University of Bridgeport

Chemical Hygiene Plan
Updated August 2022

revised September 2023
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Overview

The goal of this Chemical Hygiene Plan (CHP) is to define work practices and procedures to help ensure that faculty, staff, students, and the environment are protected from hazards associated with the handling, storage, and use of chemicals in laboratories. To that end, this manual provides a quick reference guide for University personnel to follow during the first few minutes of an emergency.

This manual was developed using an all chemical hazards approach to identify and respond. These procedures may not specifically cover every conceivable situation that may arise, but when applied with good judgment these procedures provide a prudent initial response to a Hazardous Material Spill.

This Chemical Hygiene Plan will be reviewed annually by the Departments and the University Safety Committee and/or Chemical Hygiene Officer (CHO).

SECTION 1: ADMINISTRATIVE AND EMERGENCY

Contact Information

1.01 University Administration

The President of the University has the ultimate responsibility for chemical safety. This responsibility is delegated to the Provost and Deans of the Colleges for all academic areas and to the Associate Vice President for Facilities through the Vice-President of Finance and Administration for all non- academic areas. All chemical safety will be coordinated through the University Safety Committee and its Chairperson.

The President or designee has the responsibility for providing appropriate resources to insure regulatory compliance. Each department is responsible to seek and make use of said resources through appropriate administrative channels.

1.02 Emergency Contact Information

Fire/Ambulance/Police Emergency - 911

	WORK PHONE	**CELL/HOME PHONE**
President *Dr. Danielle Wilken*	203-576-4665	
Vice President for Academic Affairs **Chief Academic Officer** *Dr. Manyul Im*	203-576-4234	203-615-8348
Dean of College of Science and Society *Amy Nawrocki*	203-576-4297	203-804-8845
Chemical Hygiene Officer *Dr. Abu Gafar Hossion*	203-576-4174	405-761-7426 / 475-282-9235
Campus Security	203-576-4911	
Student Health Services	203-576-4712	
Biological Safety Officer *Fred Ferraro*	203-576-2395	203-417-6481
Poison Control Center	1-800-222-1222	
American Red Cross	1-800-733-2767	
Police Department		911
Fire Department		911
Ambulance		911

SECTION 2: HAZARDOUS MATERIALS SPILL AND OPERATING PROCEDURES

Scope and Application

The Department of Labor's Occupational Safety and Health Administration (OSHA) has amended Part 1910 of Title 29 of the Code of Federal Regulations (CFR) to include Section 1910. 1450 as part of Subpart 2 entitled: "Occupational Exposure to Toxic Substance in Laboratories," commonly referred to as the OSHA Lab Standard.

This standard regulates all laboratories that use toxic substances and is primarily a performance standard aimed to provide flexibility in regulatory compliance. It does not mandate specific practices or procedures to be followed, but does require continued compliance for permissible exposure limits (PELS) of specific airborne contaminants listed in 29CFR1910, Subpart Z. It also includes exposure control to carcinogens or potential carcinogens listed in the International Agency for Research of Cancer (IARC) or the National Toxicology Program (NTP) published lists.

The standard removes requirements which are inappropriate to laboratories, requiring instead the formulation and implementation of a Chemical Hygiene Plan which is reasonably designed to avoid overexposure to toxic substance, thus ensuring the use of safety work practices and procedures. Because laboratory practices, procedures and chemical use vary so much, OSHA believes that a performance orientated approach is appropriate for the laboratory workplace. A performance standard allows each laboratory to tailor its Chemical Hygiene Plan to the particular circumstances of its operations in lieu of the specific requirements of Subpart Z. In addition, the proposal will allow employers to use various parts of plans which they already have in effect and aspects of other Standards as part of the existing Departmental Accident Prevention Plan.

2.01 Definitions

"Carcinogen" of "Potential Carcinogen" means any substance which meets one of the following criteria: (1) is regulated by OSHA as a carcinogen; or (2) is identified by the International Agency for Research (IARC) or the National Toxicology Program (NTP) as a carcinogen or potential carcinogen.

"Chemical Hygiene Plan" means a reasonable written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices that are capable of protecting employees from the health hazards presented by toxic substances used in that particular workplace.

"Overexposure" means an employee exposure in excess of the permissible exposure limits (PELs) for an OSHA regulated substance.

"Regulated Area" means the permanent regulated areas which are the chemistry prep area and Chemistry Chemical Storage area. A regulated area shall be a laboratory or device such as a laboratory hood for which access is limited to persons who are aware of the hazards of the substances in use and the precautions that are necessary.

"Toxic Substance" means any substance which is: (1) regulated by OSHA in 20CFR1910, Subpart Z or (2) is found to be a carcinogen or potential carcinogen.

Hazardous Chemical The OSHA Laboratory Standard defines a **hazardous chemical** as "a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term 'health hazard' includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes". Highly flammable and explosive substances comprise a category of hazardous chemicals.

2.02 Permissible Exposure Limit

The permissible exposure limits (PELs) for laboratory uses of OSHA regulated substances are not to be exceeded. These PEL values for airborne contaminants are available in the Sigma-Aldrich Library of Chemical Safety data (SAL-CSD) located in the Chemistry Laboratory prep area.

2.02.01 Standard operating procedures and control measures for use and reduction of toxic substance exposure.

All work involving toxic substances must follow standard operating procedures which are appropriate for the particular laboratory workplace. Such procedures are essential to assure uniformity of work practices for the protection of all employees from undue exposure to toxic substances. Safe operating and handling procedures for toxic chemicals shall be based on three primary factors:

i. The adequate and proper use of a ventilations system (including the hoods).

ii. Laboratory workers are using proper protective clothing to prevent skin contact, such as lab coat or apron.

iii. Laboratory workers are following good hygiene and laboratory safety practices.

2.02.02 General procedures for the procurement, use and disposal of toxic and hazardous materials are as follows:

- Personnel should check the laboratory materials inventory prior to initiation of a purchase requisition.
- Purchase requisitions for hazardous materials must be approved by the Chemical Hygiene officer of his designator.
- The originator of the purchase requisitions is responsible for assuring that the Carbon monoxide transfer coefficient, KCO hazard label is placed on all laboratory stock.
- Any solvent or reactant material received by the Laboratory should bear a label identifying the chemical composition, carcinogenicity – OSA if cancer suspect agent, and health, flammability, and reactivity hazard signals (0-4). Besides chemical SDS (Safety Data

Sheet), you should find classification and labeling of hazardous chemicals on the label of chemical container, as well.

(Table 1). Classification of hazardous chemicals can be found at http://www.unece.org/info/media/stories/use-chemicals.html

Table 1: Globally Harmonized System (GHS) and Classification of Hazardous Chemicals.

GHS Hazard Symbols and Their Definitions	
GHS Symbol	GHS Class
	**Explosive** • Explosives • Self-reactive substances • Organic peroxides
	**Flammable** • Flammable gases, aerosols, liquids, and solids • Pyrophoric liquids or solids • Self-heating substances • Self-reactive substances • Substances that emit a flammable gas upon contact with water • Organic peroxides
	**Corrosive** • Skin corrosion/burns • Eye damage • Corrosive to metals
	**Oxidizer** • Oxidizing gases, liquids, and solids
	**Compressed gas** • Gases under pressure
	**Toxic Substance** • Acutely toxic substances that may be fatal or toxic if inhaled, ingested, or absorbed through the skin
	**Irritant** • Irritant (skin and eye) • Skin sensitizer • Acute toxins • Narcotic effects • Respiratory tract irritants • Hazardous to ozone layer (non-mandatory)
	**Health Hazard** • Respiratory sensitizers • Carcinogens • Mutagens • Reproductive toxins • Target organ toxins, single exposure or repeated exposure • Aspiration toxins
	**Environmental Hazard (non-mandatory)** • Acute aquatic toxins • Chronic aquatic toxins

Source: UNECE. Globally Harmonized System of Classification and Labelling of Chemicals, 2015. www.unece.org/trans/danger/publi/ghs/ghs_welcome_e.html (accessed Dec 1, 2015).

- Materials bearing a Hazardous Materials Information System (HMIS) signal of 0 or 1 in any field other than carcinogens are exempt from the provisions of this plan for the following reasons. They require massive releases of material in order to be a workplace hazard under normal conditions. Relatively minor amounts of these materials are used under normal laboratory conditions. Any material having a HMIS signal of 2 or greater, or that is considered a cancer suspect agent regardless of HMIS ranking, is fully covered by the requirements of this plan.
- All personnel are required to familiarize themselves with proper procedures for safe handling, testing, storage, and disposal of a hazardous material before working with that material.
- All volatile hazardous materials should be transferred from one container to another in the dispensing hood.
- The maximum quantity of liquids in unprotected glass or plastic bottles with a flammability signal greater than two (2) located in the work area should not exceed four (4) liters per one hundred (100) square feet of floor area.
- The notice posted at the room entrance should include the name of the responsible person and a knowledgeable alternate and phone numbers or post locations for each.
- Cancer suspect agents and materials with HMIS reactivity or health hazard signals greater than two (2) will be kept in restricted access locked cabinets designated for storage of these materials.
- Should it become necessary to leave a potentially hazardous test/equipment unattended, a notice to that effect should be prominently posted on or near the test/equipment and at the entrance to the room.
- Specific hazards associated with the test/equipment (for example "molten cyanide—use no water", "hot concentrated acid", "flammable material", "high voltage", etc.) Should be identified on each notice.
- Fire Protection, the local fire department, should be notified prior to initiation of the overnight test that includes potential for heat or flame or the use of hazardous materials for assistance in monitoring.
- Personnel working with hazardous materials/equipment or performing hazardous operations outside of normal working hours are required to maintain contact with a knowledgeable individual who will be in the laboratory area for the duration of the operation.
- The knowledgeable individual should know what materials or equipment are being used and what operation is being performed before the work begins.
- The knowledgeable individual should maintain periodic contact at a prearranged interval until notified that the hazardous material or equipment is no longer in use or that the hazardous operation is completed.

- Compatible materials may be placed into approved waste safety cans for temporary storage prior to disposal by the Chemical Hygiene Officer.
- Reactive materials should be placed in separate containers and disposed of by the Chemical Hygiene Officer.
- Lids on waste safety cans should be closed at all times except when actually pouring into them.
- Waste safety cans should be returned to their designated storage area at the end of the working day.
- Hazardous scrap material should be disposed as stated in the Sigma – Aldrich Library of Chemical Safety Data (SAL-CSD) as well as the Flinn Scientific Catalog located on the north wall of the laboratory adjacent to the fume hoods.
- Cancer suspect agents should be packaged separately for disposal by Chemical Hygiene Officer.

2.02.02a More specific principles that shall be observed by all laboratory workers as follows:

- Know the safety rules and procedures that apply to the work that is being done. Determine the potential hazards (e.g., physical, chemical, biological) and appropriate safety precautions before beginning any new operations as stated in the SALCSD.
- Know the types of protective equipment available and use the proper type for each job.
- Be alert to unsafe conditions and action and call attention to them so that corrections can be made as soon as possible. Someone else's accident can be as dangerous to you as any you might have.
- Avoid consuming food or beverages or smoking in areas where chemicals are being used or stored.
- Avoid hazards to the environment by following accepted waste disposal procedures. Chemical reactions may require traps or scrubbing devices to prevent the escape of toxic substances.
- Be certain all chemicals are correctly and clearly labeled. Post warning signs when unusual hazards, such as radiation, laser operations, flammable materials, biological hazards, or other special problems exists.
- Use equipment only for its designed purpose.
- Wear appropriate eye protection at all times, such as goggles.
- Use protective apparel, including face shields, gloves, and other special clothing or footwear as needed.
- Individuals working in the lab will restrain from using loose clothing, long hair, and dangling jewelry as well as refrain from open toed shoes, shorts, skirts and tank tops or muscle shirts.
- Reagents will not be stored in the student's cabinets below the lab benches.

- Chemicals will be labeled accurately and with a date of receipt or preparation and any other precautionary information for handling.
- Do not use mouth suction to pipet chemicals or to start a siphon; a pipet bulb or an aspirator should be used to provide vacuum.
- Avoid exposure to gases, vapors, and aerosols. Use appropriate safety equipment whenever such exposure is likely.
- Wash well before leaving the laboratory area.
- Work areas should be kept clean and free from obstructions. Cleanup should follow the completion of any operation or at the end of each day.
- Waste should be deposited in appropriate receptacles.
- Food is not to be stored in the laboratory refrigerators. Food and drink shall not be kept in refrigerators, freezers, shelves, cabinets or on countertops or bench tops in the laboratory. Employees and/or students should not eat or drink in laboratory having hazardous chemicals.
- Working with volatile substances should be performed in a fume hood.
- Further guidelines and procedures for handling toxic substances can be found in the SAL-CSD publication which shall be made available to all laboratories.

2.02.02b Properly Functioning Equipment.

Facility Maintenance

- Place fire extinguishers and fire blankets are near escape routes, and also in areas of high hazards.
- Regularly inspect fire extinguishers and maintain records of inspections as well as train personnel in the proper use of extinguishers.
- Escape routes as well as possible exits during a fire, tornado or civil defense are not to be blocked.
- Never store materials in where heavy traffic occurs.
- Have separate containers for trash and broken glass.
- Regularly inspect safety showers (*in monthly*) and eyewash stations (*in weekly*) located on the north end of the lab and keep records of inspections.
- Regularly check the ventilation in hoods located on the north wall for proper air flow.
- All protective equipment in the laboratory will be checked during the bimonthly safety and housekeeping tour. Special items including fume hoods that require monitoring to assure they are functioning properly will be noted and reported to the CHO if suspect. Many of these pieces of equipment are regularly checked by the CHO and if found to operate satisfactory are so identified and tagged.

2.03 Training Program

A training program shall be provided to all employees who are exposed to toxic substances in the Laboratory. The purpose of the program is to assure Laboratory, its risks and what to do if an accident occurs.

2.03a The program shall make special emphasis on the training and education of employees who fall in the following categories:

- Those who are not necessarily knowledgeable about the substances with which they work because of lack of professional training.
- Those who are newly hired to perform laboratory operations and will be at risk.
- Those who are newly assigned to laboratory projects and have not previously been involved in the training program.
- Those who will be involved in new projects or will be exposed to new toxic substances for which there are no established procedures developed under the Chemical Hygiene Plan.

2.03b The content of the training program will include at least the following:

- Appropriate precautions to be taken in the event of an emergency.
- The location limitations and proper use of protective equipment.
- The content and availability of the Chemical Hygiene Plan.
- The permissible exposure limits (PELs) for OSHA regulated substances.
- The availability of reference material on the hazards and safe handling of toxic substances. The book SAL-CSD will be at least one reference made available to all employees who will work with toxic substances in the laboratory.
- The frequency of training and education will be a regular continuing activity.
- Records of the type of training, frequency of training, and employees exposed to the training will be maintained by each laboratory.

2.04 Over exposure Evaluations, Medical Consultation, Follow-Up Examination and Record Keeping.

Will perform an "exposure evaluation" in the event employees have a reasonable belief they have sustained an overexposure to a toxic substance. The evaluation will be coordinated by the Chemical Hygiene Officer. It will be an informal assessment which will consider, among other factors, the quantity of substance used, the chemical and physical properties of the substance, the overexposure potential associated with the particular operation involved, and estimated duration of exposure.

In the event the exposure evaluation indicates the likelihood an employee has sustained an overexposure to a toxic substance, the employee has the right to "medical consultation" without

cost to the employee. The consulting physician shall receive any additional information of the employee that may be relevant to the physician's decision regarding what medical action, if any, is appropriate.

The consulting physician shall make recommendations regarding the specifics of any medical action where such action is appropriate. If follow-up medical examinations are necessary they may be provided after review without cost beyond provided personal medical insurance to the employee who has, or is suspected to have, sustained an overexposure to a toxic substance.

Records shall be kept of all exposure evaluation information, medical consultations and any follow-up medical treatment or tests recommended as a result of medical consultations. The keeping of and access to such medical records shall be in accordance with 29CFR1910.20 which is the generic standard for access to employee medical and exposure records. In accordance to Section 1910.20, such records will be kept for the duration of employment plus 30 years.

2.04a Chemical spills-Indoor

In the event of a chemical spill the immediate area will be evacuated and the level of hazard will be evaluated. The evaluation will be coordinated by the Chemical Hygiene Officer. If the chemical spill is categorized hazardous, the administration will be notified. If the chemical comes into contact with skin or eyes flush for 15 minutes. It is the responsibility of the administration to evacuate the school if necessary. If the spill is of low hazard, consult the MSDS, proceed with clean up and disposal properly. In the case of a fire or major spill, the employee is responsible for evacuating the premises by activating the fire alarm. Limit the exposure of the odor or vapors from permeating throughout the building, yet individually remain safe.

In the event of a large spill evaluate ventilation and limit exposure. Contact Campus Security if chemical hazard has been identified by the label of eyewitness, proceed with clean up. If clean up cannot be done, it is the responsibility of the administration to evacuate the school if necessary and call 911. If the spill is beyond control call 911.

The written emergency action plan is located in the CHO office and will be communicated to all personnel. Spill control procedures will include approved containment, cleanup and transportation methods.

2.04b Chemical Spill- Outdoor

In the event of a chemical spill outdoors, the procedure above will work, except have people up wind or have them go in-doors. Close any doors, windows and/or air in-takes to prevent the vapors from going indoors. Keep any telephone line clear of the chemical spill. If the spill is large, Campus Security will call the fire department for consultation only if deemed necessary.

2.04c Emergency First Aid Procedures

Eye Contact: Flush eyes with copious amounts of water for at least 15 minutes and seek medical attention.

Ingestion: Read the label for directions and immediately seek medical attention. Contact the 24-hour emergency poison control center at 1-800-222-1222.

Skin Contact: Flush the affected areas with copious amounts of water and remove any contaminated clothing. If symptoms persist after flushing, seek medical attention.

2.05 Chemical Hygiene Officer

The Chemical Hygiene Officer for University of Bridgeport is Dr. Abu Gafar Hossion <ahossion@bridgeport.edu>. The written approval of this plan signifies that the Chemical Hygiene Officer may implement the requirements of this plan. It shall be the responsibility of the instructor, with concurrence from the Chemical Hygiene Officer, to implement and manage the Chemical Hygiene Plan for their laboratory.

2.05a Hazardous Chemicals

All chemical purchases must be reviewed by the appropriate department head/chairperson. The purchase and use of carcinogens, reproductive hazards, explosive, and highly toxic chemicals must be approved by the Dean or Department Chairperson and the Chairperson of the University Safety Committee and/or Chemical Hygiene Officer must be notified. Purchase of this type of material may require the filing of a report with the Department of Homeland Security as required by law.

2.05b Particular Hazardous Substance

In addition to the general safety guidelines mentioned throughout this plan, special precautions are needed when handling select carcinogens, reproductive toxins, and highly toxic substances.

2.06 Chemical Storage

- Every chemical container in the laboratory will have a definite storage place and must be returned to that location after each use. Container(s) will not be left on bench tops overnight.
- Do not store chemicals on desks, bench tops, or in hoods that are used for chemical manipulations.
- Storage trays or secondary containers will be used to minimize the spread of material should a container break or leak.
- Acids will be separated from bases and flammables will be separated from oxidizers.
- Chemical containers will be inspected periodically. Worn or faded labels will be repaired. Unneeded or unwanted items will be donated to the surplus chemicals inventory, and deteriorated or unusable chemicals will be disposed.
- Chemical containers will be dated when received and when opened.

2.06a Toxic Substances

- Chemicals known to be highly toxic will be stored in safety cabinets inside chemically resistant secondary containers when not in use. See Appendix F.
- Only minimum working quantities will be present in the work area which must be well ventilated.
- Containers of suspected carcinogens or acutely toxic chemicals will carry a label

such as the following: "CAUTION - Carcinogen or CAUTION - Highly Toxic."

2.06b. Peroxide Forming Chemicals

Specific chemicals that can form dangerous concentrations of peroxides on exposure to air include cyclohexene, cyclooctene, decalin (decahydronaphthalene), p-dioxane, ethyl ether anhydrous, diisopropyl ether, tetrahydrofuran, and tetralin (tetrahydronaphthalene). A more extensive list is located at Appendix D.

- The quantity of peroxide forming chemicals purchased will be limited to the minimum quantity required. Unused material will not be returned to the original container.
- Containers of peroxide forming chemicals will be dated when opened, tested after 6 months, and disposed of before their expiration date.
- Peroxide forming chemicals will be stored at the lowest possible temperature consistent with their freezing point to prevent decomposition, but will not be allowed to freeze.

2.07 Materials Safety Data Sheets (MSDS)

The Department Chair tracks chemical purchases from all vendors to ensure that we receive an MSDS for every hazardous chemical. A copy of an MSDS for each hazardous chemical used in one of the laboratories at the UB will be filed in the building where the chemicals are stored.

MSDS or other reference information for particularly hazardous substances should be kept on file in the laboratory or building where they are used.

Instructional laboratories should also have MSDS copies on file for the hazardous chemicals frequently used or stored in large quantities in the laboratory. It is the responsibility of the laboratory supervisor to ensure that these MSDS files are maintained and updated.

MSDS must be reviewed before working with unfamiliar or particularly hazardous chemicals, and should be obtained prior to purchase to properly evaluate substances being considered for use. MSDS contain information about safe handling and storage procedures as well as personal protective equipment that is required for adequate protection. Laboratory supervisors are responsible for disseminating this information to technicians and students.

If an MSDS is sent or mailed directly to a chemical user, please forward a copy to CHO for the file.

2.08 Ventilation

Laboratory air should be replaced continuously (8 air changes/ hour). General ventilation provides only modest protection against toxic gases, aerosols, vapors and dusts. General ventilation will not be used for protection against toxins.

2.08a Local

Local ventilation will be used to prevent harmful fumes, mists, dusts, gases, and vapors from entering the laboratory air. Your best protection is the chemical fume hood, if used properly.

Fume hoods will be inspected and validated annually by a contractor via the University Facilities. Fume hoods will have a face velocity of at least 100 linear feet per minute (fpm) with the sash in the fully opened position or at the sash catch position. If 100 fpm cannot be achieved with the sash fully open, the sash will be lowered until the face velocity is 100 fpm. The sash will be marked at this position. Each hood used for chemical operations will be labeled with the face velocity and the date certified. The sticker will be placed on the front of the hood above the face opening.

A simple visible test for users to ensure flow into fume hoods and other ventilation equipment is to tape a telltale to the hood and note its movement.

Experiments or work with highly toxic substances (LD50 <5 mg/kg oral, <40 mg/kg skin, <1000 ppm, <500 mg/m3) may require more specialized local ventilation such as the use of a glove box or other closed system.

2.08b Works Practice for Chemical Fume Hood

- Set up work at least 6 inches from the face of the hood to avoid turbulence at the sash edge
- Separate and elevate each instrument by using blocks or rack so that air can flow easily around all apparatus.
- Do not clutter the hood with unnecessary bottles or equipment. Do not use the hood for storage of chemicals or other materials if it is used for chemical operations as well. Only materials in use should be in the hood.
- Work with the sash in the lowest possible position. The sash provides a physical barrier to protect against splashes, sprays, fires, or minor explosions. Lower the sash completely when no one is working in the hood.
- Do not obstruct the slots at the back of the hood. Keep the hood baffles free of obstructions.
- Do not dismantle or modify the physical structure of your hood or exhaust system in any way without first consulting the Building Manager.
- Do not place electrical receptacles or other spark producing equipment inside the hood.
- Never put your head inside an operating hood to check an experiment. The plane of the sash is the barrier between contaminated and uncontaminated air.
- Clean up spills as soon as possible.
- Do not use a hood for evaporation of chemical wastes.
- Heating of perchloric acid will only be done in a perchloric acid fume hood.

If you suspect that your fume hood is not functioning properly let your supervisor and/or Chemical Hygiene Officer and Building Manager know.

2.09 Unattended Operations

Reactions that are left to run unattended overnight or at other times are prime sources for fire, floods, or explosions. Plan for interruptions in electrical, gas, or water service. Do not operate equipment such as power stirrers, hot plates, heating mantles, and water condensers unattended

without fail-safe provisions. Unattended operations will be checked regularly. Post appropriate signs indicating that a laboratory operation is in progress. Include in the sign any hazards associated with the operation and a telephone number of the person(s) to be contacted in an emergency.

2.10 Working Alone, *Presence in Science Laboratory*

No one will work in a laboratory building alone. If a laboratory supervisor determines that an employee or student can work alone in a laboratory room, arrangements will be made for frequent contact with someone in the immediate area. Contact will be maintained with Campus Security (203-576-4911) during work outside of normal hours (8:00 am - 5:00 pm). Science laboratories at the University of Bridgeport are multiple purpose rooms that include computers, facilities for studying, and laboratory review among other things.

Students and lab assistants are not permitted in any laboratory during off hours unless you are accompanied by faculty or staff, or you have been given special permission. You are permitted to be in a laboratory room during off hours alone if you are studying, working at a computer, or engaged in certain other work activities specifically approved by a faculty member. Off hours means any time other than a normal class day. You may not work in a laboratory during off hours if your activity involves hazardous operations. A hazardous operation means working with chemicals with a hazard rating of three or greater as determined by the NFPA or other hazard rating agency in any category, or working with electrical circuits where there is likely to be 25 volts or greater. Be prudent and consider carefully the risks in your environment when engaging in any activities during off hours.

Hazardous operations, such as working with chemicals with hazard rating of three in any category is allowed during off hours only if two people are present in the immediate area. If you undertake this kind of activity, be sure that the other person understands and agrees to his/her role as your safety backup.

As a student, no assignment shall be given to you that may require you to do any work in a laboratory during off hours without a responsible person present. No student shall be required to enter a laboratory or the chemical stockroom without the presence of a responsible person. All laboratory operations require prior approval by the faculty member responsible for the room in which the operation is carried out.

<u>2.10a Security</u>

- All laboratories will be locked when unattended and not in use to protect employees, students, equipment, supplies, and the public.
- Only faculty, staff, and science lab assistants are allowed in any rooms used for chemical storage.
- Locked storage cabinets will be utilized for expensive, hazardous, or sensitive items.
- All suspicious persons or actions will be reported to Campus Security immediately.

2.11 Sanctions for Non-Compliance

Unsafe activities are often a result of inattention. Appropriate communication should ordinarily be the only action necessary to avoid injuries. Students, faculty and staff should feel free to make these reminders when they observe unsafe procedures, or inattention. This section lists the stronger recourses available when such action regrettably becomes necessary.

Sanctions for disobedience of safety rules by enrolled students include but are not limited to the possibility of expulsion from the course with a failing grade as may be determined by the faculty. Individual syllabi may include more detail as to the degree of sanction, but such detail is not required. In egregious situations violations of safety regulations involving willful conduct or gross negligence may be treated as a violation of the UB student code of conduct and sanctions imposed including separation from the University.

Faculty in control of research labs as determined by pertinent departments shall retain the right to remove desk, study, and pass privileges of any student associated with that laboratory.

The Provost, Dean, Chairperson individually or on the recommendation of the Chairperson of the University Safety Committee and/or CHO may remove the privileges of laboratory access from any student for safety reasons.

Sanctions for safety negligence or disobedience of CHP rules by faculty shall include the possibility of a written statement for inclusion in the faculty personnel file, in accordance with the provisions of the Faculty Handbook.

2.12 Guidelines for Handling Injuries on Campus

The University has standard procedures for assisting individuals who need medical treatment as a result of an injury while on campus. Faculty and staff members handling these situations should use the following information.

A. Immediate Attention Emergencies:

For all emergency situations, phone 203-576-4911 immediately for assistance. Indicate the nature of the problem, your identification and your specific campus location. Once the injured party is attended to and transported, report the incident immediately, following the appropriate procedures indicated below.

B. Handling and Reporting All Employee (including student employee) Injuries:

1. If non-emergency medical treatment is required, have the injured person go to Student Health Services Room 119 at 60 Lafayette St. Bridgeport, CT from 8:30 am - 4:30 pm Monday- Friday.
2. After hours, the employee can report to their local emergency room or to Concentra Medical Centers. Call UB Campus Security to report all injuries that happen on campus and in the event on- site assistance is needed. Faculty or staff members should NOT attempt to transport the injured person.

*If the injured employee/student employee chooses to see their own physician, they will be responsible for any expenses incurred.

3. Give a detailed account of the incident including name of injured person, date, time, location, injury, description of what happened, the names of any witnesses and the phone number of the injured person's supervisor.

C. Handling and Reporting All Student Injuries:

1. Encourage the injured person to seek medical treatment if appropriate. The student may contact UB Student Health Services at 203-576-4712 or go to Health Sciences Center, 60 Lafayette Street, Room 116, Bridgeport, CT 06604 from 8:30 am - 4:30 pm Monday-Friday.
2. If the injured student is unable to transport him or herself for treatment, phone Campus Security for on-site assistance. Faculty and staff members should NOT attempt to transport the injured student.
3. Faculty or staff members providing assistance should inform the injured student that he/she is responsible for all medical expenses. The injured student should submit related medical bills to his/her own insurance company for coverage. DO NOT promise that bills will be paid by the University.
4. The injury should be reported to Security by the faculty or staff member providing assistance or by the student.

D. Handling and Reporting All Visitors (including students from other Universities) or Vendor Injuries:

1. Campus Security should be notified. If appropriate, encourage the injured person to seek medical treatment with any off-campus medical provider.
2. If the injured person is unable to transport him or herself for treatment, phone campus security 203-576-4911 for on-site assistance. Faculty and staff members should NOT attempt to transport the injured person.
3. Injured individuals will be responsible for their own medical expenses. They should submit related medical bills to their own insurance company for coverage. DO NOT promise that bills will be paid by the University.
4. The injured individual or Faculty or staff member providing assistance must report the injury to Campus Security.

2.13 Incident Reporting and Review

In the event of an incident that falls under any of the categories in this section, an incident report sheet shall be filled out under the supervision of the Department Chair or Department Chemical Hygiene Officer or designee. The incident report shall be filed with the Department of Security with a copy of the incident report forwarded to the University Safety Committee (send to the Administrative Assistant to the V.P. of Administration and Finance) for review. Copies shall also be provided to the Associate Vice President for Facilities and the Director of Human Resources. Depending on the nature and severity of the incident, this review will take place as soon as possible after the incident or at the next regularly scheduled meeting of the Safety and Health Committee.

2.13a General Reminders:

- NEVER CLEAN UP BLOOD OR FLUIDS CONTAINING BLOOD YOURSELF. Call Campus Security to arrange for cleanup.
- In all chemical exposure situations, the treating medical facility will be expecting a copy of the Material Safety Data Sheet (MSDS). The department must send them the MSDS immediately or as soon as reasonably possible following a chemical exposure-preferably by e-mail/fax or with the injured person.
- In non-emergency situations, if the injured person is unable to transport self, call campus Security to arrange for transportation of the individual.
- In all situations, it is the injured person's right to deny transportation and/or treatment. The injured person may seek treatment with the medical provider of his/her choice.
- If you are in doubt about how to handle the situation, call Student Health Services at 203-576-4712 or Campus Security at 203-576-4911 for assistance.
- Anyone who is exposed or thinks they may have been exposed to blood should contact Student Health Services 203-576-4712 for instructions.

If you have questions or comments about these procedures, please contact:
Student Health Services 203-576-4712
Campus Security 203-576-4911
Human Resources at 203-576-4731

SECTION 3: PRIOR APPROVAL MATERIALS AND CHEMICALS

Approval Need

The high hazardous nature of some chemicals demands that special handling and disposal techniques be used. Before beginning any laboratory operation, the supervisor or instructor must review MSDS for each chemical that they are unfamiliar with to determine precautions and waste disposal implications and methods.

3.01 Radioactive Materials

UB does not allow the purchase or presence on campus of any radioactive materials that are above the minimum threshold levels allowed by law.

3.02 Carcinogen/Potential Carcinogens

SCOPE – This section deals specifically with those substance evaluated by either the International Agency for Research on Cancer (IARC) or the National Toxicology Program (NTP- and found to be a carcinogen or potential carcinogen or is regulated by the Occupational Safety and Health Administration (OSHA) as a carcinogen.

WORK AREAS – Since carcinogens or potential carcinogens are rarely used in the Laboratory, construction and maintenance of a regulated area to which access is strictly restricted is not economically feasible. Laboratory supervision will designate specific areas in each Department in which materials judged to be carcinogens or potential carcinogens will be used. These areas will be equipped with properly operating fume hoods, glove boxes, or equivalent containment

devices. It is the responsibility of the personnel using the hood personnel, including supervision, shall not be permitted access to a restricted area for any length of time, unless they comply fully with all requirements for protective equipment.

WASTE DISPOSAL – Waste carcinogens or potential carcinogens will be placed in clearly labeled containers including accumulation start date and hazard class, approved by the Chemical Hygiene Officer for such containment. Carcinogen or potential carcinogen-contaminated waste (e.g. reaction residues, toweling, etc.) will be placed in a separate container, clearly labeled and approved for such containment by the Chemical Hygiene Officer. The containers will be removed from the Laboratory and be disposed of by the Chemical Hygiene Officer as soon as possible after completion of testing and subsequent cleanup. If the containers must be kept in the Laboratory overnight, they must be placed in a locked room designated by the such materials. A sign stating that carcinogenic or potentially carcinogenic materials are being stored in the room must be posted in the area and be clearly visible to personnel approaching the room whenever such materials are therein contained.

PERSONAL HYGIENE – Laboratory personnel will be instructed in proper safety and housekeeping procedures. Prior to procuring a carcinogen or potential carcinogen from any source either inside or outside. Laboratory personnel must prepare a detailed plan for setting up the apparatus, and conducting the test or experiment, handling the subject materials during the test or experiment, decontamination of apparatus and materials after the text, and removal of any carcinogenic or potentially carcinogenic materials from the Laboratory after completion of testing. The plan must be approved by the Chemical Hygiene Officer, before any work can commence.

3.03 Reproductive Hazards

A reproductive toxin is a chemical that (a) affects human reproductive capabilities including chromosomal damage (mutagens) or (b) effects a fetus (teratogens). A mutagen affects the chromosome chains of exposed cells. The effect may be hereditary and become part of the genetic pool passed on to future generations. A teratogen (embryo toxic or fetotoxic agent) is an agent that interferes with normal embryonic development without damage to the mother or lethal effects on the fetus. Teratogenic affects are not hereditary.

3.04 Highly Toxic Chemicals

Acutely toxic chemicals are substances falling into any of the following categories:

- A chemical that has a median lethal dose (LD50) of 50 mg or less per kg of body weight, when administered to albino rats weighing 200 to 300 g each.
- A chemical that has a median lethal dose (LD50) of 200 mg or less per kg of body weight, when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) to the bare skin of albino rabbits weighing 2 and 3 kg each.
- A chemical that has a median lethal concentration (LC50) in air of 200 parts per million by volume or less of gas or vapor, or 2 mg per liter or less of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing 200 to 300 g each.

RESPIRATOR USE:
When the use of respirators is necessary to maintain exposure below PELs, the employer shall provide, at no cost to the employee, the proper respiratory equipment. Respirators shall be selected and used in accordance with the requirements of 29CFR1910.134.

SECTION 4: REFERENCES AND SOURCES OF INFORMATION

Appendices

The following is a sample of references that may be available:

1. Guidebook for Science Safety in Illinois , Illinois State Board of Education Center for Educational Innovation and reform, 1995.
   Toxic and Hazardous Chemicals in Industry , Science Related Materials Inc., 1980.
2. Hazardous Laboratory Chemicals Disposal Guide , Margaret-Ann Armour, CRC, 2nd edition, 1996.
3. Destruction of Hazardous Chemicals in the Laboratory , George Lunn and Eric Sansone, 2nd edition, Wiley, 1994.
4. Prudent Practices in the Laboratory: Handling and Disposal of Chemicals , National Academy Press, 1995.
5. Safe Storage of Laboratory Chemicals , David Pipitone, editor, 2nd edition, Wiley, 1991.
6. Safety in Working with Chemicals , Michael Green and Amos Turk, Macmillan Publishing Co., Inc., 1978.
7. Handbook of Organic Industrial Solvents , Technical Guide # 6, 5th edition, Alliance of American Insurers, 1980.
8. Handbook of Hazardous Materials , Technical Guide # 7, 2nd edition, Alliance of American Insurers, 1983.
9. Handbook of Laboratory Safety , Norman Steere, editor, CRC, 2nd edition 1971.
10. Academic Laboratory Chemical Hazards Guidebook , William Mahn, Van Nostrand Reinhold, 1991.
11. Fundamentals of Laboratory Safety: Physical Hazards in the Academic Laboratory , William Mahn, Van Nostrand Reinhold, 1991.
12. NTP (National Toxicology Program). 2021. Report on Carcinogens, Fifteenth Edition. Research Triangle Park, NC: U.S. Department of Health and Human Services, Public Health Service. https://ntp.niehs.nih.gov/go/roc15 (EndNote XML)
    DOI: https://doi.org/10.22427/NTP-OTHER-1003

APPENDIX A. Poisonous Gases

The gases on this list are either on the Department of Transportation's Category 1 list, or the Linde Specialty Gases company's Group 6 - Very Poisonous list. These chemicals are highly toxic gases at ambient temperature and pressure. They have an extremely high potential for causing significant harm if not adequately controlled.

Arsine	Boron trichloride	Chlorine pentafluoride
Chlorine trifluoride	Cyanogen	Cyanogen chloride
Diborane	Dinitrogen tetroxide	Fluorine
Germane	Hydrogen selenide	Nitric oxide
Nitrogen dioxide	Nitrogen trioxide	Nitrosyl chloride
Oxygen difluoride	Phosgene	Phosphine
Phosphorus pentafluoride	Selenium hexafluoride	Stibine
Sulfur tetrafluoride	Tellurium Hexafluoride	Tetraethyldithiopyrophosphate
Tetraethylpyrophosphate		

Guidance: Other chemicals may be added to this list: for example, sulfur- containing compounds such as mercaptans can cause significant odor problems when used in the laboratory. Pre-approval of the conditions under which they can be used may prevent odor complaints.

APPENDIX B. Shock Sensitive Chemicals

The classes of chemicals listed below may explode when subjected to shock or friction. Therefore, users must have appropriate laboratory equipment, information, knowledge and training to use these compounds safely.

- Acetylenic compounds, especially polyacetylenes, haloacetylenes, and heavy metal salts of acetylenes (copper, silver, and mercury salts are particularly sensitive)
- Acyl nitrates
- Alkyl nitrates, particularly polyol nitrates such as nitrocellulose and nitroglycerine
- Alkyl and acyl nitrites
- Alkyl perchlorates
- Amminemetal oxosalts: metal compounds with coordinated ammonia, hydrazine, or similar nitrogenous donors and ionic perchlorate, nitrate, permanganate, or other oxidizing group
- Azides, including metal, nonmetal, and organic azides
- Chlorite salts of metals, such as $AgClO_2$ and $Hg(ClO_2)2$
- Diazo compounds such as CH_2N_2
- Diazonium salts, when dry
- Fulminates such as mercury fulminate ($Hg(CNO)_2$)
- Hydrogen peroxide (which becomes increasingly treacherous as the concentration rises above 3.0%, forming explosive mixtures with organic materials and decomposing violently in the presence of traces of transition metals
- N-Halogen compounds such as difluoroamino compounds and halogen azides
- N-Nitro compounds such as N-nitromethylamine, nitrourea, nitroguanidine, and nitric amide
- Oxo salts of nitrogenous bases: perchlorates, dichromates, nitrates, iodates, chlorites, chlorates, and permanganates of ammonia, amines, hydroxylamine, guanidine, etc.
- Perchlorate salts (which can form when perchloric acid mists dry in fume hoods or associated duct work. Most metal, nonmetal, and amine perchlorates can be detonated and may undergo violent reaction in contact with combustible materials)
- Peroxides and hydroperoxides, organic
- Peroxides (solid) that crystallize from or are left from evaporation of peroxidizable solvents (see the following Section 3)
- Peroxides, transition-metal salts
- Picrates, especially salts of transition and heavy metals, such as Ni, Pb, Hg, Cu, and Zn
- Polynitroalkyl compounds such as tetranitromethane and dinitroacetonitrile
- Polynitroaromatic compounds especially polynitrohydrocarbons, phenols, and amines (e.g., dinitrotoluene, trinitrotoluene, and picric acid)

Note: Perchloric acid must be used only in specially-designed perchloric acid fume hoods that have built-in wash down systems to remove shock-sensitive deposits. Before purchasing this acid, laboratory supervisors must arrange for use of an approved perchloric acid hood.

Appendix C. Pyrophoric Chemicals

The classes of chemicals listed below will readily oxidize and ignite spontaneously in air. Therefore, users must demonstrate to the department that they have the appropriate laboratory equipment, information, knowledge and training to use these compounds safely.

- Grignard reagents, RMgX
- Metal alkyls and aryls, such as RLi, RNa, R_3Al, R_2Zn
- Metal carbonyls such as $Ni(CO)_4$, $Fe(CO)_5$, $Co_2(CO)_8$
- Alkali metals such as Na, K
- Metal powders, such as Al, Co, Fe, Mg, Mn, Pd, Pt, Ti, Sn, Zn, Zr
- Metal hydrides such as NaH, $LiAlH_4$
- Nonmetal hydrides, such as B_2H_6 and other boranes, PH_3, AsH_3
- Nonmetal alkyls, such as R_3B, R_3P, R_3As
- Phosphorus (white)

APPENDIX D. Peroxide-Forming Chemicals

The chemicals listed below can form explosive peroxide crystals on exposure to air, and therefore require special handling procedures after the container is opened. Some of the chemicals form peroxides that are violently explosive in concentrated solution or as solids, and therefore should never be evaporated to dryness. Others are polymerizable unsaturated compounds and can initiate a runaway, explosive polymerization reaction. All peroxidizable compounds should be stored away from heat and light. They should be protected from physical damage and ignition sources. A warning label should be affixed to all peroxidizable materials to indicate the date of receipt and the date the container was first opened. Due to these special handling requirements, users must have the appropriate laboratory equipment, information, knowledge and training to use these compounds safely.

i. Severe Peroxide Hazard with Exposure to Air (discard within 3 months from opening)

- diisopropyl ether (isopropyl ether)
- divinylacetylene (DVA)
- vinylidene chloride (1,1-dichloroethylene)
- potassium metal
- sodium amide (sodamide)
- potassium amide

ii. Peroxide Hazard on Concentration

Do not distill or evaporate without first testing for the presence of peroxides (discard or test for

peroxides after 6 months)

- acetaldehyde diethyl acetal (acetal)
- cumene (isopropylbenzene)
- cyclohexene
- cyclopentene
- decalin (decahydronaphthalene)
- diacetylene (butadiene)
- dicyclopentadiene
- diethyl ether (ether)
- diethylene glycol dimethyl ether (diglyme)
- dioxane
- ethylene glycol dimethyl ether (glyme)
- ethylene glycol ether acetates
- ethylene glycol monoethers (cellosolves)
- furan
- methylacetylene
- methylcyclopentane
- methyl isobutyl ketone
- tetrahydrofuran (THF)
- tetralin (tetrahydronaphthalene)
- vinyl ethers

iii. Hazard of Rapid Polymerization Initiated by Internally-Formed Peroxides

Liquids (discard or test for peroxides after 6 months)

- chloroprene (2-chloro-1,3-butadiene)
- vinyl acetate
- styrene
- vinylpyridine

Gases (discard after 12 months)

- butadiene
- vinylacetylene (MVA)
- tetrafluoroethylene (TFE)
- vinyl chloride

APPENDIX E. Incompatible Chemicals

Certain chemicals should not be stored (and cannot be easily/safely mixed) with certain other chemicals due to severe exothermicity of reaction or uncontrolled production of a toxic product. In the event of earth tremor or other unexpected breakage, especially during fire, the consequences of proximal storage of incompatible materials can be fatal to staff, fire fighters, and other emergency responders.

The following list contains examples of incompatibilities. The list should not be considered complete. For complete information about a specific chemical, always consult at least one current Material Safety Data Sheet.

Acetic acid - aldehyde, bases, carbonates, hydroxides, metals, oxidizers, peroxides, phosphates, xylene, chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates

Acetone - Concentrated nitric and sulfuric acid mixtures, acids, amines, oxidizers, plastics

Acetylene - halogens, mercury, potassium, oxidizers, silver, copper Alkali/alkaline earth metals - Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens, aldehydes, ketones, sulfur, plastics, acids

Ammonia (anhydrous) - mercury, calcium hypochlorite, hydrofluoric acid, acids, aldehydes, amides, halogens, heavy metals, oxidizers, plastics, sulfur Ammonium nitrate - acids, alkalis, chloride salts, flammable & combustible materials, metals, organic materials, phosphorous, reducing agents, urea, chlorates, sulfur

Aniline - acids, aluminum, dibenzoyl peroxide, oxidizers, plastics, Arsenical materials - Any reducing agent

Azides -acids, heavy metals, oxidizers

Bromine -acetaldehyde, alcohols, alkalis, ammonia, amines, petroleum gases, combustible materials, ethylene, fluorine, hydrogen, ketones (acetone, carbonyls, etc.), metals, sodium carbide, sulfur

Calcium oxide -water, acids, ethanol, fluorine, organic materials

Carbon (activated) -alkali metals, calcium hypochlorite, halogens, oxidizers Carbon tetrachloride -Sodium

Chlorates -finely divided organic or combustible materials ammonium salts, acids, powdered metals, sulfur, Chlorine-acetylene, alcohols, ammonia, benzene, butadiene, butane, combustible materials, ethylene, flammable compounds (hydrazine), hydrocarbons (acetylene, hydrogen, hydrogen peroxide, iodine, metals, methane, nitrogen, oxygen, propane (or other petroleum gases), sodium carbide, sodium hydroxide Chlorine dioxide -hydrogen, mercury, organic materials, phosphorus, potassium hydroxide, sulfur, methane, phosphine, ammonia, methane, phosphine, hydrogen sulfide

Chromic acid, chromic oxide - acetone, alcohols, alkalis, ammonia, bases, acetic acid, naphthalene, camphor, glycerin, flammable liquids in general, naphthalene, camphor, glycerol, benzene, hydrocarbons, metals, organic materials, phosphorus, plastics

Copper - calcium, hydrocarbons, oxidizers, acetylene, hydrogen peroxide Cumene - hydroperoxide acids (organic or inorganic)

Cyanides -acids, alkaloids, aluminum, iodine, oxidizers, strong bases Flammable liquids - ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens, oxygen, oxidizers in general

Fluorine - All other chemicals

Hydrocarbons (liq and gas) -see flammable liquids Hydrocyanic acid -nitric acid, alkali

Hydrofluoric acid -metals, organic materials, plastics, silica (glass, including fiberglass), sodium, ammonia

Hydrogen peroxide -all organics, nitric acid, phosphorous, sulfuric acid, sodium, most metals

or their salts
Hydrogen sulfide-acetylaldehyde, metals, oxidizers, sodium, fuming nitric acid
Hydroperoxide-reducing agents Hypochlorites-acids,
activated carbon
Iodine - acetylaldehyde, acetylene, ammonia, metals, sodium, hydrogen Mercury - acetylene, aluminum, amines, ammonia, calcium, fulminic acid, lithium, oxidizers, sodium
Nitric acid - acids, nitrites, metals, sulfur, sulfuric acid , most organics, plastics, sodium
Nitrites - acids
Nitroparaffins - inorganic bases, amines
Oxalic acid - oxidizers, silver, mercury, sodium chlorite
Oxygen - all flammable & combustible materials, oil, grease, ammonia, carbon monoxide, metals, phosphorous, polymers
Perchloric acid - all organics, wood, paper, oil, grease, dehydrating agents, hydrogen halides, iodides, bismuth and alloys
Peroxides, - organic Acids (organic or mineral), avoid friction, store cold Phosphorus (white) - oxygen, air, alkalis, reducing agents
Potassium chlorate - acids, ammonia, combustible materials, fluorine, hydrocarbons, metals, organic materials, sugars, reducing agents Potassium perchlorate - alcohols, combustible materials, fluorine, hydrazine, metals, organic matter, reducing agents, sulfuric acid
Potassium permanganate - benzaldehyde, ethylene glycol, glycerol, sulfuric acid
Selenides - Reducing agents
Silver Acetylene, oxalic acid, tartartic acid, ammonium compounds, fulminic acid, ozonides, peroxyformic acid
Sodium - Carbon tetrachloride, carbon dioxide, water, acids, hydrazine, metals, oxidizers
Sodium nitrate - acetic anhydride, acids, metals, organic matter, peroxyformic acid, reducing agents
Sodium peroxide - Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural, benzene, hydrogen sulfide metals, oxidizers, peroxyformic acid, phosphorous, reducing agents, sugars, water
Sulfides - acids
Sulfuric acid - alcohols, bases, chlorates, perchlorates, permanganates of potassium, lithium, sodium, magnesium, calcium
Tellurides - Reducing agents

Reference: Guide for Safety in the Chemical Laboratory, 2nd ed., Manufacturing Chemists' Association, Van Nostrand Reinhold: New York, 1972, pp. 215-217, Safety in Academic Chemistry Laboratories, ACS 6th ed. 1995, and various MSDSs and chemical container labels.

APPENDIX F. Carcinogens, Reproductive Toxins or Highly Toxic Chemicals

The chemicals listed below are extremely hazardous. Workers must have knowledge of the dangers of these chemicals prior to use, and documentation of training in safe working procedures.

Biologically active compounds

- protease inhibitors (e.g. PMSF, Aprotin, Pepstatin A, Leopeptin);
- protein synthesis inhibitors (e.g. cycloheximide, Puromycin);
- transcriptional inhibitors (e.g. a-amanitin and actinomycin D);
- DNA synthesis inhibitors (e.g. hydroxyurea, nucleotide analogs (i.e. dideoxy nucleotides), actinomycin D, acidicolin);
- phosphatase inhibitors (e.g. okadaic acid);
- respiratory chain inhibitors (e.g. sodium azide);
- kinase inhibitors (e.g. NaF);
- mitogenic inhibitors (e.g. colcemid); and
- mitogenic compounds (e.g. concanavalin A).

Castor bean (Ricinus communis) lectin: Ricin A, Ricin B, RCA toxins

Diisopropyl fluorophosphate: highly toxic cholinesterase inhibitor; the antidote, atropine sulfate and 2-PAM (2-pyridinealdoxime methiodide) must be readily available

Jaquirity bean lectin (Abrus precatorius)

N-methyl-N'-nitro-N-nitrosoguanidine: carcinogen (this chemical forms explosive compounds upon degradation)

Phalloidin from Amanita Phalloides: used for staining actin filaments Retinoids: potential

human teratogens

Streptozotocin: potential human carcinogen

Urethane (ethyl carbamate): an anesthetic agent, potent carcinogen and strong teratogen, volatile at room temperature

APPENDIX G. U.S. Department of Health and Human services, Public Health Service. Report on Carcinogens, Fifteenth Edition.

Substances Listed in the Fifteenth Report on Carcinogens

Bold entries indicate new or changed listings in the Fifteenth Report on Carcinogens.

Known To Be Human Carcinogens

Aflatoxins
Alcoholic Beverage Consumption
4-Aminobiphenyl
Analgesic Mixtures Containing Phenacetin (see Phenacetin and Analgesic Mixtures Containing Phenacetin)
Aristolochic Acids
Arsenic and Inorganic Arsenic Compounds
Asbestos
Azathioprine
Benzene
Benzidine (see Benzidine and Dyes Metabolized to Benzidine)
Beryllium and Beryllium Compounds
Bis(chloromethyl) Ether and Technical-Grade Chloromethyl Methyl Ether
1,3-Butadiene
1,4-Butanediol Dimethanesulfonate
Cadmium and Cadmium Compounds
Chlorambucil
1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea (see Nitrosourea Chemotherapeutic Agents)
Chromium Hexavalent Compounds
Coal Tars and Coal-Tar Pitches
Coke-Oven Emissions
Cyclophosphamide
Cyclosporin A
Diethylstilbestrol
Dyes Metabolized to Benzidine (Benzidine Dye Class) (see Benzidine and Dyes Metabolized to Benzidine)
Epstein-Barr Virus (see Viruses: Eight Listings)
Erionite
Estrogens, Steroidal
Ethylene Oxide
Formaldehyde
***Helicobacter pylori* (Chronic Infection)**
Hepatitis B Virus (see Viruses: Eight Listings)
Hepatitis C Virus (see Viruses: Eight Listings)
Human Immunodeficiency Virus Type 1 (see Viruses: Eight Listings)
Human Papillomaviruses: Some Genital-Mucosal Types (see Viruses: Eight Listings)
Human T-Cell Lymphotrophic Virus Type 1 (see Viruses: Eight Listings)
Kaposi Sarcoma–Associated Herpesvirus (see Viruses: Eight Listings)
Melphalan
Merkel Cell Polyomavirus (see Viruses: Eight Listings)
Methoxsalen with Ultraviolet A Therapy
Mineral Oils: Untreated and Mildly Treated
Mustard Gas
2-Naphthylamine
Neutrons (see Ionizing Radiation)
Nickel Compounds (see Nickel Compounds and Metallic Nickel)
Radon (see Ionizing Radiation)
Silica, Crystalline (Respirable Size)
Solar Radiation (see Ultraviolet Radiation Related Exposures)
Soots

Strong Inorganic Acid Mists Containing Sulfuric Acid
Sunlamps or Sunbeds, Exposure to (see Ultraviolet Radiation Related Exposures)
Tamoxifen
2,3,7,8-Tetrachlorodibenzo-*p*-dioxin
Thiotepa
Thorium Dioxide (see Ionizing Radiation)
Tobacco Smoke, Environmental (see Tobacco-Related Exposures)
Tobacco Smoking (see Tobacco-Related Exposures)
Tobacco, Smokeless (see Tobacco-Related Exposures)
o-Toluidine
Trichloroethylene
Ultraviolet Radiation, Broad-Spectrum (see Ultraviolet Radiation Related Exposures)
Vinyl Chloride (see Vinyl Halides [selected])
Wood Dust
X-Radiation and Gamma Radiation (see Ionizing Radiation)

Reasonably Anticipated To Be Human Carcinogens

Acetaldehyde
2-Acetylaminofluorene
Acrylamide
Acrylonitrile
Adriamycin
2-Aminoanthraquinone
o-Aminoazotoluene
1-Amino-2,4-dibromoanthraquinone
2-Amino-3,4-dimethylimidazo[4,5-*f*]quinoline (see Heterocyclic Amines [Selected])
2-Amino-3,8-dimethylimidazo[4,5-*f*]quinoxaline (see Heterocyclic Amines [Selected])
1-Amino-2-methylanthraquinone
2-Amino-3-methylimidazo[4,5-*f*]quinoline (see Heterocyclic Amines [Selected])
2-Amino-1-methyl-6-phenylimidazo[4,5-*b*]pyridine (see Heterocyclic Amines [Selected])
Amitrole
o-Anisidine and Its Hydrochloride
Antimony Trioxide
Azacitidine
Basic Red 9 Monohydrochloride
Benz[*a*]anthracene (see Polycyclic Aromatic Hydrocarbons: 15 Listings)
Benzo[*b*]fluoranthene (see Polycyclic Aromatic Hydrocarbons: 15 Listings)
Benzo[*j*]fluoranthene (see Polycyclic Aromatic Hydrocarbons: 15 Listings)
Benzo[*k*]fluoranthene (see Polycyclic Aromatic Hydrocarbons: 15 Listings)
Benzo[*a*]pyrene (see Polycyclic Aromatic Hydrocarbons: 15 Listings)
Benzotrichloride
2,2-Bis(bromomethyl)-1,3-propanediol (Technical Grade)
Bis(chloroethyl) Nitrosourea (see Nitrosourea Chemotherapeutic Agents)
Bromochloroacetic Acid (see Haloacetic Acids Found as Water Disinfection By-Products [Selected])
Bromodichloroacetic Acid (see Haloacetic Acids Found as Water Disinfection By-Products [Selected])
Bromodichloromethane
1-Bromopropane
Butylated Hydroxyanisole
Captafol
Carbon Tetrachloride
Ceramic Fibers (Respirable Size)
Chloramphenicol
Chlorendic Acid

Chlorinated Paraffins (C_{12}, 60% Chlorine)
Chlorodibromoacetic Acid (see Haloacetic Acids Found as Water Disinfection By-Products [Selected])
1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea (see Nitrosourea Chemotherapeutic Agents)
Chloroform
3-Chloro-2-methylpropene
4-Chloro-*o*-phenylenediamine
Chloroprene
p-Chloro-*o*-toluidine and Its Hydrochloride
Chlorozotocin (see Nitrosourea Chemotherapeutic Agents)
Cisplatin
Cobalt and Cobalt Compounds That Release Cobalt Ions *In Vivo* (see Cobalt-Related Exposures)
Cobalt–Tungsten Carbide: Powders and Hard Metals (see Cobalt-Related Exposures)
p-Cresidine
Cumene
Cupferron
Dacarbazine
Danthron
2,4-Diaminoanisole Sulfate
2,4-Diaminotoluene
Diazoaminobenzene
Dibenz[*a,h*]acridine (see Polycyclic Aromatic Hydrocarbons: 15 Listings)
Dibenz[*a,j*]acridine (see Polycyclic Aromatic Hydrocarbons: 15 Listings)
Dibenz[*a,h*]anthracene (see Polycyclic Aromatic Hydrocarbons: 15 Listings)
7H-Dibenzo[*c,g*]carbazole (see Polycyclic Aromatic Hydrocarbons: 15 Listings)
Dibenzo[*a,e*]pyrene (see Polycyclic Aromatic Hydrocarbons: 15 Listings)
Dibenzo[*a,h*]pyrene (see Polycyclic Aromatic Hydrocarbons: 15 Listings)
Dibenzo[*a,i*]pyrene (see Polycyclic Aromatic Hydrocarbons: 15 Listings)
Dibenzo[*a,l*]pyrene (see Polycyclic Aromatic Hydrocarbons: 15 Listings)
Dibromoacetic Acid (see Haloacetic Acids Found as Water Disinfection By-Products [Selected])
1,2-Dibromo-3-chloropropane
1,2-Dibromoethane
2,3-Dibromo-1-propanol
Dichloroacetic Acid (see Haloacetic Acids Found as Water Disinfection By-Products [Selected])
1,4-Dichlorobenzene
3,3′-Dichlorobenzidine and Its Dihydrochloride
Dichlorodiphenyltrichloroethane
1,2-Dichloroethane
Dichloromethane
1,3-Dichloropropene (Technical Grade)
Diepoxybutane
Diesel Exhaust Particulates
Di(2-ethylhexyl) Phthalate
Diethyl Sulfate
Diglycidyl Resorcinol Ether
3,3′-Dimethoxybenzidine (see 3,3′-Dimethoxybenzidine and Dyes Metabolized to 3,3′-Dimethoxybenzidine)
4-Dimethylaminoazobenzene
3,3′-Dimethylbenzidine (see 3,3′-Dimethylbenzidine and Dyes Metabolized to 3,3′-Dimethylbenzidine)
Dimethylcarbamoyl Chloride
1,1-Dimethylhydrazine
Dimethyl Sulfate
Dimethylvinyl Chloride
1,6-Dinitropyrene (see Nitroarenes [Selected])
1,8-Dinitropyrene (see Nitroarenes [Selected])

1,4-Dioxane
Disperse Blue 1
Dyes Metabolized to 3,3′-Dimethoxybenzidine (3,3′-Dimethoxybenzidine Dye Class)
(see 3,3′-Dimethoxybenzidine and Dyes Metabolized to 3,3′-Dimethoxybenzidine)
Dyes Metabolized to 3,3′-Dimethylbenzidine (3,3′-Dimethylbenzidine Dye Class)
(see 3,3′-Dimethylbenzidine and Dyes Metabolized to 3,3′-Dimethylbenzidine)
Epichlorohydrin
Ethylene Thiourea
Ethyl Methanesulfonate
Furan
Glass Wool Fibers (Inhalable), Certain
Glycidol
Hexachlorobenzene
Hexachloroethane
Hexamethylphosphoramide
Hydrazine and Hydrazine Sulfate
Hydrazobenzene
Indeno[1,2,3-*cd*]pyrene (see Polycyclic Aromatic Hydrocarbons: 15 Listings)
Iron Dextran Complex
Isoprene
Kepone
Lead and Lead Compounds
Lindane, Hexachlorocyclohexane (Technical Grade), and Other Hexachlorocyclohexane Isomers
2-Methylaziridine
5-Methylchrysene (see Polycyclic Aromatic Hydrocarbons: 15 Listings)
4,4′-Methylenebis(2-chloroaniline)
4,4′-Methylenebis(*N*,*N*-dimethyl)benzenamine
4,4′-Methylenedianiline and Its Dihydrochloride
Methyleugenol
Methyl Methanesulfonate
N-Methyl-*N*′-Nitro-*N*-Nitrosoguanidine (see *N*-Nitrosamines: 15 Listings)
Metronidazole
Michler's Ketone
Mirex
Naphthalene
Nickel, Metallic (see Nickel Compounds and Metallic Nickel)
Nitrilotriacetic Acid
o-Nitroanisole
Nitrobenzene
6-Nitrochrysene (see Nitroarenes [Selected])
Nitrofen
Nitrogen Mustard Hydrochloride
Nitromethane
2-Nitropropane
1-Nitropyrene (see Nitroarenes [Selected])
4-Nitropyrene (see Nitroarenes [Selected])
N-Nitrosodi-*n*-butylamine (see *N*-Nitrosamines: 15 Listings)
N-Nitrosodiethanolamine (see *N*-Nitrosamines: 15 Listings)
N-Nitrosodiethylamine (see *N*-Nitrosamines: 15 Listings)
N-Nitrosodimethylamine (see *N*-Nitrosamines: 15 Listings)
N-Nitrosodi-*n*-propylamine (see *N*-Nitrosamines: 15 Listings)
N-Nitroso-*N*-ethylurea (see *N*-Nitrosamines: 15 Listings)
4-(*N*-Nitrosomethylamino)-1-(3-pyridyl)-1-butanone (see *N*-Nitrosamines: 15 Listings)

N-Nitroso-*N*-methylurea (see *N*-Nitrosamines: 15 Listings)
N-Nitrosomethylvinylamine (see *N*-Nitrosamines: 15 Listings)
N-Nitrosomorpholine (see *N*-Nitrosamines: 15 Listings)
N-Nitrosonornicotine (see *N*-Nitrosamines: 15 Listings)
N-Nitrosopiperidine (see *N*-Nitrosamines: 15 Listings)
N-Nitrosopyrrolidine (see *N*-Nitrosamines: 15 Listings)
N-Nitrososarcosine (see *N*-Nitrosamines: 15 Listings)
o-Nitrotoluene
Norethisterone
Ochratoxin A
4,4′-Oxydianiline
Oxymetholone
Pentachlorophenol and By-products of Its Synthesis
Phenacetin (see Phenacetin and Analgesic Mixtures Containing Phenacetin)
Phenazopyridine Hydrochloride
Phenolphthalein
Phenoxybenzamine Hydrochloride
Phenytoin and Phenytoin Sodium
Polybrominated Biphenyls
Polychlorinated Biphenyls
Procarbazine and Its Hydrochloride
Progesterone
1,3-Propane Sultone
β-Propiolactone
Propylene Oxide
Propylthiouracil
Reserpine
Riddelliine
Safrole
Selenium Sulfide
Streptozotocin (see Nitrosourea Chemotherapeutic Agents)
Styrene
Styrene-7,8-oxide
Sulfallate
Tetrachloroethylene
Tetrafluoroethylene
Tetranitromethane
Thioacetamide
4,4′-Thiodianiline
Thiourea
Toluene Diisocyanates
Toxaphene
Tribromoacetic Acid (see Haloacetic Acids Found as Water Disinfection By-Products [Selected])
2,4,6-Trichlorophenol
1,2,3-Trichloropropane
Tris(2,3-dibromopropyl) Phosphate
Ultraviolet Radiation A (see Ultraviolet Radiation Related Exposures)
Ultraviolet Radiation B (see Ultraviolet Radiation Related Exposures)
Ultraviolet Radiation C (see Ultraviolet Radiation Related Exposures)
Urethane
Vinyl Bromide (see Vinyl Halides [Selected])
4-Vinyl-1-cyclohexene Diepoxide
Vinyl Fluoride (see Vinyl Halides [Selected])

Reference: National Toxicology Program, US Department of Health and Human Services. https://ntp.niehs.nih.gov/publications/index.html