

BIOLOGY LABORATORY SAFETY MANUAL
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3.0 LABORATORY PERSONNEL

C. PRUDENT LAB PRACTICES

1.0 GENERAL PRINCIPLES

- 1.1 Plan your work to avoid working alone in the laboratory.
- 1.2 Know the safe ways to do your job.
- 1.3 Do not perform any job task until you have been appropriately instructed on the equipment or process by your supervisor or qualified individual.
- 1.4 Follow all established safety rules and regulations.
- 1.5 Report all unsafe conditions or practices to your supervisor.
- 1.6 NO PRACTICAL JOKES!
 - 1.7 Know the location of and how to use emergency equipment in your area.
 - 1.8 Be familiar with emergency procedures.
 - 1.9 Know the types of protective equipment necessary for the job.
 - 1.10 All mechanical equipment must have guards that prevent access to electrical connections or moving parts.

2.0 HOUSEKEEPING

- 2.1 Work areas should be kept clean and free from obstruction.
- 2.2 Cleanup should follow the completion of any operation or at the end of each day.
- 2.3 Spills should be cleaned up immediately and disposed of properly.
- 2.4 Aisles and hallways are not to be used as storage areas.
- 2.5 Access to exits, controls, and emergency equipment should never be blocked.

3.0 GLASSWARE

- 3.1 Adequate hand protection must be used when inserting glass tubing into stoppers or when placing rubber tubing on glass hose connections.
- 3.2 Only glassware designed for vacuum work should be used for that purpose.
- 3.3 Hand protection should be used when picking up broken glass.
- 3.4 When rinsing glassware that contained chemistry, discard the first rinse volume into the appropriate waste container. Subsequent water rinses can be discarded to the sink.

D. EMERGENCY PROCEDURES

1.0 SUMMONING EMERGENCY ASSISTANCE

The following actions are to be used to activate emergency assistance:

<u>Emergency Type</u>	<u>Dial or Activate</u>
Chemical spill	#5034
First Aid	#5034
Serious medical injury	9-911
Fire	Fire alarm pull box/9-911

2.0 PERSONAL INJURY.

- 2.1 If you are injured, obtain prompt medical assistance.
- 2.2 All accidents, injuries, illnesses, and near misses must be immediately reported to your supervisor.
- 2.3 An "Accident Investigation Report" must be completed within 24 hours.
- 2.4 In case of chemical contact:
 - 2.4.1 Flush exposed area with water in the nearest eye wash or safety shower for a minimum of 15 minutes.
 - 2.4.2 Remove contaminated clothing and continue washing.
 - 2.4.3 Get help by dialing Axt. 5034 and notify your supervisor and EH&S.

3.0 EVACUATION

- 3.1 Familiarize yourself with the evacuation routes and the location of the nearest exits.
- 3.2 When the building alarm sounds all employees must evacuate via the nearest designated emergency exit and proceed to the designated assembly areas.
- 3.3 Do not call the operator or security unless you have an emergency to report. These lines must be kept open for evacuation-related calls.
- 3.4 Follow directions given to you by your supervisor, manager or evacuation monitor.

4.0 FIRE

4.1 If a fire occurs, pull the nearest building alarm. If you feel you can use a fire extinguisher safely, then follow the instructions below:

NOTE: All fires do not use the same type of extinguisher media. Use the correct extinguisher for the specific fire.

4.1.1 Remove the fire extinguisher from the wall

4.1.2 Approach the fire with your escape route behind you.

Pull the pin.

Aim at the base of fire.

Squeeze trigger.

Sweep from the front of the fire to the back.

4.2 If you don't know how to operate a fire extinguisher, do not attempt to fight the fire. Pull the alarm, close the door behind you and evacuate the area.

5.0 CHEMICAL SPILLS.

5.1 It is important that all chemical spills be responded to in a safe and expeditious manner by trained personnel.

5.2 If a chemical is spilled in a quantity that can be safely cleaned up by the person causing the spill, then do so.

5.3 If the quantity exceeds one quart, call Janet Whelan at ext. 5034. **If there is no answer, leave recorded instructions with the following information.**

5.3.1 Your NAME

5.3.2 Your EXACT LOCATION

5.3.3 The TYPE OF EMERGENCY

5.3.4 The TELEPHONE EXTENSION you are calling from.

5.4 Clean-up procedure

5.4.1 All non-essential personnel must leave the area and barriers should be placed to prevent other personnel from entering the area.

5.4.2 All spills must be evaluated and the appropriate personal protective equipment donned.

5.4.3 The spill must be diked, neutralized (if possible) and placed in a container for disposal.

5.4.4 Contact the hazardous waste coordinator for disposal instructions.

5.4.5 An investigation report must be completed and forwarded to EH&S

6.0 EMERGENCY POWER SHUT DOWN

6.1 The power sources to the following equipment should be shut off:

- Heaters
- Agitation Equipment
- Motors
- Vacuum pumps
- UV lamps
- Air compressors
- Any electrical equipment

6.2 Leave cooling water on, if possible.

6.3 Shut off all processes like water faucet, etc...

6.4 Do not work with chemicals or equipment under emergency lighting.

7.0 CUSTOMER CALLS REGARDING SPILLS OR OTHER EMERGENCIES

7.1 Transfer the call to Janet Whelan 5034.

7.2 If you can not transfer the call to Janet, record the following information:

7.2.1 Time the call was received.

7.2.2 The name of the company and the name of the person.

7.2.3 The telephone number of the company.

7.2.4 Nature of the incident.

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2.3 Tier I Assessments - PHA and JSA

When: Before beginning any experiment involving unfamiliar chemistry or equipment, or a significant process change.

Who: Lab employee plus supervisor, or research team.

Procedure: JSA form (Appendix E1) or PHA checklist (Appendix E2)

Deliverable: A record of the process (completed checklist or form) that includes all recommendations and a determination whether a more exhaustive review is necessary.

2.4 Tier II Assessments - EH&S Review

When: For highly toxic materials, extreme operating conditions (e.g.: temperature and pressure) unusual equipment requirements, scale-ups to pilot plant or production.

Who: EH&S plus research team.

Procedure: EH&S Review Checklist

Deliverable: Written report that includes all EH&S concerns, a list of necessary actions, and identification of action item responsibilities.

2.5 Tier III Assessments - HAZOP

When: Whenever the potential consequences of a systems failure may be severe (e.g. fire, explosion, chemical release to the environment).

Who: EH&S plus a cross-functional team

Procedure:

1. The team defines process intentions.
2. Guide words are systematically applied to each intention to identify deviations.
3. The team identifies possible causes and consequences of the deviation.
4. Recommendations and comments are recorded for follow-up action.

Deliverable: HAZOP Worksheets with a summary of recommendations, action plans, and closure

APPENDIX E2

PRELIMINARY HAZARD ANALYSIS for Laboratory Operations

Author: _____

Date: _____

Instrument or Procedure: _____

Lab location: _____

PHA Participants (other than author): _____

EH&S Review Recommended: _____ Yes _____ No

<u>Protection</u>	<u>Required (Yes/No)</u>	<u>Protection</u>	<u>Required (Yes/No)</u>
Splash Goggles	_____	Respirator	_____
Face Shield	_____	Safety Shoes	_____
Gloves	_____	Apron	_____
Ear Plugs	_____	Other (Specify)	_____

Comments: _____

III. HAZARDS ASSOCIATED WITH LABORATORY OPERATION:

Carefully consider each question as it applies to your operation. Check () those that require clarification and include what safeguards are in place to address the perceived hazards.

A. REACTIONS/PROCEDURES:

Is there a hazard due to any one of the following?

- Runaway chemical reaction or side reactions _____
- Loss of cooling _____
- Blocked vent lines _____
- Equipment/power failure _____
- Loss of temperature control _____
- Loss of pressure control _____
- Faulty pressure/temperature monitoring devices _____
- Inadequate ventilation _____
- Glassware/apparatus failure _____

B. EQUIPMENT:

- Radiation _____
- Excessive noise _____
- Flammability hazard (ignition sources) _____
- Ventilation _____
- Instrument exhaust _____
- Shielding (moving parts, hot or cold surfaces, high or low pressure sources, sharp edges)
- Wiring/grounding _____
- Compressed gasses/cryogenic liquids _____

- Vacuum _____
- Accidentally changing control settings _____
- Mislabeled feed/discharge lines _____
- Spill large quantities of chemicals _____
- Spills into sinks _____
- Pump control failure _____
- General power failure _____
- Service failure (house/water pressure/hoods/compressed gasses/N₂) _____
- Instrument alarm failure _____
- Control system loss (computer failure) _____
- Potential hazards not yet mentioned _____
- Are there potential hazards associated (e.g., electrical shock)? _____
- Out of hours operation _____

C. ARE OPERATING INSTRUCTIONS NEEDED?

F. EQUIPMENT

1.0 LABORATORY METHODS FOR HEATING SOLUTIONS

1.1 SOLUTION HEATING: IMMERSION HEATERS

1.1.1 Immersion heaters *must be an integral part of a heater-controller system.*

1.1.2 For *in situ* heating, use Teflon™ coated immersion heaters only.

1.1.3 Controllers: Must be equipped with the following features:

Thermistor-controlled solution temperature

Single set-point latched system

P-III thermocouple heater control-separate wiring

Twist lock plug from heater to controller (no other type outlet permitted!)

2.0 ELECTRICAL EQUIPMENT: GENERAL STANDARDS

2.1 ELECTRICAL SPECIFICATIONS FOR EQUIPMENT

- 2.1.1 Save all catalogs and manuals. Copy and save all important specifications (voltage, current limits).
- 2.1.2 Motor-driven electrical equipment used where volatile materials may be present must be equipped with a nonsparking induction motor rather than a series-wound motor that uses carbon brushes.
- 2.1.3 Electric power receptacles for operations in hoods should be located outside the hood.

2.2 FRAYED CORDS: Repair immediately

- 2.2.1 Tag defective electrical items to prevent their use while waiting for repair.
- 2.2.2 Remove the item to Maintenance to ensure timeliest return to service.

2.3 EXTENSION CORDS: Use only if necessary

- 2.3.1 When necessary, they must be supported and secured.
- 2.3.2 They must not lie on the floor or across aisles (lab or office).

2.4 Locate Variacs and other electrical items in a way which protects them from spills or leaks.

2.5 The choice of solution agitation equipment should take into account the flammability rating of the substances.

2.6 Since flammable solvents pose a static discharge hazard during pouring, minimize the container-to-container free fall distance when transferring.

2.7 Switch off all appliances before removing plugs from outlets in order to avoid voltage surges when plug is reinserted to the outlet.

2.8 All appliances must have grounded plugs.

2.9 **Remember to unplug** all electrical equipment at the end of each workda 221.4 272.3401 Tm0 Tcy6028 Tw[2a

3.2.3 The output of each pump should be vented to an exhaust system.

4.0 DRYING OVENS

- 4.1 Volatile materials should not be dried in a conventional laboratory oven unless the oven has continuous ventilation of the atmosphere **inside** the oven.
- 4.2 “Explosion proof” drying ovens with rear blow-out panels should be used for volatile materials.
- 4.3 Bimetallic strip thermometers should be used for monitoring oven temperatures. Mercury thermometers should not be mounted through holes in the tops of ovens.

5.0 REFRIGERATORS

- 5.1 Laboratory refrigerators must never be used for the storage of food or beverages.
- 5.2 “Explosion-proof” refrigerators are to be used for storing flammable or combustible materials.
- 5.3 Uncapped containers should never be placed in a refrigerator.

6.0 STIRRING AND MIXING DEVICES

- 6.1 Only spark-free induction motors should be used to run stirring and mixing devices.
- 6.2 Stirring motors that will be left unattended should be fitted with a suitable fuse or thermal-protection device.
- 6.3 For stirring motors that will be left unattended, it is good practice to attach a stirring impeller to the shaft of the stirring motor by using lightweight rubber tubing. If the motion of the impeller becomes blocked, the rubber will twist until it breaks.

7.0 AUTOCLAVES

- 7.1 High temperatures. Care must be taken when putting in or taking out items for sterilization
- 7.2 Must always be drained out once a week through pressure relief valve

G. COMPRESSED GASES, PRESSURE REACTIONS, AND VACUUM WORK

1.0 COMPRESSED GASES

- 1.1 Gas cylinders must be firmly secured at all times.
- 1.2 Only Compressed Gas Association (CGA) standard combinations of valves and fittings can be used in compressed gas installations.
- 1.3 Compressed gas cylinders must be placed so that the cylinder valve is accessible at all times.
- 1.4 When the cylinder is not in use, the main cylinder valve must be closed.
- 1.5 The main cylinder valve should be opened slowly and only to the extent necessary. It is never necessary to open the main cylinder valve all the way.
- 1.6 Empty cylinders must be clearly marked as “empty” and returned to a storage area.
- 1.7 Empty and full cylinders should not be stored in the same place.

2.0 PRESSURE VESSELS

- 2.1 Inspection and Testing
 - 2.1.1 You must always know the allowable working pressure of a vessel. The allowable pressure should be stamped on the vessel or be attached via a name plate.
 - 2.1.2 All pressure equipment must be tested or inspected periodically. Consult the equipment's instructions or manufacturer for the appropriate testing intervals.
- 2.2 Assembly and Operation
 - 2.2.1 Piping must not be used to support the weight of the equipment.
 - 2.2.2 All threaded connections must match correctly and not be forced.
 - 2.2.3 Sharp tubing bends should be avoided.
 - 2.2.4 **All pressure reactions must be shielded.**
 - 2.2.5 Adequate space should be left in all vessels to accommodate the expansion of liquids.
 - 2.2.6 Signs or placards should be placed in the area to inform others of the reaction in progress.
- 2.3 Pressure-Relief Devices

- 2.3.1 All pressure or vacuum systems and all vessels that will be subjected to pressure or vacuum must be protected by pressure relief devices. Rupture discs and spring-loaded valves are examples of pressure-relief devices.
 - 2.3.2 The maximum operating pressure of the system must never exceed two-thirds of the rated working pressure of the vessel or system.
 - 2.3.3 The maximum setting for the pressure-relief device must be less than the rated working pressure for the vessel or for the weakest member of the pressure system.
 - 2.3.4 Shutoff valves must not be placed between the equipment and the pressure-relief device.
 - 2.3.5 The discharge side of a pressure-relief device must be vented to a safe area (e.g.: a Lab Hood).
- 2.4 Glass or Plastic Equipment
- 2.4.1 The use of glassware for work at pressure extremes should be avoided whenever possible.
 - 2.4.2 Glass equipment should be provided with adequate shielding to protect from flying glass.
 - 2.4.3 A liquid seal, Bunsen tube, or equivalent relief device is to be used for protecting glassware against excess pressure. Corks, rubber stoppers, and rubber or plastic tubing **must not** be used.
 - 2.4.4 Plastic equipment for pressure or vacuum work must not be used unless it is rated for the pressure or vacuum work to be undertaken.

3.0 VACUUM WORK

- 3.1 Equipment and Glassware
- 3.1.1 All glassware should be inspected for cracks or flaws before each use.
 - 3.1.2 Only glassware specifically designed for operations at reduced pressure (e.g., Pyrex) can be used.
 - 3.1.3 Flasks and desiccators must be shielded by a friction tape or by an enclosure
- 3.2 Assembly and Operation
- 3.2.1 **All vacuum work must be shielded.**
 - 3.2.2 All equipment should be set up to avoid equipment strain or stress.
 - 3.2.3 Heavy apparatus should be supported from below as well as by the neck.
- 3.3 Cold Traps
- 3.3.1 Input lines from the system to a mechanical vacuum pump need to be fitted with a cold trap to collect volatile materials from the system and minimize the amount that enters the pump and pump oil.
 - 3.3.2 Do not use liquid nitrogen or liquid air in cold traps. The use of these liquid materials increases the flammability hazard.

- 3.3.3 The output of each pump should be vented to an exhaust system.
- 3.3.4 Change the vacuum pump oil regularly.
- 3.3.4 After the operation is complete, the system must be vented and the trap must be cleaned. This venting and cleaning is important because volatile substances that have collected in the trap may vaporize when the coolant has evaporated and cause a pressure buildup that could blow the apparatus apart.

J. PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Personal protective clothing and equipment, in conjunction with emergency procedures, help to minimize injuries or damage. Every laboratory worker must be familiar with the location and proper use of the available protective clothing and safety equipment.

1.0 EYE AND FACE PROTECTION

- 1.1 Contact lenses may not be worn when working in a laboratory.
- 1.2 Safety glasses with side shields must be worn by **all** people (including visitors) entering into or working in a laboratory where chemicals are used or stored. Only glasses meeting the American National Standards Institute requirements or equivalent are acceptable.
- 1.3 Ordinary prescription glasses are not acceptable unless protective goggles are worn over them.
- 1.4 Goggles (or face shield) must be worn when splashing is a possibility.
- 1.5 Full-face shields must be used when working with glassware under reduced or elevated pressure, glassware used in high-temperature operations, or any time there is a possibility of implosions or explosions.

4.0 BODY PROTECTION

- 4.1 Laboratory coats must be worn when working in the laboratory.
- 4.2 Rubber aprons should be worn when handling corrosive liquids.
- 4.3 Coats and aprons must be removed when leaving the laboratory. Lab coats are prohibited from being worn in meeting rooms and cafeterias.

5.0 RESPIRATORY PROTECTION

- 5.1 Laboratories are designed so that respiratory protection is not usually needed because of the engineering controls in place (i.e. laboratory hoods).
- 5.2 When effective engineering controls are not possible, respiratory protection should be provided. Refer to the EH&S "Respiratory Protection Policy".

6.0 SAFETY SHOWERS

- 6.1 Safety showers must be provided in all areas where chemicals are handled.
- 6.2 Safety showers must be located in areas that are accessible and unblocked by obstacles.
- 6.3 The shower should have a quick opening valve which requires manual closing.
- 6.4 Safety showers must be tested at least quarterly.

7.0 EYEWASH FOUNTAINS

- 7.1 Eyewash fountains must be provided in all laboratories where chemicals are handled.
- 7.2 Eyewash fountains must be capable of providing at least 15 minutes of water in a soft stream.
- 7.3 Fountains should be located close to the safety showers so that, if necessary, the eyes can be washed while the body is showered.
- 7.4 Eyewash fountains must be tested at least monthly.

K. VENTILATION

1.0 Laboratory Hoods

- 1.1 All chemical operations that may generate air contaminants are to be conducted in a hood.
 - 1.2 Conduct all work at least 6 inches back from the face of the hood. Hoods are to be kept clear and the sash at the proper working height.
 - 1.3 Air flows will be routinely monitored by EH&S and the proper sash height noted.
 - 1.4 Hoods used for flammable liquids must be made of flame-proof materials with electrical outlets on the outside of the hood.
 - 1.5 Do not put your head in the hood when contaminants are being generated.
 - 1.6 Do not use a hood for chemical or equipment storage. Store chemicals in an approved storage area.
 - 1.7 Keep the hood sash closed as much as possible.
 - 1.8 Keep the slots in the hood baffle free of obstruction by equipment or containers.
- 2.0** Local exhaust is to be used when it is not possible to use a hood. Examples of equipment which need local exhaust include ovens, solvent cabinets, process equipment and instrumentation.
- 3.0** Cold traps are to be used during distillations and vacuum drying in order to minimize the contact of fumes or vapors with the vacuum source and/or release to the atmosphere and to protect vacuum pumps.
- 4.0** All new ventilation additions need to be approved by EH&S.

L. ENVIRONMENTAL MONITORING

Environmental monitoring is not normally warranted or applicable in a laboratory setting. However, on occasion a situation will arise that requires environmental monitoring. In most cases, the monitoring is conducted to assess the effectiveness of the ventilation equipment.

1.0 General Exposure Reduction Principles

- 1.1 Even for small substances of no significant hazard, exposure should be minimized.
- 1.2 It should be assumed that any mixture will be at least as toxic as its most toxic component.
- 1.3 All containers of chemicals must be capped or sealed to avoid escape into the work atmosphere.
- 1.4 Permissible exposure limits (PEL) and Threshold

