BRISTOL
COMMUNITY COLLEGE

ATTLEBORO
FALL RIVER
NEW BEDFORD
TAUNTON
ONLINE

Laboratory Safety Manual
&
Chemical Hygiene Plan
Revision 1
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1.0 Introduction

Bristol Community College policy mandates a safe and healthy environment for its faculty, staff, students, and visitors on all college campuses. The college strives for transparency of the known hazards and potential risks involved in the handling and use of chemicals and other hazards present in the workplace.

1.1 Purpose

This document provides information regarding the policies and procedures that were developed to maintain a safe laboratory environment and to comply with federal (29 CFR 1910.1450) and state regulations as to the occupational exposure to hazardous chemicals in laboratories.

1.2 Scope

This plan applies to all activities conducted in Bristol Community College's chemistry, biology and science laboratories within Division V. All college faculty, staff, students, and visitors are covered under this plan.

1.3 Roles and Responsibilities

President:

The president of the college has the ultimate responsibility for the safety and health of all personnel within the college and must provide continuing support for health and safety policies and procedures.

Division V Dean:

- Implement college safety policies
- Ensure compliance with existing health and safety policies.
- Review and grant approval for laboratory operations that involve particularly hazardous chemicals and processes

Safety Coordinator:

- Development and implementation of appropriate laboratory safety policies.
- Act as the chemical hygiene officer.
- Maintain Safety Data Sheets (SDS) in all laboratories.
- Inspect laboratories to ensure compliance with safety guidelines and applicable regulations, and to assist with remediation of safety issues.
- Investigate incidents and recommend action to reduce the potential for recurrence.
- Coordinate clean-up operations in the event of chemical spills or other contamination.
- Develop and conduct training programs in laboratory safety.

- Work with state and local officials on matters of codes and enforcement.
- Assist laboratory personnel with evaluating, preventing and controlling hazards.
- Maintain and update the Laboratory Safety Manual / Chemical Hygiene Plan annually.
- Supervise chemical and biological waste collection and storage.
- Arrange for hazardous waste disposal.
- Retain relevant records (e.g., training, monitoring).

Faculty and Staff:

- Inform students and staff under his/her supervision of the potential hazards associated with laboratory operations and procedures for dealing with incidents and/or injuries.
- Assure that staff, students, and employees under his/her supervision are trained as required by the Massachusetts Right-to-Know Law and College safety policies.
- Ensure the safety of all visitors to the laboratories.
- Ensure that safe practices, personal protective equipment, and engineering controls are employed in the laboratory.
- Instruct students on the location and use of safety equipment in the facility.
- Ensure that students understand how to work safely with chemicals.
- Report incidents and any other safety problems to the Dean and Safety Coordinator.
- Attend required health and safety training sessions.
- Ensure that all hazardous waste is disposed of in accordance with all municipal, state and federal regulations; this includes the segregation, containment, and labeling of materials generated in the laboratory.

Students (applies to tutors and supplemental instructors) and Visitors:

- Follow all safety and health procedures in the laboratory as specified in the Laboratory Safety Manual / Chemical Hygiene Plan and by the faculty/staff supervisor.
- Attend required health and safety training sessions. Students attending laboratory classes will receive safety training during the first week of classes.
- To participate in laboratory courses, students are required to read and sign the “Student Safety Agreement”.
- Report incidents, unhealthy, and unsafe conditions to the faculty supervisor, and/or safety coordinator.
- Notify the faculty supervisor of any pre-existing health conditions that could lead to a serious health situation in the laboratory.
- Realize that their actions may affect the safety of others.

2.0 LABORATORY PRACTICES and SAFETY RULES

Avoid underestimation of risk. Even for substances of no known hazard, exposure should be minimized. When working with substances with known hazards, special precautions should be taken. Reference should be made to the safety data sheet (SDS) that is provided for each chemical, prior to any handling of this chemical. Unless otherwise known, one should assume that any mixture will be more hazardous than its most hazardous component.

2.1 Hygiene

- Eating, drinking, smoking/vaping, and applying make-up or lip balm are not permitted in the lab or anywhere hazardous materials are used or stored. No food or drink, even sealed in closed containers, should be present in any laboratory or storage area containing chemicals.
- Wash hands before leaving lab and after contact with hazardous materials.
- Keep work areas clean and free from obstructions.
- Clean benchtops and other work areas and equipment at the end of the experiment.
- Remove personal protective equipment (lab coat and gloves) before leaving the laboratory.
- Do not leave experiments involving hazardous chemicals or open flames unattended even for a brief period.
- Always use mechanical pipetting aids. Pipetting by mouth is prohibited.
- Earbuds or headphones such as those connected to cell phones and iPods™ (MP3 players) must not be used in the laboratory.
- Wear appropriate personal protective equipment (e.g., lab coats, gloves) as specified in the chemical SDSs or as instructed when you or others nearby are working with chemicals or chemical-containing apparatuses.
- When working with hazardous chemicals, use in a properly operating chemical fume hood with the sash pulled as low as possible.
- Wear chemical splash goggles (ANSI Z87.1, indirectly vented) at all times when in a chemistry lab.
- Wear the appropriate eye protection (ANSI Z87.1 chemical splash goggles or safety glasses) when performing dissections, working with chemical reagents or bacterial cultures, or otherwise instructed to do so in biology labs. Chemical splash goggles are required when there is a risk of a chemical splash.
    - Remove goggles before leaving the laboratory.

2.2 Apparel

Always wear appropriate clothing in the laboratory; long pants, full length skirts, socks, closed toed shoes. Do not wear shorts or short skirts, high heeled shoes, open-toed shoes, or sandals/flip flops. Clothing should cover all exposed skin when working with chemicals, including long sleeves. Confine long hair and loose clothing when in a lab.

2.3 Equipment and glassware

Equipment that is broken or has a damaged electrical cord must be taken out of service and not used. Inspect all glassware before use. Clean, broken glassware should be placed in the "broken glass box". Contaminated glassware should be given to the instructor or laboratory technician for proper disposal.

2.4 Hazardous Materials

- Pay attention to all safety warnings and/or pictograms located on chemical labels.
- Understand the hazards of each chemical and follow all laboratory procedures.
- Keep containers closed when not in use.
- Label all secondary containers with the chemical name
- Do not pour a chemical down the sink drain or place in the general trash unless specified to do so in the procedures

2.5 Accidents and spills

Report any accident or spill immediately regardless of how minor it may be. Turn off any gas sources if it is safe to do so and back away from the spill carefully. Make others aware of the incident to avoid further contamination, falls, etc. Evacuate the lab if necessary and alert campus police.

2.6 Laboratory Behavior

- Students are not allowed in a laboratory without the presence of an instructor.
- Students are never allowed in the stockroom.
- Perform given experiments only according to directions.
- Cell phones should not be used in lab unless otherwise instructed.
- Always move slowly and carefully when in a laboratory, especially when chemicals are in use.

3.0 STANDARD OPERATING PROCEDURES

Prudent chemical management includes the following processes:

3.1 Chemical Procurement and Receiving

- Information on proper handling, storage, and disposal should be known to those who will be involved before a substance is received.
- Only containers with adequate identifying labels should be accepted.
- All shipments should be received on the loading dock.
- Shipments with breakage or leakage should be refused or opened in a chemical fume hood.

- Only the minimum amount of the chemical needed to perform the planned work should be ordered.
- Purchases of high risk chemicals should be reviewed and approved by the Dean.
- Proper protective equipment and handling and storage procedures should be in place before receiving a shipment.

3.2 Chemical Storage/Chemical Inventory

- Chemicals should be separated and stored according to hazard category and compatibility.
- Bristol Community College uses the Flinn Scientific compatible chemical family codes.
- Open shelves used for chemical storage should be secured to the wall and contain ¾-inch lips.
- Acids should not be stored on metal shelves or shelves with metal brackets, and should not be stored above shoulder height.
- Liquid chemicals cannot be stored above eye level.
- Chemicals should not be stored in chemical hoods, on the floor, under sinks, in areas of egress, on the benchtop, or in areas of direct heat or sunlight.
- Laboratory refrigerators should not be used to store food or beverages.
- Flammable chemicals should be stored in a spark-free environment and in approved flammable-liquid containers and storage cabinets.
- Chemical storage rooms should be controlled-access areas.
- An accurate chemical inventory of all areas should be maintained and updated at least annually.
- Expired chemicals should be disposed of appropriately.

3.3 Chemical Labels

- Maintain existing labels on incoming containers of chemicals.
- Chemical shipments should be dated upon receipt and stock rotated.
- Secondary containers used to store chemicals should be labeled with the full chemical name, hazards, date, and the initials of who is responsible for it.

3.4 Laboratory Security

Laboratory security is an integral part of an effective safety program. Follow these steps to ensure a secure working environment in your laboratory and to limit the possible theft, sabotage, or vandalism of chemicals or high-value equipment.

- Keep laboratory and stockroom doors locked when unoccupied.
- Do not allow students in labs unsupervised.

- Keep an accurate inventory of chemicals, cultures, project materials, growth media, and equipment.
- Notify campus police if materials are damaged or missing from laboratories.
- Inspect all packages arriving into the laboratory before opening them.
- Do not open packages not addressed to you.
- Seek assistance before opening damaged packages containing hazardous materials.
- When research is completed for the day, ensure that chemicals and biological materials have been stored properly and securely.
- Ask strangers to exit the room if they are not authorized to be there.
- Discuss other security-specific requirements with your supervisor and colleagues, including the location of telephones and other means to call for help.

3.5 Housekeeping

Housekeeping can help reduce or eliminate a number of laboratory hazards. Proper housekeeping includes appropriate labeling and storage of chemicals, safe and regular cleaning of the facility, and proper arrangement of laboratory equipment.

3.6 Glass Disposal

All non-contaminated glass waste including broken or damaged glassware should be placed in the glass disposal box located in the lab or stock area. When nearly full, the box should be closed and taped to prevent a possible spill. Label all boxes as “broken glass” and dispose of as solid waste.

Potentially contaminated glassware and/or plastic pipettes used in microbiology/biology should be collected in the appropriate bin and autoclaved prior to disposal as solid waste.

4.0 CONTROL MEASURES INCLUDING PERSONAL PROTECTIVE EQUIPMENT

The hierarchy of controls prioritizes intervention strategies based on the premise that the best way to control a hazard is to systematically remove it from the workplace, rather than relying on employees to reduce their exposure.

4.1 Prior Approval for Working with Hazardous Chemicals

Before beginning any laboratory work, the hazards and risks associated with an experiment or activity should be determined and the necessary safety precautions implemented. A risk assessment for hazardous chemicals and procedures is required prior to acquiring chemicals or performing laboratory work (Appendix A). For very toxic or hazardous substances, or specialized practices, consideration must be given to whether additional consultation with safety professionals and development of lab specific SOPs is warranted or required. The Divisional Dean must review and approve all requests.

4.2 Chemical Substitution and/or Procedure Modification

As part of the experiment planning process efforts should be made to reduce both the quantity and degree of toxicity of the chemicals to be used. Successful source reduction efforts result in at least three beneficial factors:

- Minimization of the quantities of chemicals to be used.
- Minimization of waste chemicals that require proper disposal.
- Minimization of risk and future liability.

The easiest way to help insure safety and the proper handling of chemicals and hazardous waste is to prevent the handling and generation of such wastes whenever possible. This requires meticulous experiment planning and a complete hazard assessment of the waste products that may be generated. Waste minimization strategies may include:

- Micro-Scale: Whenever possible consider carrying out experiments and laboratory procedures on as small a scale as possible.
- Product Substitution: Whenever possible, substitute less hazardous chemicals in experiments. This might include alternate synthetic routes or procedures for working up reaction mixtures.

4.3 Chemical Inventory Control

The act of purchasing chemicals, and tracking their shelf life, is an important part of waste minimization and laboratory safety. Before chemicals are ordered, the chemical inventory should be checked to make sure the chemical in question is not already available. Older chemicals should be used fully before purchasing a replacement whenever possible.

It is the College's policy that no chemicals can be brought onto College property that have not been purchased by the College or otherwise received prior approval of the Divisional Dean. If a donated chemical is accepted, it is the Dean's responsibility to ensure that it is added to the chemical inventory and an SDS sheet for the specific chemical is added to the appropriate binder(s). These chemicals become the responsibility of the College once on College property and must be used, stored and handled the same as all other chemical products.

4.4 Safety Data Sheets (SDS)

Each laboratory, storage area, and prep room must have a binder(s) containing a safety data sheet (SDS) for every chemical that may be used or stored in that space. When a new chemical is added, the corresponding SDS should be placed in the binder. After the chemical inventory is updated, the binder should be reviewed for accuracy. If a chemical is no longer used, the SDS can be removed from the room binder, but must be retained by the safety coordinator for 30 years.

4.5 Signs

Prominent signs of the following types should be posted:

- Laboratory Safety Information Signs should be posted on the laboratory door, facing the corridor. The sign identifies hazards within the facility, the personal protective equipment required in the lab, the responsible staff member, and other persons responsible for the laboratory. These Laboratory Safety Information signs should be updated as changes in laboratory personnel or chemical usage occurs.
- Emergency telephone numbers.
- Location signs for safety showers, eyewash stations, other safety and first aid equipment, and exits.
- Warnings at areas or equipment where special or unusual hazards exist.

4.6 Laboratory Hazard Assessment

Each laboratory will be evaluated to determine the hazards present and control measures that are required to work in that space. Labs will be evaluated annually and any time a new chemical and/or procedure is added. Results from these evaluations are used to create the laboratory safety information signs.

4.7 Personal Protective Equipment

Personal protective equipment (PPE) is considered the last line of defense against exposure to hazardous materials. Whenever possible, risk should be minimized using other control measures before resorting to PPE. It is the responsibility of the Instructor to ensure that all students have available and are wearing the appropriate PPE. Lab instructors must be dressed in the same protective gear and clothing as their students, not only for their own protection, but to set a good example for their students. All PPE for instructors must be provided by the College, at no cost to the employee.

4.7.1 Eye and Face Protection

- Chemical splash goggles must be worn at all times in chemistry labs. Chemical splash goggles must meet or exceed ANSI Standard Z87.1. These goggles are indirectly vented and are close fitting.
- Prescription glasses are not substitutes for chemical splash goggles and should be worn under the appropriate chemical splash goggle.

- Contact lenses should not be worn in chemistry labs as many chemicals can produce vapors that are trapped against the eye by contact lenses. Also, in the event of an accident, contact lenses will prevent proper flushing when using an eyewash station.
- For biology labs, the type of eye protection needed depends on the hazard. For example, safety glasses are required when working with bacterial cultures, while dissecting preserved specimens and when there is a risk of impact. Chemical splash goggles should be used when working with hazardous chemicals. When hazards are present, the person performing the work should wear appropriate eye protection, as well as any person adjacent to them.
- Face shields provide additional protection to the eyes and face when used in combination with safety glasses or splash goggles. They should be used in operations when the entire face needs protection and are necessary when working with 1) severely corrosive or strongly reactive chemicals, 2) glassware under reduced or elevated pressures, 3) combustion and other high temperature operations, 4) whenever there is a possibility of an explosion or implosion, 5) use of certain biohazardous materials. Face shields must not be used alone and are not a substitute for appropriate eyewear. Face shields should always be worn in conjunction with a primary form of eye protection such as safety glasses (impact protection) or goggles (chemical protection).
- Special safety glasses may also be required for work with UV light, lasers, and other types of radiation which is absorbed by the eyes or skin (chemical splash goggles are not adequate protection for these types of work).

4.7.2 Hand Protection

- Nitrile gloves are provided in all laboratories.
- Nitrile gloves are not appropriate for highly toxic chemicals or solvents. Always consult chemical compatibility and permeation information when working with unfamiliar chemicals.
- Always wear gloves when handling chemicals or biological agents.
- Always wash your hands after removing gloves.
- Replace gloves immediately if they are contaminated or torn.
- Never reuse disposable gloves.
- Appropriate hand protection should always be used when handling hot glassware and equipment or cryogenic liquids.

4.7.3 Laboratory Aprons and Other Protective Clothing

Wearing appropriate clothing will minimize the risk of exposure to hazardous materials. Long pants and full length sleeves along with closed toed shoes should be worn at all times in chemistry labs and when working with chemicals or conducting dissections in biology labs. Lab aprons should be worn in chemistry labs when working with hazardous chemicals.

4.7.4 Respiratory Protection

The use of air-purifying respirators for routine laboratory work is not recommended. Respirators are discouraged because they protect only the wearer and require annual medical monitoring, specific training, and fit testing to be sure they can be worn effectively. Properly-operating laboratory chemical fume hoods and biosafety cabinets provide the best overall protection from chemical, biological, and radiological hazards in the laboratory. Speak with the Safety Officer if you voluntarily use a respirator.

5.0 SAFETY EQUIPMENT, MAINTENANCE, and INSPECTIONS

The following control measures and safety equipment should be used when necessary to reduce exposure to chemical and other hazards.

5.1 Chemical Fume Hoods

General room ventilation does not provide adequate protection against hazardous gases, vapors, and aerosols. All work with corrosive, flammable, malodorous, toxic, or other dangerous materials must be conducted in a properly operating chemical fume hood.

Chemical fume hoods are checked annually for proper air-flow by a contracted vendor. The velocity of the air at the face of the hood is measured with the sash fully open and at 16-18 inches opening. The resulting air-flow is posted on a sticker attached to the hood.

The college recommends that students work with the sash lowered as much as possible when conducting experiments. The sash should never be higher than the "SASH POSITION" arrow to be fully protected from potential splashes, explosions or other dangerous reactions.

Hoods that do not meet the minimum exhaust requirements during annual inspection are posted "Warning Do Not Use." Facilities is then notified to repair the hoods. After repairs have been made, the college will retest the hoods to verify their proper operation.

5.1.1 Procedures for Proper Use of Chemical Fume Hoods

- Before using a hood, make sure air is entering the hood and the hood is functioning properly.
- Report any problems with chemical hood operations to Facilities x2533.
- Do not block baffle openings or place bulky items in the hood that will prevent air from entering the baffle opening.
- Avoid opening and closing the hood sash rapidly and avoid swift arm movement in front or inside the chemical hood.
- Conduct work at least six inches in from the edge of the hood.
- Lower the sash to at least "SASH POSITION" arrow to protect yourself from dangerous reactions and/or chemical splashes.
- Keep the hood clean and uncluttered. Wipe up spills immediately.
- Be aware that drafts from open windows and open doors may interfere with normal hood exhaust. Windows and doors should be closed when conducting lab work.
- Do not attach "Kim-wipes" or other similar material to the hood sash.
- Keep the hood sash closed whenever the hood is not actively in use or is unattended to conserve energy.

5.1.2 Best Practices when using Filtered Fume Hoods

- Do not leave open containers in the filtered fume hoods.
- Work with the goal to minimize evaporation and avoid spills within the filtered fume hood.
- Clean up spills promptly, do not leave to evaporate.
- Provided it does not interfere with the lab objectives, cover containers whenever possible (e.g. not being used, storage, mixing, etc.).
- Promptly close and seal all waste storage devices (bags, bottles, jars, etc.).
- Long-term storage of waste should not be in the fume hood, use a proper waste container.
- Minimize solvent use when cleaning. Use only as much as necessary, typically just a few ml works.
- Dispense solvents with squirt bottles that have a nozzle designed to prevent evaporation when not in use.
- Liquid waste collection should be performed in a ducted fume hood, not the filtered fume hood.
- Ensure that any liquid waste poured into the waste container is compatible with material already in the waste container. If this is unknown, create and use a separate waste container.
- Use condensers on apparatus that allow them when evaporating.
- When demonstrating highly exothermic reactions, use the ducted hood not a filtered hood

5.2 Biological Safety Cabinets

A biological safety cabinet (BSC) is the primary barrier protection for individuals working with biohazardous materials. Laboratory procedures that could create airborne biohazards should always be performed in a BSC as it protects the laboratory workers and the environment from aerosols or droplets that could spread biohazardous material. BSCs are tested annually by a contracted vender.

The common element to all classes of biological safety cabinets is the high efficiency particulate air (HEPA) filter. This filter removes particles with aerodynamic diameters of 0.3 microns (i.e., the most penetrating particle size) with an efficiency of 99.97 percent. Particles with aerodynamic diameters both smaller and larger than 0.3 microns are removed with nearly 100 percent efficiency. However, HEPA filters do not collect/remove vapors or gases.

The following general rules apply when using BSCs:

- BSC surfaces must be decontaminated frequently and after work is complete.
- Gas lines are prohibited in BSCs.
- Open flames are not recommended inside BSCs
- Toxic and volatile chemicals are prohibited inside Class II, Type A BSCs. Small quantities of these materials may be used in Class II, Type B BSCs.
- Ultraviolet lights are not recommended for use in BSCs.

5.3 Safety Showers and Eyewash Stations

Safety showers should be used if you receive a chemical splash to the body.

- In order to wash chemicals from the body properly, clothing should be removed as water is applied.
- Once the shower is activated, it must remain activated for at least 15 minutes in order to wash chemicals from exposed areas.
- The shower can be used to extinguish a clothing fire, but this is not recommended if the shower is more than 10 seconds away. The best method for extinguishing a clothing fire is to "Stop, Drop & Roll", then remove clothing.
- At least three feet of free space in each direction is required beneath the shower. This area must be kept free of all obstacles.
- Facilities inspects all drench showers once per year for proper flow and operation in compliance with the Code of Massachusetts Regulations 527 CMR 10.02. A tag or card is hung on the unit if it is "Out-of-Service." A request for service is then submitted so that necessary repairs can be made.

Eyewash stations should be used if a chemical is splashed in or near the eyes.

- Specifications for plumbed eyewash stations shall comply with ANSI/ISEA Z358.1 – 2009.
- Plumbed eyewash stations are activated weekly to verify proper operation.
- The best first aid treatment for chemical splashes of the eye and face is immediate flushing with copious amounts of water for at least 15 minutes. Hold eyelids open for the full 15 minutes.

Plastic eye wash bottles are not acceptable but are provided on a temporary basis while awaiting installation of plumbed eyewash stations.

5.4 Chemical Spill Control Stations

Spill control stations are provided in all chemistry labs, chemistry stock rooms and the main hazardous waste accumulation area. These kits contain materials needed to safely contain and clean up a small chemical spill (less than 1 Liter).

The microbiology labs maintain bacdown and alcohol solutions for cleaning up small amounts of biohazardous materials. Supplies must be replenished if used.

5.5 First Aid Kits

First Aid kits are available in each laboratory. First Aid kit contents are maintained by campus police and restocked annually.

- A First Aid Kit should be used as a primary means of aid to stem blood flow or to cover a wound to protect it from contamination.
- Remember that First Aid does not replace a physician's care.
- If emergency assistance is needed call 3-9-1-1
- Any injuries requiring more than a Band-Aid should also be reported to campus police.

5.6 Fire Extinguishers

Fire extinguishers have been strategically placed in all laboratories. ABC-type extinguishers are located in laboratory facilities where flammable liquids are used. Specialty-fire extinguishers such as Metal-X extinguishing agent, a graphite material, are used to smother a Class D (flammable solids) fire and are distributed to laboratories when appropriate.

5.7 Fire Blankets

Fire blankets are located in some laboratories. They can be used to smother a clothing fire or to provide modesty to someone who needs to remove clothing while under the safety shower.

6.0 WORKING WITH HAZARDOUS CHEMICALS

The following provides practical guidance on the handling and storage of common chemical hazards.

6.1 Flammable and Combustible Chemicals

Flammable liquids are among the most common of the hazardous materials found in laboratories. They are usually highly volatile (have high vapor pressures at room temperature) and their vapors, mixed with air at the appropriate ratio, can ignite and burn. The danger of fire and explosion presented by flammable liquids can usually be eliminated or minimized by strict observance of safe handling, dispensing, and storing procedures.

- Never heat flammable liquids with an open flame or hot plate. Use a heating mantle, steam bath or hot water bath.
- Never use or store flammable liquids near an open flame.
- Whenever possible, dispense and handle flammables in a chemical fume hood.
- When dispensing flammable solvents into small storage containers, use metal or plastic containers or safety cans (avoid glass containers).
- The preferred storage location is in flammable storage cabinets.
- Flammable liquids should not be stored or chilled in domestic refrigerators and freezers but in units specifically designed for this purpose.
- Commonly used flammable liquids include: acetone, toluene, isopropyl alcohol, and methanol.

6.2 Oxidizing Agents

- Oxidizing agents can initiate combustion and are incompatible with flammable chemicals and reducing agents.
- Perform all manipulations of highly reactive or high-energy oxidizers in a chemical fume hood.
- Commonly used oxidizing agents include: hydrogen peroxide, nitric acid, bromine, and iodine.

6.3 Peroxidizible Agents

- Peroxide formers react with oxygen to form peroxides during storage and especially after exposure to the air (once opened).
- Containers should be labeled with the “open date” and discarded within 6 months after they were first opened.
- Containers should be inspected for peroxide formation before opening. If crystals are present around the lip of the container or the liquid appears cloudy, do not open or move it.
- Commonly used peroxide formers include: potassium metal and cyclohexane.

6.4 Corrosive Chemicals

Corrosive chemicals are commonly used in laboratory experiments.

- Acids and alkalis are corrosive to containers and other materials in a storage area and should be stored in dedicated corrosive cabinets.
- Corrosive chemicals should be used in the chemical fume hood when handled in bulk quantities (>1 liter) and when dispensing, as inhalation of vapors or mists of these substances can cause severe bronchial irritation.
- Acids and metals are incompatible as they can form dangerous hydrogen gas when mixed.
- Commonly used corrosive chemicals include: hydrochloric acid, acetic acid, sulfuric acid, and sodium hydroxide.

6.5 Particularly Hazardous Substances

Hazardous chemicals are chemicals for which there is scientific evidence that adverse acute or chronic health effects may occur in exposed workers. An agent is an acute toxin if its toxic effects are manifested after a single or short-duration exposure. Chronically toxic agents show their effects after repeated or long-duration exposure and the effects usually become evident only after a long latency period. Many of the substances in frequent use in laboratories are classified as hazardous substances. There are some substances, however, that pose such significant threats to human health that they are classified as "particularly hazardous substances" (PHSs). The OSHA Laboratory Standard requires that special provisions be established to prevent the harmful exposure of researchers to PHSs. General procedures for working with such materials are presented in detail in Section 3.3. PHSs include carcinogens, reproductive toxins, and acutely toxic materials.

6.5.1 Select Carcinogens

Certain potent carcinogens are classified as "select carcinogens" and treated as PHSs. A select carcinogen is defined in the OSHA *Laboratory Standard* as a substance that meets one of the following criteria:

1. It is regulated by OSHA as a carcinogen,

2. It is listed as "known to be a carcinogen" in the latest Annual Report on Carcinogens published by the National Toxicology Program (NTP),

3. It is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer (IARC), or

4. It is listed under IARC Group 2A or 2B, ("probably carcinogenic to humans") or under the category "reasonably anticipated to be a carcinogen" by the NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria: (i) after inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m3; (ii) after repeated skin application of less than 300 mg/kg of body weight per week; or (iii) after oral dosages of less than 50 mg/kg of body weight per day.

The following is a list of the substances meeting criteria (a), (b), or (c). For information on compounds meeting criteria (d), examine IARC Group 2A and 2B lists and the NTP lists that are available on the Internet. See Appendix II-C for more information on PHSs.

<u>Partial List of Select Carcinogens (Includes OSHA Carcinogens)</u>

- 2acetylaminofluorene
- acrylamide
- acrylonitrile
- 4-aminodiphenyl
- arsenic and certain arsenic compounds
- asbestos
- azathioprine
- benzene
- benzidine
- bis(chloromethyl) ether
- 1,3 butadiene
- 1,4-butanediol dimethylsulfonate (myleran)

- cadmium
- chlorambucil
- chloromethyl methyl ether
- chromium and certain chromium compounds
- coal-tar pitches
- coal tars
- coke oven emissions
- conjugated estrogens
- cyclophosphamide
- 1,2-dibromo-3-chloropropane
- 3,3'-dichlorobenzidine (and its salts)
- diethylstilbestrol
- dimethylaminoazobenzene
- dimethyl sulfate
- ethylene dibromide
- ethylene oxide
- ethylenimine
- formaldehyde
- hexamtehylphosphoramide
- hydrazine
- melphalan
- 4,4'-methylene-bis(2-chloroaniline)
- methylene chloride
- methylene dianiline
- mustard gas
- N,N'-bis(2-chloroethyl)-2-naphthylamine (chlornaphazine)
- alpha-naphthylamine
- beta-naphthylamine
- nickel carbonyl
- 4-nitrobiphenyl
- N-nitrosodimethylamine
- beta-propiolactone
- thorium dioxide
- treosulphan
- vinyl chloride

Note: the above list is not intended to be complete, and it is the responsibility of the faculty member (in consultation with their Dean) to evaluate each compound involved in their work and to determine whether it should be handled as a select carcinogen.

6.5.2 Reproductive and Developmental Toxins

Reproductive toxins can affect the reproductive health of both male and female employees and students if proper procedures and controls are not used. For women, exposure to reproductive toxins during pregnancy can cause adverse effects on the fetus; these effects include embryolethality (death of the fertilized egg, embryo or fetus), malformations (teratogenic effects), and postnatal functional defects. Examples of embryotoxins include thalidomide and certain antibiotics such as tetracycline. Women of childbearing potential should note that embryotoxins have the greatest impact during the first trimester of pregnancy. Because a woman often does not know that she is pregnant during this period of high susceptibility, special caution is advised when working with all chemicals, especially those rapidly absorbed through the skin (e.g., formamide). Faculty and students who are pregnant or intending to become pregnant should consult with a medical professional before working with substances that are suspected to be reproductive toxins. For men, the affects of certain reproductive toxins may include decline in fertility, malformations in off-spring, and certain types of cancer. Therefore, adequate protection from exposure must be employed.

Information on reproductive toxins can be obtained from Safety Data Sheets.

The following Table lists some common materials that are suspected to be reproductive toxins; in most laboratories it will be appropriate to handle these compounds as particularly hazardous substances.

<u>Partial List of Reproductive Toxins</u>

- arsenic and certain arsenic compounds
- benzene
- boric acid
- cadmium and certain cadmium compounds
- carbon disulfide
- ethylene glycol monomethyl and ethyl ethers
- ethylene oxide lead compounds
- mercury compounds
- tin(II) chloride
- toluene
- vinyl chloride
- xylene

Note: The above list is not intended to be complete, and it is the responsibility of the faculty member (in consultation with their Dean) to evaluate each compound involved in their work and to determine whether it should be handled as a reproductive toxin.

6.5.3 Compounds with a High Degree of Acute Toxicity

Compounds that have a high degree of acute toxicity comprise a third category of particularly hazardous substances as defined by the OSHA Laboratory Standard. Acutely toxic agents include certain corrosive compounds, irritants, sensitizers (allergens), hepatotoxins, nephrotoxins, neurotoxins, agents that act on the hematopoietic systems, and agents which damage the lungs, skins, eyes, or mucous membranes. Substances that have a high degree of acute toxicity are interpreted by OSHA as being substances that "may be fatal or cause damage to target organs as the result of a single exposure or exposures of short duration".

Toxic and Highly Toxic Agents

OSHA regulations (29 CFR 1910.1200 Appendix A) define toxic and highly toxic agents as substances with median lethal dose (LD50) values in the following ranges:

TEST	TOXIC	HIGHLY TOXIC
Oral LD50 (albino rats)	50-500 mg/kg	<50 mg/kg
Skin Contact LD50 (albino rats)	200-1000 mg/kg	<200 mg/kg
Inhalation LC50 (albino rats)	200-2000 ppm/air	<200 ppm/air

It is important to note that the above classification does not take into consideration *chronic toxicity* (e.g. carcinogenicity and reproductive toxicity). Also, note that LD50 values vary significantly between different species, and the human toxicity for a substance may be greater or less than that measured in test animals. OSHA considers substances that are either toxic or highly toxic, as defined above, to be *particularly hazardous substances*.

In evaluating the acute toxicity of chemical substances, the HMIS (Hazardous Materials Identification System) rating criteria developed by the National Paint and Coatings Association may be helpful. HMIS numbers, along with LD50 values, can often be found in SDSs. The following is a list of the compounds that have a high degree of acute toxicity:

Partial List of Compounds with a High Degree of Acute Toxicity

abrin	nitrogen dioxide
acrolein	osmium tetroxide
arsine	ozone
chlorine	phosgene
diazomethane	ricin
diborane (gas)	sodium azide
hydrogen cyanide	sodium cyanide(& other cyanide salts)
hydrogen fluoride	strychnine
methyl fluorosulfonate	ethidium bromide
nickel carbonyl	guaiacol

Note: the above list is not intended to be complete, and it is the responsibility of the faculty member (in consultation with their Dean) to evaluate each compound involved in their work and to determine whether it is a substance with a high degree of acute toxicity.

In evaluating the hazards associated with work with toxic substances, it is important to note that a number of factors influence the response of individuals to exposure to toxic compounds. For example, people are rarely exposed to a single biologically active substance. With this point in mind, it is noteworthy that one toxin can influence the effect of a second. This underscores the importance of maintaining good laboratory practices at all times, and with all chemicals.

6.6 Compressed Gases

Compressed gases expose laboratory personnel to both chemical and physical hazards. It is essential that these are monitored for leaks and have the proper labeling. Leaking gas cylinders may require an immediate evacuation of the area and activation of the emergency response system.

- All cylinders must be firmly secured at all times using a clamp, belt, or chain.
- A cylinder cap or regulator value should always be in place.

6.7 Cryogenic Liquids

- All cryogenic dewars should be clearly labeled and operated in accordance with the manufacturer's instructions.
- The pressure relief valve should be periodically inspected for ice formation.
- Liquid nitrogen dewars have one pressure relief valve set at 22psig.
- Proper PPE must be worn whenever handling cryogenic liquids including face shields over chemical splash goggles and cryogenic rated gloves.

6.8 Water-Reactive Chemicals

- These materials react violently with water and should be used in a chemical fume hood.
- Commonly used water-reactive chemicals include: aluminum chloride and all hydrides.
- Alkali metals such as lithium, sodium, and potassium should be stored under mineral oil.
- In the event of a fire, use a Class D fire extinguisher or sand.

7.0 TRAINING and INFORMATION

The purpose of Laboratory Safety Training is to explain and reinforce the information presented in the chemical hygiene plan and to give a broad overview of various laboratory safety topics.

7.1 Employee Information and Training

Training for faculty and staff will occur when first hired and annually thereafter as an online module using Bristol's eLearning system.

Training will cover the following topics:

- General information on safety equipment and personal protective equipment.
- Proper use of laboratory chemical hoods.
- Emergency procedures for fire, injury, chemical exposure, and chemical spills.
- Information on the Massachusetts Hazard Communication regulation, including location and availability of additional reference materials on the hazards, safe handling, storage, and disposal of hazardous chemicals found in the laboratory, including Safety Data Sheets (SDS).
- Basic toxicology, including routes of entry and occupational exposure limits (PELs, TLVs).
- Personal protective equipment (PPE) and their proper selection and use.
- Hazardous waste management training including: Federal and State requirements for point of generation, collection, management and disposal of hazardous waste.

7.2 Student Information and Training

Faculty members are responsible for providing laboratory specific safety training for all students at the start of each semester.

Safety information will include:

- Appropriate clothing and use of PPE
- Understanding GHS pictograms and how to read SDS
- Safe chemical handling specific to each chemical they will use.
- How to use a chemical fume hood

- Disposing of chemical waste
- Lab hygiene
- When and how to use emergency shower and eyewash stations (demonstration of safety equipment does not require the activation of the equipment).

Students are required to sign a laboratory safety agreement after completing the lab safety training.

7.3 Supplemental Training

In addition to laboratory safety issues, laboratory personnel should be familiar with established facility policies and procedures regarding emergency situations including, but not limited to: evacuation procedures, shelter in place, security issues, and communications during an emergency.

8.0 HAZARDOUS CHEMICAL WASTE MANAGEMENT and DISPOSAL

Bristol Community College will contract with a chemical disposal company to dispose of unwanted and waste chemicals on an annual basis. The chemical waste pick-up will typically occur in August. If you have unwanted chemicals, chemical waste, or biological waste in your area, please contact the safety coordinator by July of each year.

8.1 Laboratory Chemical Waste

- Chemical waste should be collected in each laboratory in a compatible container pending transfer or disposal. Waste containers should be clearly labeled.
- Some liquid wastes are non-hazardous and water soluble. These materials may be flushed down laboratory sinks (buffer, salt solutions, etc.).
- Non-hazardous liquids that are not water soluble can be solidified/absorbed and disposed of as a solid in the general trash.

Prevent Waste Commingling: Preventing non-hazardous chemicals from being mixed with hazardous chemicals will help to reduce the quantity of hazardous waste generated.

8.2 Satellite Accumulation Areas (SAA)

- All SAA must be clearly labeled with a laminated sign.
- All containers must have a hazardous waste label including contents (full chemical name(s), no trade names, abbreviations or chemical formulas) and the appropriate GHS hazard stickers.
- Include chemical group on label when appropriate (to identify compatibility).

- Date container when filled and ready to be moved to Main Accumulation Area.
- Incompatible waste types should be kept separate to ensure that heat generation, gas evolution, or another reaction does not occur.
- Waste containers should be stored in a designated location that does not interfere with normal laboratory operations.
- Use secondary containment when storing liquids.

SAA areas must be inspected weekly to ensure proper labeling and chemical compatibility. When a chemical waste container is full, it must be moved to the Main Accumulation Area within four days. Do not begin collecting additional bottles of the same waste stream in an SAA, as this is not allowed in Massachusetts. Contact the facilities department or the safety coordinator when waste containers are full.

8.3 Main Accumulation Area (MAA)

The MAA for Bristol Community College is J130. The MAA is inspected weekly by the safety coordinator and must maintain the following:

- door label (Hazardous waste, authorized personnel only, chemical hazards)
- spill kit
- gloves
- Ventilated storage and secondary containment may be appropriate for certain waste types.
- All containers must be labeled correctly with the labels facing front for easy identification.
- All waste must be segregated correctly.
- All waste must be recorded on the MAA log.

8.4 Minimization/Reduction & Other Considerations

- When the reuse or recycling of chemicals is possible, it is always preferable rather than disposal.
- The potential waste produced by the chemical and process in question should be considered from both a health and safety and a cost perspective.
- It is difficult and very costly to dispose of unlabeled materials. Always label containers so laboratory personnel know how to safely dispose of chemical and biological waste.

9.0 EMERGENCIES and ACCIDENTS

9.1 Preparation

Before beginning an experiment, you should have an understanding of Bristol Community College's policies and procedures for how to handle an accidental release of a hazardous substance, a spill, or a fire. You should also be aware of the location of all safety equipment in the laboratory, the different mean of egress from the room and also the emergency exits from the building. You should always have an understanding of the possible hazards involved with the laboratory work you are conducting.

9.2 Chemical Spills

Always work with the smallest quantity of chemical required to minimize any potential chemical spill. Always move slowly and deliberately when in a lab where chemicals are being used. Be careful not to bump into another person, especially when chemicals are in use.

In the event of a spill:

- Determine if the chemical came into contact with anyone. If clothing is contaminated, remove it immediately and use the safety shower for 15 minutes. If a chemical was splashed on the face or in the eyes, use the eyewash for 15 minutes.
- Move everyone away from the spill, evacuate the room if necessary.
- Notify campus police of the situation (x3911).
- If the chemical is not particularly hazardous and the spill is small, proceed to clean it using the chemical spill kit provided in the lab.
- If the chemical is hazardous and the spill is large, evacuate the room and call campus police. If necessary, pull the fire alarm to evacuate the building.

9.3 Fire

Small laboratory fires can often be controlled by removing the source of ignition, dousing with water (do not apply water to chemical fires), or smothering the flame with a watch glass or beaker.

- Know the location of the fire extinguisher and the nearest fire alarm.
- Use the fire extinguisher only if it is safe to do so, you have been trained in its use, and someone has been sent to pull the fire alarm. Always maintain a safe escape route when using the fire extinguisher.
- After an extinguisher has been used, designated personnel must promptly recharge or replace it.

9.4 Injuries

If an injury occurs:

- Seek the assistance of a faculty or staff member.
- Rescue the victim from life threatening danger if it is safe to do so.
- If the injury is serious, call campus police (x3911) immediately.
- If the injury is minor, it may be treated using the first aid kit. All injured personnel are encouraged to visit an emergency health services facility if additional medical attention is required.
- If the injury involved chemical contamination, request a copy of the SDS for that chemical for further medical care.

9.5 Incident Reporting

All accidents, injuries, or chemical contamination to an individual within a laboratory MUST be recorded using the Laboratory Accident Report Form (Appendix B).

Any “near-misses” or “close calls” including minor chemical spills cleaned up by the faculty or staff must be reported to the safety coordinator.

9.6 Incident Review

All accidents and incidences that occur in the laboratories are reviewed by the College Wide Safety Committee. The goal of this review is to prevent the same or similar incident from occurring a second time and to evaluate if any additional safety precautions are necessary.

10.0 MEDICAL CONSULTATION and EXPOSURE MONITORING

The employer must provide all employees who work with hazardous chemicals an opportunity to receive medical attention, including any follow-up examinations that the examining physician determines to be necessary, whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory.

If an employee encounters a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure, the affected employee must be provided an opportunity for a medical consultation by a licensed physician.

All medical examinations and consultations must be performed by or under the direct supervision of a licensed physician and must be provided without cost to the employee, without loss of pay and at a reasonable time and place. The identity of the hazardous chemical, a description of the incident, and any signs and symptom that the employee may experience must be relayed to the physician.

1.0 RECORD KEEPING

11.1 Training Records

Training records will be maintained by the risk/compliance officer.

11.2 Medical Records

All accident, fatality, illness, injury, and medical records and exposure monitoring records must be retained by the institution in accordance with the requirements of state and federal regulations (see 29CFR parts 1904 and 1910.1450). Any exposure monitoring results must be provided to affected laboratory staff within 15 working days after receipt of the results.

11.3 Equipment Inspection Records

Equipment inspections records will be maintained by the safety coordinator.

12.0 BIOLOGICAL WASTE MANAGEMENT

Bristol Community College has a written document for Biological Waste Management Policies and Procedures. Refer to this document for a full explanation of the following waste types:

12.1 Medical Waste

Medical and biological waste such as blood and blood products, cultures and stocks of bacterial agents and contaminated animal waste should be collected in a clear autoclavable bag within a secondary container that is clearly marked as “Biohazard Waste”. When bags are ¾ full, the safety coordinator should be contacted to arrange for autoclave sterilization before disposal in general trash

12.2 Sharps Disposal

Bristol Community College contracts with an outside vendor for disposal of sharps containers. Full sharps containers should be sealed and stored in the MAA. If you have full sharps containers, contact the safety coordinator for removal.

13.0 ELECTRICAL SAFETY

- Faculty and staff should know the basic procedures for removing a person from contact with a live electrical conductor.
- Labs should be designed so that all 110 volt AC outlet receptacles accept a three-prong grounding plug.
- It is required that ground fault circuit interrupters (GFCI) be used near any wet operations including sinks.
- Outlets for chemical fume hoods should be placed outside of the hood to prevent any possible electrical sparks inside the hood.
- All electrical cords should be inspected before use. Never use a cord with visible damage. Place cord or equipment out of use and inform the lab technician about the problem.

14.0 CENTRIFUGE SAFETY

The following procedures for centrifugation are recommended:

- Examine tubes and bottles for cracks or stress marks before using them.
- Never overfill centrifuge tubes as leakage may occur when tubes are filled to capacity. The maximum capacity for centrifuge tubes is 3/4 full.
- Always cap tubes before spinning. Use screw cap tubes.
- Never exceed safe rotor speed.
- Ensure that the load is balanced.
- Stop the centrifuge immediately if an unusual condition (noise or vibration) begins.

User error is the biggest cause of centrifuge malfunction. Common causes of centrifuge malfunctions include:

- Failure to place the lid on the rotor.
- Failure to properly secure the rotor lid.
- Failure to properly secure the rotor to the drive.
- Overloading the rotor's maximum mass.
- Improper balancing of centrifuge tubes.
- Utilization of centrifuge tubes that are not rated for the correct speed.

15.0 INDIVIDUAL LABORATORY HEALTH and SAFETY PLAN/PROCEDURES

Certain programs at Bristol Community College may have additional safety procedures that apply to a specific laboratory. Laboratory specific safety rules and procedures should be followed in addition to those specified within this Laboratory Safety Manual and Chemical Hygiene Plan.

APPENDIX A

Risk Assessment for Hazardous Chemicals and Procedures

1. Identify chemicals to be used, amounts required, and circumstances of use in the experiment. Consider any special employee or laboratory conditions that could create or increase a hazard. Consult sources of safety and health information and experienced scientists to ensure that those conducting the risk assessment have sufficient expertise.

2. Evaluate the hazards posed by the chemicals and the experimental conditions. The evaluation should cover toxic, physical, reactive, flammable, explosive, radiation, and biological hazards, as well as any other potential hazards posed by the chemicals.

3. Select appropriate controls to minimize risk, including use of engineering controls, administrative controls and personal protective equipment (PPE) to protect staff and students from hazards. The controls must ensure that OSHA's Permissible Exposure Limits (PELs) are not exceeded. Prepare for contingencies and be aware of college procedures in the event of emergencies and accidents.

4. What, if any, hazardous waste will be generated in this procedure and how will it be collected and/or disposed of?

APPENDIX B

Laboratory Accident Report Form

Name:	Phone # & E-Mail:
Location of the incident (building & room #):	Date & Time of incident:
Description of the incident (include the use of safety equipment such as personal protective equipment, chemical fume hood):	
Did the incident result in an injury? If yes, describe the injury:	
Was anyone exposed to a hazardous material? If yes, identify the material & amount:	
Was anyone exposed to bodily fluids (blood, vomit, etc.): If yes, please describe:	
Was campus police called to the scene?	
Was any action taken at the time of the incident? If yes, please describe:	
Witness Name	Contact Info:
Witness Name	Contact Info:
Witness Name	Contact Info:

Form must be submitted to Division V Dean within 48 hours.