# Carnegie Mellon University- Qatar
# Policy and Procedures on Occupational Exposure to Hazardous Chemicals in Laboratories
# 29 CFR 1910.1450

Prepared by:

Environmental Health and Safety Department – Pittsburgh

And

Chemical Safety-Doha

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This plan is available in the Doha Chemical Safety Guidelines at
https://www.cmu.edu/ehs/Guidelines/index.html#chem

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# Carnegie Mellon University – Qatar
# Policy and Procedures on Occupational Exposure to Hazardous Chemicals in Laboratories

## Introduction: Purpose and Policy

***Purpose***

This is a statement of official University policy to establish the process for compliance with the Occupational Safety and Health Administration (OSHA) regulation "Occupational Exposure to Hazardous Chemicals in Laboratories." The purpose of the process is to protect employees from the health hazards of the hazardous chemicals in their laboratories and to keep chemical exposures below the OSHA Permissible Exposure Limit (PEL).

***Policy***

Carnegie Mellon University is dedicated to providing safe and healthy laboratory facilities for students and employees, and to comply with federal and state occupational health and safety standards. Laboratory administrators, managers, faculty, staff and students all share responsibility for minimizing their exposures to hazardous chemical substances. Lab workers must not be exposed to substances in excess of the permissible exposure limits (PEL) specified in OSHA rule 29 CFR 1910, Subpart Z, Toxic and Hazardous Substances.

The standard applies where "laboratory use" of hazardous chemicals occurs. OSHA defines laboratory use as handling or use of chemicals on a "laboratory scale". "Laboratory Scale" is when the work involves containers which can easily and safely be manipulated by one person, when multiple chemical procedures or chemical substances are used, and when protective laboratory practices and equipment are available and in common use to minimize the potential for employee exposures to hazardous chemicals.

The Chemical Hygiene Plan (CHP) shall be reviewed and evaluated at least annually for its effectiveness, and updated as necessary. It shall be made available to all applicable employees and employee representatives. The CHP is currently located in the Doha Chemical Safety Guidelines at https://www.cmu.edu/ehs/Guidelines/index.html.

Carnegie Mellon's Chemical Hygiene Plan for Qatar (CHP) includes: 1) periodic monitoring of the performance of ventilation systems, 2) periodic safety inspections of laboratories, 3) procedures that ensure that disposal of waste chemicals occurs at regular intervals, and 4) training opportunities for all laboratory workers. Implementation of these CHP procedures is a regular, continuing effort, endorsed by administration and faculty. All Carnegie Mellon University laboratory faculty and staff shall follow its recommendations.

## Responsibilities

***Current Relevant Personnel***

The names and contact information of current relevant personnel in Qatar campus are the following.

***Current Relevant Personnel***

**Chemical Hygiene Officer:** Simon Faulkner
*Email: sfaulkne@andrew.cmu.edu phone: 974 4454 6748*

**Laboratory Manager:** Maria Navarro
*Email: navarrom@qatar.cmu.edu phone: 974 4454 8471*

**Chief Executive Officer and the Dean of CMU-Qatar:** Michael Trick *Email: trick@cmu.edu phone: 974 4454-8420*

**Director of Safety and Security:** Stephen McCarty
*Email: smccarty@andrew.cmu.edu phone: 974 4454 8434*

**Director of Facility Management:** Elissar Hajjar
*Email: ehajjar@qatar.cmu.edu phone: 974 4454 8607*

**Laboratory Supervisors:**

Annette Vincent
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Ihab Younis
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Mahmoud Maksoud
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**Laboratory Support**

Laboratory Education Manager: Maya Kemaldean
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Research Associate II: Bernadette Bernales
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Teaching Assistant: Humera Inayat
*Email: hinayat@andrew.cmu.edu phone: 974 4454 2262*

***Roles and Responsibilities***

**Chief Executive Officer and the Dean of CMU-Qatar**

- The Dean of Carnegie Mellon University Qatar (CMU-Q) has ultimate responsibility for chemical safety at the university and must, with other administrators, provide continuing support for the University's Chemical Hygiene Plan (CHP).
- The CEO is responsible for the continued training of the Chemical Hygiene Officer so they are able to provide appropriate facilities, suppliers, references, instruments, etc., to survey and evaluate safety systems and processes.

**Chemical Hygiene Officer**

The Chemical Hygiene Officer – Qatar (CHO-Q) provides technical guidance, continuing support for the University's CHP and represents the chief academic officer**.**

- Makes the CHP available via electronic means
- Reviews the CHP with EHS-P as needed.
- Directs periodic laboratory safety audits and ensures compliance in response to the audit. (utilizing the SciShield system – checklist guide and documentation.)
- Arranged for exposure assessments if needed upon request or if an employee shows signs or symptoms associated with hazardous chemical exposure.
- Requires timely input and maintenance of the hazardous chemical inventory, specify those chemicals that are particularly hazardous substances (PHS). Ensure the review of the inventory periodically.
- Arranges for the periodic testing of exhaust hoods.
- Routine inspection of laboratory spaces to identify and correct potential safety hazards.
- Post signs on hoods that are not functioning properly.
- Ensure that laboratory employees are familiar with electronic SDS library.

**Director of Safety and Security**

- The Director of Safety and Security shall prepare, review and distribute the University's Emergency Response Plan.
- Arranges for the disposal of hazardous waste.
- Signs all manifests.
- Maintains annual training for waste disposal.
- Remains current on regulatory issues.
- Investigates reported workplace injuries of chemical exposures and incidents and report to Lab Safety Committee.

**Environmental Health & Safety - Pittsburgh**

- Environmental Health & Safety Pittsburgh (EHS-P) assists in the review of CMU-Q's CHP.
- Provides support for the plan's implementation.
- With the CHO-Q, establishes laboratory safety program goals and acceptable performance levels.
- Periodically advises the faculty, Dean and the CHO-Q on safety standards and practices regarding the use of chemicals in laboratories.
- Provides technical assistance and consultation on laboratory safety issues and the creation of safety policies.
- Provides training to laboratory personnel concerning the provisions of the CHP and hazardous waste disposal via teleconferencing.
- Maintains safety-training records of Carnegie Mellon University Qatar personnel.
- Provides approval for the wearing of any air filtering respirators.
- Approves all chemical orders.
- Reviews laboratory audits performed by the CHO-Q.

**Facilities Management**

- The Director of Facility Management in Doha (FM) shall make request the repair of installed laboratory safety equipment and request they receive immediate repair.
- Director of FMS shall request reports from the Qatar Foundation (QF) of their periodic inspections and maintenance of fire extinguishers and laboratory safety equipment.

***Roles and Responsibilities***

**Laboratory Supervisors**

- Implement all provisions of the CHP for laboratory facilities under their control.
- Ensure that appropriate personal protective equipment is available and that it provides adequate protection.
- Ensure that facilities, equipment, and materials are organized for intended use; e.g., corrosive chemicals are near continuous-flow eyewash.
- Ensure preparation, maintenance, implementation and training on written standard operating procedures (SOP) regarding safety and health considerations for each hazardous procedure.
- Require laboratory personnel to obtain specific permission for deviation(s) from an SOP.
- Complete laboratory safety training and ensure that direct reports have received basic lab safety training from EHS-P.
- Train laboratory personnel regarding the specific work practices, and procedures according to the provisions of their laboratories' SOPs.
- Ensure inspections for housekeeping and safety.
- Report all workplace injuries, chemical exposures, incidents, or unsafe conditions to CEO, Director of Safety and Security and EHS-P.
  (*A folder with hard copies of Accident Reporting and Non-Injury Near-Miss Incident Forms can be found in each laboratory.*)
- Maintain a hard copy Material Safety Data Sheets (MSDS) for Particularly Hazardous Substances (PHS) in laboratory facilities under their control.
- Determine where changes in university policies, guidelines and resources are needed to ensure the Chemical Hygiene Plan is implemented effectively.
- Aid in the resolution of issues involving application of safety rules/practices or engineering controls in laboratories.
- Update lists of the employees and students working in their laboratories in SciShield.
- Ensure employees/students have completed all necessary training.
- Maintain a hazardous chemical inventory and review annually in ChemTracker.

**Individual Researchers and Laboratory Users**

- Complete Carnegie Mellon's hazard communication, laboratory safety, and hazardous waste management training via telecom/online from EHS-P.
- Follow Standard Operating Procedures (SOP) and the requirements of the Chemical Hygiene Plan.
- Report all workplace injuries, chemical exposures, incidents, or unsafe conditions to their laboratory supervisors and/or the Director of Safety and Security and Director of Facilities as soon as possible.
- Assist with the maintenance of the inventory of all hazardous chemical substances, and identification of PHS on the inventory. Maintain PHS and SDSs for their laboratory.
- Contact laboratory Supervisor, CHO-Q or EHS-P when safety questions arise.
- Work with laboratory Supervisor to evaluate existing SOPs and develop new SOPs as needed.

## Employee Information and Training

***Training***

The purpose of laboratory safety training is to provide employees with information about the physical and health hazards of the hazardous chemicals in their work area and of the methods and procedures employees should follow to protect themselves from these materials. It is a requirement of OSHA that all laboratory personnel who work with hazardous chemicals are required to have this training. The training occurs at two levels:

- General chemical safety training is provided by the Department of Environmental Health and Safety-Pittsburgh *via* scheduled online training with EHS-P (*Laboratory Safety and Hazardous Waste Management Training*). The employee should receive this training within the first thirty days of a laboratory assignment.
- Laboratory specific training is to be provided by the laboratory supervisor. This training

should be performed and documented before the employee is permitted to work unsupervised in the laboratory.

Refresher training in laboratory safety is to be performed every two years, through either re-attendance at the general initial training class or through the EHS-P refresher training provided via SciShield. Reading the monthly CHO-P newsletter is highly recommended to ensure lab workers stay current with any compliance or safety law changes between two-year periods.
[Note that any personnel involved with the generation of hazardous waste must also attend Hazardous Waste Generator training, also offered by EHS-P concurrently with the Lab Safety Class.]

***Training***

**1. General Chemical Safety Training**

EHS-P will provide training, Laboratory Safety and Hazardous Waste Management, to laboratory workers (e.g., faculty, principal investigators, supervisors, researchers, etc.) within 30 days of their initial assignment to the laboratory work area. Ensuring that each worker obtains the training will be the responsibility of department and laboratory supervisors.

The training will include the following topics.

- This Chemical Hygiene Plan and its content.
- The contents of the OSHA standard (29CFR1910.1450) https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.1450 and its appendices.
- The availability of the Chemical Hygiene Plan.
- Location of reference material on the hazards (including Material Safety Data Sheet/Safety Data Sheets), safe handling, storage, and disposal of hazardous chemicals found in the laboratory.
- Methods and observations that may be used to detect the presence or release of hazardous chemicals.
- Protective measures an employee or student can take to prevent or reduce exposure to a hazardous chemical.
- Emergency response procedures.

Training documentation, including attendees, dates and subjects addressed, shall be maintained by EHS-P.

**2. Laboratory Specific Training**

Laboratory supervisors will ensure that training is provided to laboratory personnel for the procedures/experiments they are performing. This training should be provided before laboratory work begins for the employee. It should include specifics of the hazardous materials to be used and the specific safe work practices for each.

***Information***

**Material Safety Data Sheet/Safety Data Sheets (MSDS/SDS)**

Material Safety Data Sheet/Safety Data Sheets (MSDS/SDSs) are critical elements to a chemical safety program. All laboratory employees should be able to locate, read and understand the relevant MSDS/SDS. Most MSDS documents can be found at https://www.cmu.edu/ehs/sds/index.html. (MSDSonline link).

MSDSonline is a service EHS-P provides to all CMU employees and students that contains over two million MSDS and SDS documents.

Starting in 2012, due to changes in the OSHA Hazard Communication Standard, Materials Safety Data Sheets are correctly called “Safety Data Sheets (SDS.) These MSDS/SDS may have a different format.

**General Information**

Assistance will be provided by EHS-P to any faculty, staff or student requesting guidance or training to satisfy implementation of this policy.

## Control Measures

***Engineering Controls***

The best way to prevent exposure to airborne hazards is to prevent their escape into the working atmosphere by use of hoods and other ventilation devices. Operations such as running reactions, heating or evaporating solvents, and transfer of chemicals from one container to another should be performed in a hood when there is reasonable potential for hazardous material exposure.

**1. General Laboratory Ventilation**

General ventilation must not be relied on to control chemical vapors, gases, and mists

**2. Fume Hoods**

Use the fume hood for operations that might result in release of hazardous chemical vapors, gases, mists, or dusts.

Confirm adequate hood performance before use; typically it is best to maintain the hood sash at a working height of approximately 18 inches; keep materials stored in hoods to a minimum and do not allow them to block air flow.

In the event of ventilation hood failure, stop all experiments within the hood (if possible), lower the sash completely. If there is the possibility of a release of a health hazard the building should be evacuated. Activate the fire alarm and notify the Director of Safety and Security, Director of Facilities and the Chemical Hygiene Officer. If there is no health hazard, the Director of Facilities Management will initiate repairs.

Laboratory hoods shall be provided according to the following specifications.

- Where applicable, the hood shall have a working sash.
- When the hood sash is open approximately eighteen inches, an average face velocity of 80-150 fpm or 170 cubic meters per hour m3/h at the hood face shall be provided.
- The hood enclosure should be fire- and chemical-resistant.
- In new construction, consideration shall be given to locating the hood such that ambient air currents do not unacceptably reduce the containment efficiency of the hood.
- In new construction, the hood shall be designed to produce laminar airflow.
- The hood shall have only modifications approved by EHS-P. Any modification must not detract from the hood performance.
- In new construction, the room in which the hood is located shall have a source of sufficient make-up air to replace the air that is exhausted out.
- All hoods shall have a monitoring device to measure airflow.
- The fume hood should be appropriate for the material used within (e.g., perchloric acid usage requires stainless steel or PVC lined hoods.)
- Airflow shall be such that contaminants within do not escape the fume hood, as shown by a smoke tube test.

Face velocity and airflow monitors will be evaluated by Director of Facilities Management upon installation of laboratory hoods. Each laboratory hood is re-checked periodically by the Chemical Hygiene Officer for usage and performance. Where performance parameters fall outside specifications, a repair request by the Director of Facilities Management to the Qatar Foundation shall be initiated to repair the hood. When appropriate, a notice is placed on the hood

indicating that it is not to be used until its performance is within the specified performance parameters.

Non-venting hoods (e.g., laminar flow hoods with in-room venting) shall be clearly labeled as such. No work with volatile hazardous chemicals shall be performed in hoods that do not vent outdoors.

Laboratory hoods are not to be modified without the involvement of EHS-P. Changes in airflow quantity and airflow patterns can significantly affect laboratory exposure potential. EHS-P and the Director of Facilities Management at CMU-Q will ensure that modifications will not degrade the safety of the laboratory environment. After any hood modification the airflow must be retested to ensure that airflow specifications have been met.

**3. Other Local Ventilation Devices**

***Engineering Controls***

Exhaust air from glove boxes and isolation rooms should release into the hood exhaust system.

Each laboratory should have access to protective apparel and equipment appropriate for the hazards present. Appropriate protective apparel and equipment should be determined by the laboratory supervisor, in consultation with EHS-P. The laboratory supervisor must assure that all persons, including visitors, wear appropriate eye protection where chemicals or hazardous materials are stored or used.

***Personal Protective Equipment***

**1. Respiratory Protection**

Engineering controls should maintain all contaminant levels below the PEL or other applicable standard. When efficient engineering controls are not possible, suitable respiratory protection should be provided. Respirator use must be approved by EHS-P and must follow the Carnegie Mellon- Pittsburgh Respiratory Protection Program. Refer to the Carnegie Mellon University Respiratory Protection Program for further details: https://www.cmu.edu/ehs/Workplace-Construction/documents/RespProtPlan.pdf.

**2. Protective Clothing**

Protective clothing such as chemically-resistant gloves, lab coats, aprons, or suits should be used when working with hazardous materials. Wear a lab coat or an apron specific for the hazards of the procedures performed in the laboratory. This includes, but is not limited to, using flame resistant clothing for use with pyrophorics, acid resistant protection when working with acids (especially HF), and protective items when working with hot or cold materials. The laboratory supervisor is responsible for determining the protective clothing needed. The EHS-P may be consulted as a resource for clothing selection.

Protective clothing should be inspected prior to each use. Laboratory coats should be laundered as needed. The CMU-Q provides a lab coat laundering service. Contact the ***Laboratory Manager*** for further information on this process. Care should be taken to avoid producing further contamination when having the lab coats laundered.

Wear appropriate gloves when the potential for contact with hazardous materials exists. Refer to the SDS for appropriate selection or contact EHS-P for additional information. Inspect the gloves before each use, wash them before removal, and replace them periodically. Gloves should not be worn outside of the laboratory. Disposable gloves should not be reused.

**3. Hearing Protection**

Hearing protection will be provided for anyone working in an area where the sound levels exceed 85 dBa. Measurements can be obtained by use of an iPhone. Contact EHS-P to consult measure noise levels, recommend proper hearing protection, and evaluate the need for noise reduction

engineering controls.

***Personal Protective Equipment***

**4. Eye Protection**

Eye protection is mandatory for all entries into a work area within a laboratory where hazardous chemicals are used. The laboratory supervisor will determine the level of eye protection required. All eye protection used should meet ANSI Z87.1 requirements. EHS-P should be consulted to assist in selecting proper eye protection.

***Standard Operating Procedures***

Standard Operating Procedures prepared by the laboratory should be made available to all applicable laboratory personnel, to the CHO-Q, EHS-P and/or auditors.

***Administrative Controls***

**Chemical Inventory**

All locations where chemicals are stored and/or used must have an accurate inventory of the chemicals, maintained currently in the Carnegie Mellon University's designated program, Chemtracker.

**Housekeeping, Repair, Maintenance and Inspections**

Inspections

The CHO-Q should perform a laboratory safety inspection at least annually to ensure that adequate safety equipment is available and functioning, personal protection is available, chemicals are properly used and stored, MSDS/SDSs are readily accessible and good housekeeping is being practiced. Inspections may be performed more frequently as deemed necessary by EHS-P. Follow-up inspections will be performed as necessary, to confirm completion of corrective actions. The results of these inspections can be viewed online by the laboratory supervisor through SciShield. Access to SciShield is through the EHS-P web site. using one's Andrew ID. The web address for access is:

https://cmu.bioraft.com/

Self-audit

Housekeeping and chemical hygiene inspections for all Laboratories (Chemistry and Biology) are recommended and should be conducted by the laboratory supervisor at least quarterly. Refer to Self-Inspection formats in SciShield website.

Housekeeping and chemical hygiene inspections are done regularly after every laboratory class. Laboratory technicians or Teaching Assistants do the inspections using the approved laboratory checklist. The checklist forms are filed and kept in the laboratory for review by the Laboratory supervisors or CHO-Q, when necessary. Refer to the Appendix in page 26 for the checklist forms.

A door checklist on housekeeping and chemical hygiene inspections is posted in every laboratory. All lab users are reminded to do quick inspection every time they leave the lab.

Repair

The Director of Facilities Management (FM) should be contacted if safety equipment is malfunctioning. Malfunctioning fume hoods should be marked "Do Not Use" if they are to be repaired. If the fume hood is not working properly, it should be labeled "Out of Service". To re-start an "Out of Service" fume hood, contact the Director of FM. Malfunctioning eyewashes and safety showers should be marked "Do Not Use".

Maintenance.

***Administrative Controls***

Laboratory personnel should inspect eyewashes frequently, by operating them until the water runs clear. FM should request and/or coordinate periodic testing of safety showers.

Personal housekeeping

Keep the work area clean and uncluttered, with chemicals and equipment being properly labeled and stored; clean up the work area on completion of an operation and at the end of each day. Stairways and halls should not be used for storage. Access to exits, emergency equipment, and utility controls must never be blocked.

**Usage of laboratories**

Work conducted in Carnegie Mellon laboratories is for research or instructional purposes. Work is laboratory scale in nature, and activities are conducted within the physical limitations of the laboratory facilities and safety equipment, especially the local exhaust systems. EHS-P shall be informed by the laboratory supervisor should chemical usage fall outside of typical laboratory scale operations.

**Working alone**

If possible, avoid working alone in a laboratory. A working definition of "working alone" is only one person in a lab or contiguous space who is working with hazardous materials, hazardous procedures or hazardous equipment. If necessary, working alone in a laboratory requires the Laboratory Supervisor to complete, sign and submit to the EHS-P a "Permission to Work Alone" form, which is available on the EHS-P web site. The permission requires that careful consideration be given to the hazards and potential hazards of the materials present in the laboratory and of the work being performed. Advance planning should be made in these cases to address emergency response procedures and including consideration of when to inform outside parties of the employee's work plan and schedule. Submit all forms to the CHO-Q and EHS-P who will review all Working Alone forms.

**Non-Carnegie Mellon Employees in the laboratory**

Special activities must be performed when persons who are not employees of Carnegie Mellon are present in the laboratory.

*Students*

All students *regardless of age* enrolled in regular or other university-sanctioned classes or related businesses are covered under the universities liability agreements. If these students are under age 18, hazardous material exposure must be minimal, and constant supervision by a staff member of the lab is required, no other action is needed.

*Other persons under age 18*

If the applicable persons are enrolled in an Outreach program, the issue of whether a waiver of liability will be required from the parent or guardian of the person will be decided on a case by case basis. Contact University Counsel for further details and information.

If persons under age 18 are NOT enrolled in an Outreach program or regular university function, as noted above, they are NOT permitted to be in the laboratory where hazardous materials are present.

*Volunteers in the laboratory*

Volunteer workers in the laboratory (who are NOT Carnegie Mellon employees nor students) are NOT permitted. This includes (but is not limited to) children of any age or spouses of employees. Exceptions will be considered on a case by case basis by EHS-P.

*Other Non-Carnegie Mellon Persons*

A formal relationship with the outside personnel must be established in such cases. The employer of this outside worker must have a current agreement with Carnegie Mellon-Qatar addressing the issues of the liability of the worker while at our site. This addresses outside researchers using Carnegie Mellon facilities. The lab or department is responsible to ensure that such an agreement is in place.

Unaccompanied visitors to the laboratories are not permitted (such as sales reps).

*Waivers*
In some of the above circumstances, the university may require waivers to be signed by the outside person (or their parent or guardian (for persons under age 18). It is the responsibility of the laboratory or department to obtain such waivers, in a format approved by University Counsel. Contact Counsel for details.

***Administrative Controls***

*Final Authority*
University Counsel is the final authority on the resolution of all issues associated with non-Carnegie Mellon employees present in the laboratory.

**Other University Safety Programs**

Laboratory personnel who work with biological agents and radiation sources or radiation producing devices, are subject to the requirements of the University's Biological Safety and Radiation Safety Programs, respectively. Further information on each is available at https://www.cmu.edu/ehs/Guidelines/index.html.

## Chemical Usage Procedures

***Minimizing Chemical Exposures***

It is prudent to minimize all chemical exposures by any route, and to observe good laboratory practice by using an exhaust hood, wearing eye and hand protection, and a laboratory coat or apron. The cardinal rule for safety in working with hazardous substances is that all work with these materials in a laboratory should be performed in such a way that they do not enter the body by any mode, including inhalation, absorption or ingestion. Quantities of vapors or dust should be prevented from entering the general laboratory atmosphere. Because few laboratory chemicals are without hazards, general precautions for handling all laboratory chemicals have been adopted in addition to specific guidelines. These general hazards for handling chemicals in the laboratory may be classified broadly as physical or chemical.

Physical hazards include those of fire, explosion or electric shock. Other physical hazards arise from high or low pressure, such as cylinders of compressed gases and experimental vessels, cryogenic equipment, furnaces, refrigerators and glass apparatus.

Chemical hazards are associated with their health effects and may be sub-classified as acute or chronic. Acute hazards are those capable of producing prompt effects (such as burns, inflammation, or damage to eyes, lungs, or nervous system). Some chemicals are extremely dangerous in this respect and a small amount can cause death or severe injury very quickly. Other toxicological effects of chemicals may be delayed or develop only after exposure over long periods of time and are referred to as chronic hazards. (See: "Particularly Hazardous Substances," Page 18.) Do not smell or taste chemicals. Vent apparatus that may discharge toxic chemicals (vacuum pumps, distillation columns, etc.) into local exhaust ventilation systems. Inspect gloves and test glove boxes before use. Do not allow release of toxic substances in cold rooms and warm rooms, since these have contained re-circulated atmospheres.

***Understanding Chemical Hazards***

**Avoid Underestimation of Risk**

Under some circumstances, all chemicals can be hazardous. Even for substances of no known significant hazard, exposure should be minimized; for work with substances that present special hazards, special precautions should be taken. One should assume that any mixture would be

more hazardous than its most hazardous component. Especially in the research laboratory where new preparations are constantly being developed, it is wise to maintain at least the same level of safe practice in the disposal of chemical waste and residues as in the actual preparative procedure. All substances of unknown hazard must be considered hazardous until proven otherwise.

***Routes of Chemical Entry***

Hazardous chemicals may enter the body in a number of different ways; all should be considered in identifying protective practices.

- Through inhalation of vapors, dust or fumes,
- Through skin or eye contact or absorption,
- Through the mouth or other mucous membranes, or
- Through a cut, puncture or other opening in the skin.

***Environmental Monitoring and Surveillance***

**Routine sampling** scheduled by FM, will occur when initial monitoring results are at or above any applicable exposure limit or action level.

NIOSH or OSHA validated sampling methods, or equivalent methods, will be used to perform air sampling.

- Appropriate quality assurance will be used for all sampling and monitoring.
- Laboratory analysis shall be performed by an AIHA accredited laboratory where applicable

**Non-routine Sampling** is conducted for short-term operations or other reasons such as those listed below:

- A single step operation where verification of process controls is desired.
- Requests by the laboratory supervisor or laboratory worker.
- Laboratory accidents involving release of air contaminants.

**Observe the PELs, TLVs**

The permissible exposure limits (PEL) of OSHA and the threshold limit values (TLV) of the American Conference of Governmental Industrial Hygienists (ACGIH) should not be exceeded. This may be achieved by a combination of experimental design and engineering controls. In general, use of a hood is recommended when working with a volatile substance. These exposure limits may be found on a chemical's Material Safety Data Sheet/Safety Data Sheet.

**Environmental Monitoring and Surveillance**

- Air sampling may be performed for any chemical process where laboratory hood/filtered glove box or comparable exposure control device is not used to contain the contaminant.
- Air sampling will be performed where respiratory protection is required.
- Air sampling will be performed upon the request of the laboratory supervisor, laboratory worker.
- Air sampling will be performed in any situation where there is reason to believe a PEL or similar exposure standard has been exceeded.
- Air sampling specifications, including frequency and test method will be determined by the CHO-P in consultation with the CHO-Q.
- Constant and fixed instrumental monitoring of airborne concentrations is required when a volatile and highly toxic substance is used. Monitoring is not usually justified or practical in laboratories, but may be appropriate when testing or redesigning hoods or other ventilation devices.

***Chemical Hazard Types***

**Corrosive agents**

Corrosive agents shall always be handled using proper personal protective equipment appropriate for the type of material, the quantity being used and the potential exposure route. This may include gloves, lab coat or protective apron, goggles or face shields. Volatile corrosives shall be used in a fume hood when there is any potential for inhalation exposure. Be aware that many corrosive materials (i.e., perchloric and hydrofluoric acid and phenol) exhibit additional hazards that must be addressed when they are used in the laboratory.

**Handling flammable materials**

Do not use an open flame to heat a flammable liquid or to carry out a distillation under reduced pressure.

Use an open flame only when necessary and extinguish it when it is no longer needed.
Before lighting a flame, remove all flammable materials from the immediate area. Check all containers of flammable materials in the area to ensure that they are tightly closed.
Store flammable materials properly.
When volatile flammable materials may be present, use only non-sparking electrical equipment.

**Performing activities with explosion potential**

***Chemical Hazard Types***

When a reaction is attempted for the first time small quantities of reactants should be used to minimize hazards.

Safety shielding shall be used for any operation having the potential for explosion:

- When a familiar reaction is carried out on a larger than usual scale (i.e., 5-10 times more material).
- When operations are carried out under non-ambient conditions.

Shields must be placed so that all personal in the area are protected from hazard.

**Fire and explosion hazards.**

In the event of a small-scale fire (sized less than a square foot) the room fire extinguisher can be used to extinguish the fire. Be familiar with the location of the closest fire extinguisher and pull stations.

All building occupants MUST evacuate when building alarms are sounded.

In the event of a fire or an explosion of any size or type, report it to the Director of Safety and Security and Director of Facilities.

***Labeling***

**Signs and Labels**

All Carnegie Mellon University personnel who work with chemicals must be familiar with conventions used for hazard communication via signs and labels. This information is provided in EHS-P laboratory safety training and in the handout supplied at that class.

Labels on incoming containers of hazardous chemicals are not to be removed or defaced until product is emptied from the container. In March of 2012, OSHA revised the Hazard Communication Standard which addresses the format of chemical container labels. Specifically, there is a new system of label requirements, designed to meet the Global Harmonization Standard, used throughout much of the world. Information on the new details of these changes is available from EHS-P through written documents and on the web site, https://www.cmu.edu/ehs/Laboratory-Safety/chemical-safety/index.html
.

Secondary use containers (containers used for dispensing from bulk containers or containers of "made-up" chemical mixtures) must be labeled with the identity of the contents of the container, as a minimum. It is recommended that secondary use containers also be labeled with the substance name, type of hazard, name of laboratory worker who prepared the container, and date

of preparation.

Laboratories shall prominently post:

1. Emergency telephone numbers.
2. Location signs for safety showers, eye washes, fire extinguishers, spill response kits, and first aid equipment.
3. Warning signs at areas or equipment where special or unusual hazards exist.
4. Locations of any area were particularly hazardous substances are use.

***Procurement and Storage of Chemicals***

**Procurement of Chemicals:**
No container shall be accepted without an adequate identifying label. Delivery should be refused for leaking containers. Persons who receive hazardous chemical shipments must take DOT Hazardous Materials Receiving on-line training, accessed at this location: https://www.cmu.edu/ehs/Training/index.html. This training outlines further requirements for hazardous chemical receipt.

In order to minimize the presence of hazardous materials at the university, chemicals should be ordered in the smallest quantity needed to conduct the work.

EHS-P shall be contacted in advance of any acquisition of chemicals that will not be purchased but are to be transferred to the Carnegie Mellon University from another university or organization.

Note that the University Procurement Services places restrictions on how hazardous chemicals may be purchased. Use of a Purchase Order is the preferred method; some materials are prohibited from purchase using a purchasing card. Check this link to view Procurement policies: http://www.cmu.edu/finance/procurementservices/policies-procedures/index.html

**Stockrooms/Storerooms:**
Hazardous substances in storage should be segregated by hazard categories, following manufacturer recommendations. Containers of PHS materials should be placed in secondary containers. Stored chemicals shall be examined periodically (at least annually) for replacement, deterioration, and container integrity.

Stockrooms should not be used as preparation or repackaging areas.

**Laboratory Storage:**
Storage in laboratories will be performed as follows:

- Chemicals will be stored so incompatible chemicals are separated. Compatibility information is available on the chemical's Material Safety Data Sheet/Safety Data Sheet.
- A UL-rated flammable storage cabinet must be used to store flammables when there are more than five gallons present in the lab.
- A corrosive storage cabinet is strongly recommended for storage of acids and bases. Corrosive storage cabinet should not be made of metal.
- Acetic acid should be treated as a flammable rather than a corrosive.
- Refrigerators used for storage of flammable liquids should be either flammable or explosion proof.
- New construction should follow NFPA 45 for guidelines on flammable and combustible liquid storage.
- Chemical storage in hoods and on bench tops should be minimized.

***Transport & Shipment of Chemicals***

**Chemical Transport**
The following safety precautions should be taken for chemical transport:

- Chemicals should be transported in safety containers, or on a wheeled cart with a design capable of containing leakage or spillage and negotiating uneven surfaces (e.g.

expansion joints or floor drains) without tipping the chemical container or cart.

- Chemicals should be transported on freight elevators where possible.
- Chemical containers should be sealed during transport.
- Cylinders should be strapped to a hand truck specifically designed for that purpose and cylinder cover caps should be in place.
- Transportation of hazardous materials on any public road, aircraft, railway or navigable waters should NEVER be performed by university personnel except under the oversight of EHS-P. This transportation is highly regulated and the University MUST ensure that all regulations are followed for such moves. These regulations include personal or commercial transportation by any vehicle, including cars, trucks, trains, buses, watercraft, vans or aircraft. Contact EHS-P for advice and guidance.

***Chemical Segregation***

Refer to the Material Safety Data Sheet/Safety Data Sheets of each hazardous material to identify any incompatible material. Incompatible materials may NEVER be stored together. Common storage incompatibilities are as follows:

1. Flammable materials must be separated from oxidizers (this includes gases as well as liquids)
2. Acids and bases must be separated in storage

***General Laboratory Rules***

The following rules should be followed for all laboratory work with chemicals and hazardous materials:

1. Know the safety rules and procedures that apply to the work that is being done. Determine the potential hazards and appropriate safety precautions before beginning any new operation.
2. Know the location of and how to use the emergency equipment in your area, as well as how to obtain additional help in an emergency, and be familiar with emergency procedures.
3. Be alert to unsafe conditions and actions 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.
4. Use equipment only for its designed purpose.
5. Use only those chemicals for which the quality of the engineering controls and protective equipment is appropriate for safe handling.
6. Eating, drinking, smoking, gum chewing, or application of cosmetics should not occur in areas where laboratory chemicals are present. Laboratory workers should be sure to wash their hands before eating, drinking, smoking, etc. outside the laboratory environment.
7. Avoid storage, handling, or consumption of food or beverages in storage areas, refrigerators, glassware, or utensils that are also used for laboratory operations.
8. Handle and store laboratory glassware with care to avoid damage; do not use damaged glassware. Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain chemicals and fragments should implosion occur.
9. Wash areas of exposed skin well before leaving the laboratory. It is especially important to wash hands routinely before leaving. Leave all protective equipment in the lab when exiting. This includes lab coats and protective gloves.
10. Avoid practical jokes or other behavior that might confuse, startle, or distract other workers.
11. Do not use mouth suction for pipetting or starting a siphon.
12. Confine long hair and loose clothing. Wear closed-toed shoes at all times in the laboratory; NO SANDALS ARE PERMITTED TO BE WORN IN THE LABORATORY. Appropriate protective clothing (e.g., aprons, lab coats, safety glasses, etc.) should be kept in the laboratory and worn routinely.
13. Hazardous experiments should not be unattended. Standard Operating Procedures must be submitted and approved by the laboratory supervisor or his/her designee when there are any plans to leave an experiment unattended.
14. Be alert to unsafe conditions and see that they are corrected when detected.

15. All new procedures should be evaluated for potential hazards associated with the work. The following resources are available for this evaluation.

    - Environmental Health and Safety-Pittsburgh
    - Review the MSDS/SDSs for the materials in question.
    - Section 6 of Prudent Practices in the Laboratory, 2011.

## Particularly Hazardous Substances

***Introduction***

The Occupational Safety & Health Administration's (OSHA) Laboratory Standard (29 CFR 1910.1450 (e) (3)(viii), requires that provisions be made for employee protection for work with particularly hazardous substances. These include select carcinogens, reproductive toxins, and acutely toxic substances. Specific consideration should been given to the establishment of a designated area, the use of containment devices, procedures for safe removal of contaminated waste, and decontamination of the procedures.

***Definitions***

**"Particularly Hazard Substances"** are defined as belonging to one of three groups.

1. Select carcinogens, acutely toxic chemicals, reproductive toxins and chemicals known to have undesirable biological effects. Refer to the information document "Particularly Hazardous Table (PHS)" https://www.cmu.edu/ehs/Guidelines/index.html#chem for lists of PHSs and guidance in identifying them.
2. Chemicals for which reliable toxicity information is not available but are highly suspected to be a PHS because of their similarity in chemical structure or function to known toxic agents.
3. Chemicals that are explosive or otherwise violently reactive, such as pyrophorics and water-reactive materials.

**"Select carcinogens"** are any substance that meets at least one of the following criteria:

- Regulated by OSHA as a carcinogen or;
- Listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) or;
- Listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer (IARC) Monographs or;
- Listed in either Group 2A or 2B by IARC or under the category "reasonably anticipated to be carcinogens " by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:
    - 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
    - After repeated skin application of less than 300 mg/kg of body weight, per week or
    - After oral dosages of less than 50 mg/kg of body weight per day

**"Acute toxicity"** is the ability of a chemical to cause a harmful effect after a single exposure. Parameters for assessing the risk of acute toxicity of a chemical are its LD50 and LC50 values. Acutely toxic chemicals meet the following criteria:

- Chemicals with an oral LD50 in rats <50mg/kg
- Chemicals with a skin contact LD50 in rabbits <200mg/kg
- Chemicals with an inhalation LC50 in rats <200ppm/per hour

**"Lethal Dose 50 (LD50)"** is defined as the amount of a chemical that when ingested, injected, or

applied to the skin of test animals under controlled laboratory conditions will kill one-half (50%) of the animals.

**"Lethal Concentration 50 (LC50)"** is the concentration of the chemical in air that will kill 50% of the test animals exposed to it.

**"Reproductive toxins"** are substances that cause chromosomal damage and substances with lethal or teratogenic effects on fetuses.
**"Designated areas"** are areas that may be used for work with particularly hazardous substances. A designated area may be the entire laboratory, an area of a laboratory, or a device such as a laboratory hood or glove box.

***Responsibilities***

It is the responsibility of the laboratory supervisor to ensure that PHS determination is conducted on all existing chemical inventories and on all future chemical purchases. Furthermore, prior to beginning work with a PHS, or once the PHS determination is made, employees of Carnegie Mellon University shall complete a PHS Safety Protocol Form and submit it to EHS-P. All lab workers approved to work with a particularly hazardous substance shall comply with that form.

***PHS Safety Protocol Forms***

The purpose of the **PHS Safety Protocol Form** is to ensure that **lab workers** (including faculty, staff and students) are adequately trained and familiar with the particularly hazardous substance's chemical/physical properties, health hazard information, and toxicity data, prior to the use of the material. Procedures for containment, storage, and waste management shall be described in detail. Safety precautions shall be addressed including: assignment of a designated area, personal protective equipment, ventilation requirements, methods of monitoring exposure, first aid procedures, and spill or leak clean-up procedures.

The laboratory supervisor shall approve all PHS Safety Protocol Forms where applicable. Consultation with the CHO-Q and/or EHS-P is recommended to ensure that procedures and safety precautions are adequate. The approved protocol will be kept on file in the laboratory (readily accessible for use in an emergency). A copy of a blank PHS Safety Protocol Form is located at https://www.cmu.edu/ehs/Guidelines/index.html#chem

**Laboratory supervisor approval:**
A written PHS Protocol must be approved and signed by the laboratory supervisor before work with PHS chemicals may begin. The entire PHS Safety Protocol Form shall be reviewed by the laboratory supervisor for accuracy. These procedures shall be reviewed and changed at the time of any process change.

Additional employees may be added to an existing PHS Safety Protocol Form, or an existing protocol form may be approved for use in another laboratory. In these cases, the protocol form must still be reviewed by the laboratory supervisor and approved for use for each additional employee. All personnel authorized to use a PHS must complete the employee information sheets and attach it to the PHS Safety Protocol.

**Record keeping**
The original approved copy of the PHS Safety Protocol shall be kept on file in the laboratory. Employee information sheets should be kept on file with the PHS Safety Protocol Form in the laboratory. Copies should be given to the CHO-Q and EHS-P by uploading in SciShield.

**Designated areas**
PHSs are to be used in designated areas ONLY. The designated area must be identified and the boundaries clearly marked (See: "Warning signs", below). Unauthorized personnel (i.e., persons

who are NOT approved for use on the PHS Protocol form) are restricted from entry into a designated area while work with the PHS is being performed.

**Warning signs**
When the PHS is being used, designated areas must be posted with signs that denote the nature of the hazard. Contact EHS-P for appropriate signage, which will be supplied to properly address the type of designated area identified by the laboratory, and will provide suitable hazard warnings.

***PHS Safety Protocol Forms***

**Personal protective equipment**
Chemically compatible gloves shall be used with particularly hazardous substances. It is recommended that glove manufacturers and/or EHS-P be contacted for compatibility information and assistance in selecting the appropriate glove. Other protective equipment and apparel such as a fully closed laboratory coat and chemical splash goggles and/or a face shield may be required according to the approved PHS Safety Protocol Form.

**Containment**
PHSs should be used in a fume hood or glove box. Spill protection in the form of plastic backed matting or chemical resistant pans should be employed. All weighing operations involving PHSs shall be performed in a certified laboratory hood, glove box, or approved vented enclosure. Air exhausted from glove boxes where PHSs are handled must be vented to a certified hood or exhaust system.

**Storage**
PHS containers have some form of secondary containment. Refer to other sections of the Chemical Hygiene Plan for general information on proper chemical storage, transportation and compatibility.

**Decontamination and Waste**
Every effort should be made to minimize spills or loss of PHSs. All PHS compounds shall be disposed of as hazardous waste.

During decontamination, all exposed equipment should be thoroughly rinsed with a suitable solvent. This solvent should be collected as hazardous waste. Care should be exercised to prevent contamination of the outside of the waste container. In the event that decontamination is not feasible, the equipment should be placed in an impervious container that is sealed and properly labeled and disposed of as hazardous waste.

All solid PHS wastes shall be sealed in double-lined plastic bags and disposed of as hazardous waste.
Carnegie Mellon's Hazardous Waste Certification Tags, with all pertinent information, shall be attached.

Finely divided solid materials and PHS spill cleanup material should be cleaned by wet wiping, or mopping. Dry sweeping should not be done. Contaminated toweling used for the clean up of hazardous materials shall be disposed of as a PHS hazardous waste.

Laboratory workers should leave protective apparel in designated areas and wash hands and arms before leaving designated areas if possible.

**Safety precautions**
Ensure that all laboratory occupants are aware of the hazards involved with each PHS. Keep first aid procedures and materials readily accessible for use during an emergency.

***Exposures***

Never exceed exposure limits (consult MSDS/SDS). Know how a particular chemical can enter the body and symptoms of exposure. Notify your supervisor and CHO-Q and CHO-P if you

suspect exposure. **Seek medical attention if you suspect exposure.** (recommend specific places to take patient)

The Lab Standard and Carnegie Mellon University provides medical services to all employees who have received a hazardous chemical exposure along with the opportunity to receive medical attention.

***Items Not Covered***

Any items not covered by this plan should be submitted to the EHS-P for consideration.

***Animal Work with Chemicals of High Chronic Toxicity***

Animal work is not allowed in Qatar campus.

## Emergencies and Exposures

***Emergency Response Plan***

The University has prepared and has made available to appropriate persons an Emergency Response Plan. Details of the plan may be found in the Doha Chemical Safety Guidelines at https://www.cmu.edu/ehs/Guidelines/index.html. Questions about the content of any response activity should be addressed to the Director of Safety and Security (974 4454 8434) and Director of Facitlites at (974 4454 8607).

***Emergency Response Equipment***

**Eyewashes**

Plumbed eyewashes should be present in or near all lab areas in which there is a potential for hazardous chemicals to be splashed into the eyes.

**Safety Showers**

A safety shower should be present in or near all lab areas in which there is a potential for toxicologically significant quantity of a hazardous chemical to be splashed onto the body.

**Fire Extinguishers**

A fire extinguisher must be present in or near each laboratory area. The extinguisher must be appropriate for the classes of fires possible in a particular laboratory. Fire safety equipment is tested at least annually per posted schedules.

**Spill Response**

A spill response kit must be present in or near each laboratory are that contains hazardous materials with a potential for release. The spill kit needs to accommodate a cleanup of the contents from the largest container of the hazardous material present and be appropriate for the specific class of hazard present in the lab, such as acids, bases and solvents.

Accidents involving a large chemical spill, fires, or explosion shall be immediately reported to the Chemical Hygiene Officer in Doha, the Director of Safety and Security and the Director of Facilites. If necessary, the Director of Facilities will contact the Qatar Foundation's Ministry of Environment, Radiation and Chemicals Protection Department.

***Emergency Response Guide for Labs***

**Planning and Preparation**

A written Emergency Operations Plan has been prepared for Carnegie Mellon University Qatar. A summary document, Emergency Response Guidebook - Appendix C for Carnegie Mellon

University Doha Campus should be posted in each laboratory. This document identifies procedures for medical assistance, evacuation, and reporting of accidents. You may find the document here:
https://www.cmu.edu/ehs/Laboratory-Safety/chemical-safety/documents/Appendix%20C%20New%20Lab%20ER%20Guide%20for%20CMU-Q%20.pdf

***Accident Reporting***

**Accident Notification**

Accidents involving fire or explosions will activate installed automatic alarm sensors and fire extinguishing systems. Where automatic systems do not exist, manual alarms are installed in egress routes and must be activated during evacuation.

Reporting of accidents should be clear and concise, including the following information:

- Nature of the accident
- Hazardous material and quantities involved
- Nature of any injuries
- Location
- Name of the caller
- Phone number where caller can be reached

Personnel at the immediate scene of the accident should take actions that will mitigate the extent of the accident without jeopardizing their health and safety. When in doubt, warn others in the area, evacuate the area, travel to a safe location.

**Accident Investigation and Reporting**

Accidents involving injury or illness must be reported on the Supervisor's Injury/Illness Report form (available from Human Resources) located at this link:
*https://www.cmu.edu/hr/assets/workers-comp/workers-comp-forms.pdf* and distributed as indicated in the form.

All other accidents and near accidents (injuries, fires, spills, explosions) shall be reported in writing to the CHO-Q, Human Resources-Q, EHS-P, Director of Safety and Security and Director of Facilities as soon as possible after the occurrence.

***Medical Consultations & Examinations***

**Medical consultations are offered for the following.**

1. Documented exposures above established action levels or airborne concentrations above the PEL, TLV, or other recognized exposure limit.
2. Personnel exhibiting signs or symptoms consistent with exposure to the chemicals with which they are working.
3. Personnel exposed to hazardous chemicals as a result of a significant spill, leak or explosion.

The licensed physician (from QF clinic in student center) performing the initial consultation will identify the need for further medical examination. (QF – Primary Health Care Center (QF-PHCC) contact number (974) 4454 1244)

**Medical Examinations**

1. The medical exam criteria will be determined by the licensed physician. (from QF clinic in student center)
2. For examinations resulting from exposures to OSHA regulated substances, the examination frequency will be the period set within the OSHA standard.
3. For examinations resulting from potential overexposure to hazardous substances, the

licensed physician will determine the examination frequency.

4. The following information will be provided to the examining physician.
   - The MSDS/SDS for the applicable hazardous chemical(s)
   - A description of the conditions under which the exposure occurred, including monitoring data and accident reports.
   - A description of the signs and symptoms of exposure that the employee is experiencing.
5. Upon completion of the exam, the physician will provide the following reports.
   - Any medical condition of the employee which places them at risk as a result of exposure to hazardous chemicals found in their workplace
   - Recommendations for further examination
   - Results of the examination to the employee
   - A statement that the employee has been informed by the physician of the results of the exam and consultation

For serious injury, call QF HSSE at (974) 4454 0999, they will call up the ambulance and the ambulance will directly bring the patient to Hamad Emergency.

**First Aid**

- Personnel trained in first aid are available during working hours.
- Emergency transport to local hospitals is available 24 hours a day. (Call QF HSSE at (974) 4454 0999 to request for an ambulance)
- First Aid shall only be performed by persons suitably trained to do so.

## Waste Disposal

***Hazardous Waste Program***

**Hazardous Waste:**
Information on the identification, handling, storage and collection of laboratory wastes, and personnel safety of waste generators, is presented in the Carnegie Mellon University-Pittsburgh hazardous waste written program. This document includes procedures for hazard identification, hazardous waste accumulation, requesting removal of hazardous waste, and the disposal process. Also included is information on waste minimization activities. The written program may be found at https://www.cmu.edu/ehs/Hazardous-Waste-Management/index.html.

Carnegie Mellon University Qatar Campus has its own process of hazardous waste disposal. The document may be found in the Doha Chemical Safety Guidelines at https://www.cmu.edu/ehs/Guidelines/index.html.

Hazardous waste generator training is a requirement for all generators of hazardous waste. Annual refresher training in hazardous waste generation is strongly recommended (see the TRAINING section on page 7 of this document).

***Non-Hazardous Waste***

**Non-hazardous Waste** (as defined by EPA) must be handled in the following fashion:

- All "sharps" or needles must be disposed of in "sharps" containers available from the ***Laboratory Manager***. (Sharps are defined broadly as any laboratory waste item that can puncture human skin. This includes needles, syringes with needles, lancets, scalpels, razor blades, precision knives, pipettes and pipette tips. Broken glass is specifically excluded as it is addressed below. For disposal of sharps that are contaminated with chemicals, biological agents and/or radioactive materials, contact EHS-P for further details of accumulation requirements.
- All broken glass must be disposed of in "broken glass" containers or in completely sealed cardboard boxes. The box must be in sound condition, lidded, and with a poly lining of at least 2 mils. Filled containers should be completely sealed with sturdy tape (to prevent puncture to the handlers), marked “For disposal”, and placed in the hallway outside the lab. Custodial services will pick-up and remove the container.

- Finely divided powders, such as silica gel or toners, must be placed in tightly sealed containers before disposal.

***Sink Disposal***

Do not discharge any waste to the sewer that

- Is an irritant,
- Is malodorous,
- Is a lachrymatory agent (producing tears),
- May interfere with the biological activity of a waste water treatment plant,
- May create a fire hazard, or
- May cause structural damage or obstruct the flow of the system.

## Physical Hazards

***Compressed Gases***

**Compressed Gases**

Please refer to Environmental Health & Safety-Pittsburgh's Toxic Gas Protocol for additional requirements, such a use of gas cabinets, detection and warning systems and special controls, for certain high hazard compressed gases. These documents are available at EHS-P website:

Compressed Gas Cylinders - Guideline
https://www.cmu.edu/ehs/Laboratory-Safety/chemical-safety/documents/ehs-guideline---compressed-gas-cylinder.pdf

Toxic and Highly Toxic Gas Handling Program
https://www.cmu.edu/ehs/Laboratory-Safety/chemical-safety/documents/ehs---toxic-and-highly-toxic-gas-handling-procedure.pdf

1. Compressed gas cylinders shall be stored and secured in an upright position.
2. In areas of gas cylinder storage, cylinders shall be segregated according to their properties. Oxidizers (oxygen) and flammable gases must be stored 20 feet apart or separated by a fireproof partition**.** Additionally, signs shall be posted identifying type of cylinders permitted and identifying any potential hazard. When more than one cylinder is stored together, cylinders shall be kept tightly nested and secured with straps or chains.
3. On cylinders not equipped with a valve shutoff, a wrench shall be provided and kept on the valve at all times to permit rapid emergency shutoff.
4. Cylinders shall be stored with the protective valve cap in place. No cylinder shall be stored with the regulator still installed.
5. Cylinders of compressed gases should be securely strapped or chained to a wall or bench top.
6. Close the gas cylinder at the valve located at the top of the tank when not in use.
7. All compressed gas cylinders and chemical containers should be stored away from heat sources and direct sunlight.
8. Only use regulators and equipment approved for the gas being handled.
9. Cylinder handling will be performed using equipment appropriate for the task, i.e., cylinder hand carts.
10. Wherever poisonous gas such as chlorine, carbon monoxide or hydrogen sulfide are used in quantities larger than a standard lecture bottle size, they must be contained in a gas cabinet that is tied into a hazardous exhaust system and leak detection with alarms must be present, properly tested and maintained. Small lecture bottles must be used in a chemical fume hood.
11. Wherever hydrogen is present, all tubing must be of braided stainless steel hose. Alternative tubing materials will be approved by EHS-P on a case by case basis, to ensure that the

alternative meets fire protection requirements.

Contact EHS-P for additional information on the handling of compressed gas cylinders.

Compressed gases present hazards due to their high pressure in additional to any hazard presented by the gas itself (for example, flammable, corrosive or oxidizing gases).

***Pressure and Vacuum***

**Pressurized and vacuum operations (including use of compressed gas cylinders)**

Reactions should never be carried out in, nor heat applied to, an apparatus that is a closed system unless it is designed to withstand the pressure that may be created. Pressurized apparatus shall have an appropriate pressure relief device.

***Cryogens***

**Low temperature procedures (cold traps and cryogenic hazards)**

1. Gloves and a face shield should be used when there is a potential exposure to the cryogen.
2. Neither liquid nitrogen nor liquid air should be used to cool a flammable mixture in the presence of air because oxygen can condense from the air, which leads to an explosion hazard.
3. Appropriate **thermal** gloves should be used when handling dry ice. Dry ice should be added slowly to the liquid portion of the cooling bath to avoid boiling and subsequent splashing.
4. Workers should avoid lowering their head into a dry ice chest; carbon dioxide is heavier than air and suffocation can result. Dispense cryogens in areas with adequate ventilation.

***Ergonomics***

Laboratories present special challenges in the prevention of repetitive stress injuries. EHS offers consultations for Ergonomic evaluations of the workspace. To request an evaluation, please email safety@andrew.cmu.edu with Subject: Ergonomics.

## Recordkeeping

***Records***

**Records Retention**

1. Carnegie Mellon Department of Human Resources (HR) maintains illness and accident reports.
2. The Department of Environmental Health and Safety Pittsburgh maintains documentation of the annual review of the Chemical Hygiene Plan.
3. EHS-P oversees the University' chemical inventory program, ChemTracker.
4. HR maintains all medical records relating to chemical exposure and potential chemical exposures.

**Internal Program Evaluations**

Records of EH&S laboratory inspections and hood evaluations will be maintained in the EH&S office, for a minimum of three years.

**External Program Evaluations**

Reports of external (regulatory) inspections will be retained by EH&S.

## Appendix

# Laboratory 3025/3026 Safety Inspection Checklist - Biology

***Post lab checklist for Laboratory Staff in Biology Labs - Genetics, Biochemistry, Phages, Research***

**INSPECTOR NAME: _____ DATE/TIME: _____**

| *BIOLOGICALS* | *YES* | *NO* | *NA* | *COMMENTS* |
|---|---|---|---|---|
| **Are all temperature-sensitive substances put back in its proper storage (freezer, fridge)?** | | | | |
| **Are unused plates stored back in the fridge?** | | | | |
| **Are all students biological samples labelled properly before storage?** | | | | |
| | | | | |

| *CHEMICALS* | *YES* | *NO* | *NA* | *COMMENTS* |
|---|---|---|---|---|
| **Are all toxic chemicals properly capped and temporarily stored in the assigned hood?** | | | | |
| **Are all temperature-sensitive chemicals stored back in its proper storage (freezer, fridge)?** | | | | |
| **Are all solid chemicals by the balances properly capped and ready for storage?** | | | | |
| **Are all chemical reagent bottles, media bottles, etc. properly labelled?** | | | | |
| | | | | |

| *EQUIPMENT & ELECTRICALS* | *YES* | *NO* | *NA* | *COMMENTS* |
|---|---|---|---|---|
| **Are all equipment in a safe condition and/or turned off prior to leaving?** | | | | |
| • **Shakers** | | | | |
| • **Centrifuge (floor)** | | | | |
| • **Getinge Autoclave** | | | | |
| • **PCR work station (check if UV light is off)** | | | | |
| • **Water bath** | | | | |
| • **Heating blocks** | | | | |
| • **Microscope** | | | | |
| • **Fridge (4°C) (Showing correct temperature settings and doors are properly closed?)** | | | | |
| • **Incubators (Showing correct temperature settings and doors are properly closed?)** | | | | |
| • **Balances (doors of analytical ones are closed, power is off for all)** | | | | |
| | | | | |

| *FIRE & PRESSURE* | *YES* | *NO* | *NA* | *COMMENTS* |
|---|---|---|---|---|
| **Is the portable propane torch off? (in 3026)** | | | | |
| **Are the LPG gas valves off in each benches?** | | | | |

| | | | | |
|---|---|---|---|---|
| **Is the LPG Emergency Stop button pushed to off the gas supply? (check both 3025 and 3026)** | | | | |
| **Is the Carbon dioxide gas main valve off? Or in standby?** | | | | |
| **Are the vacuum valves off in each benches?** | | | | |
| | | | | |

| ***BIOHAZARD WASTES*** | ***YES*** | ***NO*** | ***NA*** | ***COMMENTS*** |
|---|---|---|---|---|
| **Are all the waste plates properly collected and disposed of in the red biohazard bins?** | | | | |
| **Are all the waste disposable pipets, tips, microfuge tubes properly collected in label containers and disposed of?** | | | | |
| **Are all used reusable glass pipets collected ready for washing?** | | | | |
| **Are all sharps (needles, syringes, broken glass) properly collected and disposed of?** | | | | |
| **Are the accumulated biohazard wastes in the red bins ready for autoclave and disposal?** | | | | |
| | | | | |

| ***OTHER HAZARDOUS WASTES*** | ***YES*** | ***NO*** | ***NA*** | ***COMMENTS*** |
|---|---|---|---|---|
| **Are the waste culture media properly disposed?** | | | | |
| **Are the toxic wastes (DMSO, APS, including PHS - Trypan blue, ethidium bromide, sodium azide, others) labelled and moved to the waste hood of 2198 for storage?** | | | | |
| | | | | |

| ***HOUSEKEEPING*** | ***YES*** | ***NO*** | ***NA*** | ***COMMENTS*** |
|---|---|---|---|---|
| **Are the work benches clean, decontaminated and free from chemical spills, dirty paper towels, used gloves, unsorted lab ware and other messes?** | | | | |
| **Is the weighing balance area clean from chemical spills, used weighing boats and dirty glassware?** | | | | |
| **Is the sink area clean and free from dirty paper towels and unsorted lab ware?** | | | | |
| **Are the used/dirty glassware loaded in the washer?** | | | | |
| | | | | |

| ***SECURITY*** | ***YES*** | ***NO*** | ***NA*** | ***COMMENTS*** |
|---|---|---|---|---|
| **Did you ensure that the door to the laboratory is closed and locked when leaving?** | | | | |

# Laboratory 2198 Safety Inspection Checklist - Chemistry

***Post lab checklist for Laboratory Staff in Chemistry 207 and 101***

**INSPECTOR NAME: _____ DATE/TIME: _____**

| *CHEMICALS* | *YES* | *NO* | *NA* | *COMMENTS* |
|---|---|---|---|---|
| **Are all chemicals returned to the assigned dispensing hood?** | | | | |
| **Are all chemicals in the dispensing hoods properly capped?** | | | | |
| **Are all solid chemicals by the balances removed and put back in storage?** | | | | |
| **Are all the containers of analytical solutions made by the students labelled?** | | | | |
| **Is storage above eye level avoided? (for analytical solutions made by the students)** | | | | |

| *EQUIPMENT & ELECTRICALS* | *YES* | *NO* | *NA* | *COMMENTS* |
|---|---|---|---|---|
| **Are all equipment in a safe condition and/or turned off prior to leaving?** | | | | |
| • **HPLC-1 (if in operation, set to shut down after the run has completed)** | | | | |
| • **HPLC-2 (if in operation, set to shut down after the run has completed)** | | | | |
| • **UV-Vis-1** | | | | |
| • **UV-Vis-2** | | | | |
| • **ICP-AES (power of main instrument is always on )** | | | | |
| • **IC** | | | | |
| • **pH meter** | | | | |
| • **Hotplates/stirrer (for analog type -make sure both knobs are set to off, power cable is unplugged)** | | | | |
| • **Melting point apparatus (power cable is unplugged)** | | | | |
| • **Sonicators (backroom)** | | | | |
| • **Water distiller (backroom)** | | | | |
| • **Balances (doors of analytical ones are closed, power is off for all)** | | | | |

| *FIRE & PRESSURE* | *YES* | *NO* | *NA* | *COMMENTS* |
|---|---|---|---|---|
| **Are the propane gas valves off in each benches?** | | | | |
| **Are the main valves of compressed gases off?** | | | | |
| • **Propane gas (back room)** | | | | |
| • **Argon gas (classroom)** | | | | |
| **Are the vacuum valves off in each benches?** | | | | |

| *HAZARDOUS WASTES* | *YES* | *NO* | *NA* | *COMMENTS* |
|---|---|---|---|---|
| **Are all the chemical wastes in the dispensing hood properly disposed?** | | | | |
| **Are all chemical wastes/broken items of students properly collected and disposed of?** | | | | |
| **Are the wastes containers in the waste hood properly capped/covered?** | | | | |

| *HOUSEKEEPING* | *YES* | *NO* | *NA* | *COMMENTS* |
|---|---|---|---|---|
| **Are the student benches clean and free from chemical spills, dirty paper towels, used gloves, unsorted glassware and other messes?** | | | | |
| **Is the weighing balance area clean from chemical spills, used weighing boats and dirty glassware?** | | | | |
| **Is the sink area clean and free from dirty paper towels and unsorted glassware?** | | | | |

| *SECURITY* | *YES* | *NO* | *NA* | *COMMENTS* |
|---|---|---|---|---|
| **Did you ensure that all doors to the laboratory are closed and locked when leaving?** | | | | |