WHMIS Symbols:** http://www.ccohs.ca/oshanswers/legisl/whmis_classifi.html
23. **WHMIS classification system:**
http://www.ccohs.ca/oshanswers/legisl/whmis_classifi.html
24. **Working environment comfort:**
http://www.ccohs.ca/oshanswers/phys_agents/thermal_comfort.html and OSHA Part 1910–Occupational Safety and Health Standards

25. **WorkSafeBC guideline for respiratory protection:**

[http://www2.worksafebc.com/Publications/OHSRegulation/GuidelinePart8.asp
?reportID=24511](http://www2.worksafebc.com/Publications/OHSRegulation/GuidelinePart8.asp?reportID=24511)

Appendix F: Kwantlen Polytechnic University Policies

POLICY F.4 EMERGENCY RESPONSE PLAN

POLICY F.4a EMERGENCY RESPONSE/COMMUNICATION PLAN

POLICY F.12a FACILITIES PROCEDURES

POLICY F.13 WASTE MANAGEMENT/ENVIRONMENT

**POLICY G.13 WORKPLACE HAZARDOUS MATERIAL INFORMATION SYSTEM
(WHMIS)**

POLICY G.22 SAFETY & HEALTH PROGRAM

INDEX

A		Contact lenses	12, 83
Absorbents	77, 79	Contractors	33, 34, 36, 38, 39, 77, 96, 105, 106, 111, 120, 125
Acid and bases	26, 76, 79, 83, 140, 141, 142, 143, 144, 145, 147	Corrosive materials	40, 41, 48, 66, 67, 106, 145, 154
Analytical equipment	62	Cryogenic hazards	43
Autoclave maintenance	99	E	
Autoclaves	99	Emergency	
B		exits	14
Baths	44, 49, 56, 57, 58	response procedures	75
Biological safety cabinets	13, 95	Emergency contact numbers	2
Biological safety manual	157	Emergency response	
Biological safety training	86	to fire	81
Biological waste handling	33	to infectious agents	84
borosilicate glass	64, 65	Emergency Response	
Broken glass	35	to chemical exposure	82
C		Emergency Shower maintenance	115
Canadian Standards Association (CSA)	70	Ergonomics	52
Centrifuges	55, 56	Eyewash stations, regular maintenance	83
Chemical		F	
fire hazards	32	Fire Extinguishers	33
packing and moving	29	Flammable liquid storage cabinets	28
storage guidelines	25	Fume hoods	
waste disposal	33	safe use	36
Chemical bunker	27, 34, 103, 119	Fumehoods	36
Chemical Spills	75	G	
Cobalt 60	88, 89, 91, 129, 130, 132, 157	Gas regulators	42
Compressed gases	40	Glassware	
safe handling and storage	40	types of	63
contact lenses	16	Gloves	

guidelines for usage	68	Lockout procedure	54
selection guide	150		
H			
Hazardous Materials Information System (WHMIS)	19	Material Safety Data Sheets (MSDS)	13, 22
Hazardous waste disposal	33	Mercury	63, 140, 142, 155
Hearing protection	71	Microtome	97, 98, 112, 113, 158
Hydrogen gas safety	41	microwave oven	47, 60, 61, 67, 133, 158
I			
Ignition source	31, 32, 41, 47, 76, 136, 139, 145, 154		
Inventory management	25		
K			
Kwantlen Biosafety manual	84		
L			
laboratory			
after working in	17		
chemical storage in	25		
coats and gowning	66		
guidelines for fire	33		
reporting accidents	16		
Richmond Biology	93		
safety	10		
working in	15		
Laboratory			
EPT	117		
Physics	87		
Richmond Chemistry	122		
Richmond Physics	127		
Sample labels	21		
Surrey Biology	109		
Surrey Chemistry	101		
ventilation	36		
Lasers	70, 92, 133		
M			
N			
		National Fire Protection Association (NFPA)	28
O			
		OHS	61, 143, 157, 158
P			
		Personal protective equipment (PPE)	66
		Personnel Training	54
		physical hazards	44
		Polonium 210	129, 130
		PPE	13, 29, 42, 58, 62, 66, 68, 69, 70, 71, 75, 76, 78, 81, 89, 95, 105, 110, 119, 124, 130, 150
		Pressure and vacuum	46
R			
		Radiation	
		general procedures for Richmond	130
		general procedures for Surrey	89
		safety training	86
		Regular garbage	34, 35, 62, 77, 89, 91, 130, 132
		Respiratory hazard protection	70
		Risk assessment	18
S			
		Safety	
		Basic procedures	15

Electrical	47
Equipment	53
Fire	31
Kwantlen Committee	10
Kwantlen Policy	10
Training	86
Sharps	34, 91, 96, 98, 106, 111, 113, 132
Spill kits	77
spills	26, 30, 48, 75, 76, 77, 79, 82, 90, 95, 105, 111, 119, 124, 132, 154, 155
Strontium 90	129, 130, 158

T

Training	20, 24, 86, 158
----------	-----------------

U

Ultra Violet (UV) radiation	70, 98, 107, 114
Underwriters Laboratories (UL)	28

V

ventilation	48
Ventilation	32, 36, 37, 84, 139

W

Work Hazards Material Information Sheets (WHMIS)	11, 13, 19, 20, 21, 22, 23, 24, 25, 26, 42, 81, 86, 136, 139, 158, 159, 160
Working alone	16