Messiah College

School of Science, Engineering and Health

Chemical Hygiene Plan

2019-2020
(reviewed 5/22/19)
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School of Science, Engineering and Health Chemical Hygiene Plan 2014-2015 (revised 1/11, 1/12, 5/13, 6/14, 7/17, 6/17, 6/18)
1.0 Purpose of the Chemical Hygiene Plan

The Chemical Hygiene Plan (CHP) exists to provide the guidelines for the safe and effective use of all laboratory equipment and chemicals by the employees and students of Messiah College in accordance with all federal and state regulations put forth by the U.S. Occupational Safety and Health Administration (29CFR 1910.1450), the Environmental Protection Agency and the Pennsylvania Department of Environmental Protection. It is the goal of this document to minimize and/or eliminate employees’ and students’ exposure to hazardous, or potentially hazardous chemicals, procedures or equipment associated with all laboratory activities through the use of personal protective equipment, engineered controls, laboratory practices, as well as policies and procedures. All applicable users of chemicals under this plan as defined below must be familiar with the requirements set forth in this Plan and applicable state and federal regulations and must conduct their operations in accordance with them. It is essential that Messiah employees follow the “cradle to grave” responsibility under the Resource Conservation Recovery Act (RCRA) and Superfund Amendments and

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Reauthorization Act (SARA Title III) regulations when purchasing and disposing of chemicals. Further information is providing in Section 14 regarding proper waste disposal. This plan is available for inspection at any time from the School of Science, Engineering and Health’s Chemical Hygiene Officer and online on the Compliance Office website.

2.0 **Scope**

2.1 **Applications**

This plan implements the provisions of the OSHA Laboratory Standard (29CFR 1910) for laboratory spaces which use or store hazardous chemicals as defined by that standard. These include all laboratories in Kline and Jordan Halls within the Departments of Biology and, Chemistry/Biochemistry. In addition the following laboratories are covered: the Nutritional Laboratory (J057), the Psychology Research Lab (J076), and three Engineering department laboratories located in Frey Hall; the BioMed research lab (F51), the Materials lab (F49) and the Environmental lab (F45).

The policies and procedures set forth in this document apply to all laboratory courses, experimental settings, classroom environments and any other area or situation associated with courses or research conducted in the above mentioned laboratories as determined by the School of Science, Engineering and Health Safety Committee, the Chemical Hygiene Officer or the Compliance Coordinator.

This document does not replace the OSHA standards for workplace safety including, but not limited to, lock-out/tag-out, electrical safety, machine safety, walking/working surfaces and evacuation planning, but it defines regulations specific to working in a laboratory with hazardous chemicals. These regulations, in addition to those guidelines outlined by the college’s Safety Manual, address all hazardous chemical, laboratory and workplace safety concerns.

2.2 **Exclusions**

This Chemical Hygiene Plan does not include provisions for the following:

- Areas within the Engineering Department located in Frey Hall not specifically listed above. Chemicals found in those areas fall under the purview of the OSHA HAZCOM Standard (29CFR 1910.1200) and guidance of the Campus Compliance Coordinator.

- Hazardous chemicals used in departments other than the School of Science, Engineering and Health by departments such as Art, the Community Garden and College Operations. While chemicals in support of these departments may be located in Kline, Jordan and Frey the also fall under the purview of the OSHA HAZCOM Standard (29CFR 1910.1200) and guidance of the Campus Compliance Coordinator.

3.0 **Responsibilities**

3.1 **Compliance Coordinator**

1. Advises departments of current issues and requirements for worker health and safety.
2. Assists with the development of departmental policies and procedures pertaining to worker health and safety.

3. Maintains a contract with 3E/Verisk Company for Messiah College’s Safety Data Sheets (SDS) online access program and chemical inventory as outlined in the Hazard Communication Program.

4. Provides guidance, training, and conducts audits for College-wide compliance with federal, state and local environmental, health and safety (EHS) regulations.


6. Develops campus-wide procedures for compliance with EHS regulations and provide guidance for the waste programs, including proper storage, inspection, disposal, and record retention.

7. Serves as contact for EHS agencies, including US EPA, PA DEP and OSHA.

8. Completes and submits EHS reports (ex., Tier II) required for the College.

3.2 Dean of the School of Science, Engineering and Health

1. Responsible for the overall development, writing, implementation and adjustment or updating of the School of Science, Engineering and Health’s Chemical Hygiene Plan.

2. Develops an attitude of and commitment toward the safety and health for the School of Science, Engineering and Health by emphasizing the importance of the program and setting a good example.

3. Notifies the Safety and Risk Management Committee of the implementation of the Chemical Hygiene Plan and updates them as changes are made.

4. Communicates Chemical Hygiene Plan policies to faculty and School employees and ensures compliance with the Chemical Hygiene Plan.

5. Delegates authority to the Chemical Hygiene Officer as needed to ensure compliance with the Chemical Hygiene Plan.

3.3 Chemical Hygiene Officer

1. The Chemical Hygiene Officer (CHO) is appointed by the Dean of the School of Science, Engineering and Health.

2. Serves as the technical advisor to the School of Science, Engineering and Health on issues of chemical hygiene and the management of hazardous chemicals.

3. Serves as a resource for assistance with the Chemical Hygiene Plan.

4. Serves as a resource for campus-wide chemical safety.

5. Maintains a current copy of the Chemical Hygiene Plan.

6. Provides assistance to faculty and staff in the proper handling of hazardous material spills and other emergencies.

7. Informs the appropriate personnel within the School of Science, Engineering and Health of any changes in legal requirements pertaining to regulated substances as needed.


9. Function as the Radiation Safety Officer for the campus.

3.4 Office of Facilities Services

1. Performs all necessary maintenance for laboratory ventilation systems including fume hoods, local exhaust systems and general ventilation in accordance with federal and state regulations.
2. Conducts annual testing of fume hoods and maintains records of annual fume hood inspections and performance of individual fume hoods
3. Maintains laboratory and building systems including, but not limited to all HVAC, plumbing and electrical systems
4. Conducts annual inspections and testing of all eye wash stations and safety showers. Maintain records of eye wash station and safety shower inspections.
5. Repairs any hazard or safety concerns pertaining the building or mechanical systems
6. Alerts the appropriate personnel of any possible hazards
7. Oversees the disposal of chemical and hazardous waste for all campus departments maintains all necessary Environmental Protection Agency and Pennsylvania Department of Environmental Protection documents pertaining to waste disposal.

3.5 Department of Human Resources
1. Manages all Workers’ Compensation claims
2. Maintains all employee medical records in accordance with federal regulations
3. Schedules all medical evaluations as required by OSHA or at the recommendation of Public Safety, medical personnel or laboratory managers

3.6 Natural Sciences Laboratory Program Managers and Engineering Department Technicians
1. Oversee the daily operations of college laboratories within their respective departments within the School of Science, Engineering and Health. They work with the Compliance Coordinator to address health and safety issues in their designated laboratories. The Natural Science Laboratory Programs Manager will serve as the CHO for the School assisted by the Biological Sciences Lab Coordinator and the Engineering Technicians.
2. Inform all laboratory workers (employees and work study students) of the guidelines put forth in the Chemical Hygiene Plan.
3. Maintain responsibility for laboratory safety, regulatory compliance and implementation of, and compliance with, the Chemical Hygiene Plan for laboratories within their applicable departments.
4. Oversee the proper disposal of all hazardous and chemical waste generated within their respective laboratories in conjunction with the Compliance Coordinator
5. Conduct periodic testing of the function of emergency equipment including but not limited to, eye wash stations and safety showers. Eye wash stations must be flushed weekly and documented. Safety Showers are flushed quarterly and documented. Maintains access to emergency equipment through general housekeeping
6. Work with faculty in the development of Standard Operating Procedures for specific hazardous procedures
7. Identify hazardous or potentially hazardous chemicals or processes in the laboratory.
8. Report possible overexposures to hazardous chemicals to Human Resources, the Compliance Coordinator, and the School of Science, Engineering and Health Safety Committee.
9. Inspect and control inventory of hazardous chemicals used in his/her operations to minimize inventory and assure proper storage. A physical annual inventory will conducted every year in the May/June timeframe and an electronic copy forwarded to the School’s Chemical Hygiene Officer and Compliance Coordinator.
3.7 **Faculty**
1. When designing new experiments, considers the hazards involved and chooses to use chemicals (starting materials, intermediates and products) which will provide the desired learning experience with minimum hazard. They will investigate the hazards of each chemical being introduced to the laboratory for the first time by referring a Safety Data Sheet (SDS) for that chemical and substitutes less hazardous chemicals when practical, Faculty are also required to complete a Project Checklist as contained in the Messiah College Safety Manual for any new projects/assignments.
2. Provides laboratory assistants, students conducting research and laboratory managers under his/her direction with safety and health information needed to avoid hazards prior to their involvement in experiments.
3. Inspects and controls inventory of hazardous chemicals used in his/her operations to minimize inventory and assure proper storage and keeps the appropriate lab manager appraised of changes to requirements or generation of new wastes.

3.8 **Laboratory Instructors**
1. Reviews physical and chemical hazards of all experiments to be performed under his/her direction in the laboratory. Where special precautions may be necessary, discusses the situation with the Chemical Hygiene Officer.
2. Assures that pre-lab discussions include consideration of specific safety and health hazards of the experiment, safety equipment to be used and steps to be taken in case of emergency. Makes learning how to be safe an integral part of the chemical education process.
3. Sets a good example by observing all rules, wearing recommended protective equipment and being enthusiastic about safety.
4. During the laboratory period inspects to see that students are following instructions and provides prompt correction where needed. Instructors must insist on safe procedures and use of Personal Protective Equipment, including cleaning and storage.
5. Assumes responsibility for visitors and requires that they follow the same rules as students and other laboratory workers whenever in the lab.
6. Reports accidents, near misses or significant safety/health incidents to the appropriate Laboratory Manager promptly.
7. Ensures that hazardous wastes are disposed of properly and in accordance with the Messiah College Hazardous Waste Disposal Protocol.
8. Ensures that all operations under his/her direction are performed in accordance with the Chemical Hygiene Plan.

3.9 **Laboratory Workers**
1. Attends all required trainings.
2. Wears Personal Protective Equipment as required.
3. Performs all required tasks in accordance with the Chemical Hygiene Plan.
4. Maintains ultimate responsibility for his/her personal on-the-job safety.
5. Reports potential or suspected hazards to the appropriate Laboratory Manager.

3.10 **Building Maintenance and Custodial Staff**
1. Maintain general cleanliness for aesthetic and safety purposes.
2. Reports potential or suspected hazards to the Natural Sciences Program Laboratory
Manager.

3. Uses appropriate precautions and/or Personal Protective Equipment when cleaning laboratory areas.

3.11 Students
1. Follow all instructions as provided by instructor.
2. Become familiar with posted safety rules, location of safety equipment and availability/location of chemical hygiene information.
3. Report to the instructor any safety or chemical hygiene problems, injuries, accidents or incidents.

3.12 Radiation Safety Officer
1. Determines Standard Operating Procedures (SOP’s) for all radioactive materials used in the laboratory in conjunction with faculty.
2. Provides approval for the purchase of radioactive materials within the School of Science, Engineering and Health.

3.13 Department of Safety
1. Conducts fire extinguisher inspections in accordance with applicable regulations
2. Maintains all emergency systems such as fire alarms, sprinkler systems and emergency lighting systems

4.0 General Laboratory Safety Guidelines

4.1 Introduction
Laboratory work involves potential hazards which cannot be completely removed even by use of proper procedures and safety equipment. Messiah College is committed to providing a safe environment for all students and employees, but in the end, individuals are responsible for exercising safe behavior. The following rules have been developed to achieve the goal of making the laboratory as safe as possible. They must be followed in all laboratories and laboratory storerooms.

4.2 Laboratory Safety Rules
The Safety Rules for Laboratories are posted for each Department in each laboratory and called to the attention of students at the start of each laboratory course. The rules are as follows:

Laboratory work involves potential hazards which can be removed by use of proper procedures and safety equipment. Messiah College is committed to providing a safe environment for all students and employees. These rules have been developed to achieve this goal. They must be followed in all laboratories and laboratory storerooms.

1. Proper eye protection must be worn at all times in laboratories and lab related activities.

   In laboratories where there is a risk of splashes from toxic, corrosive, infectious or otherwise dangerous chemicals (referred to below as wet chemistry) goggles and/or other protective
measures such as face shields or sashed hoods as appropriate must be used. Appropriate safety
glasses are to be worn in laboratories where chemicals are not in use but laboratory procedures
(such as dissection or engineering work) would create a physical hazard to the eyes. Safety
glasses do not provide splash protection, and therefore do not meet lab safety requirements in
wet chemistry laboratories. In laboratories where both wet chemistry work is being conducted
and equipment is being used which would preclude the wearing of goggles (i.e. microscope),
then the wet chemistry should be restricted to a specified area of the room and goggles will be
worn in that area. Visitors to laboratory rooms must wear the appropriate eye protection even
if they are not working in the laboratory. Students who do not have proper eye protection will
not be able to participate in lab and will be asked to leave the laboratory.

2. Horseplay, pranks or other acts of mischief are especially dangerous and are prohibited.

3. The hazards of chemicals used should be known prior to the experiment.
In order to understand the hazards involved in an experiment, you must read through and
become familiar with the lab protocol prior to your lab period. These hazards include, but are
not limited to, corrosiveness, flammability, reactivity, stability and toxicity. This information
will be supplied by the instructor or obtained by the students as advanced preparation prior to
laboratory work. Additional information, in the form of Safety Data Sheets (SDS) is available
from the Laboratory Program Manager or the 3E Company whose phone number is posted on
laboratory phones. An SDS contains information about the chemical properties of a substance
such as hazards, reactivity, melting point, flash point etc. An SDS also contains information
on spill cleanup and accident procedures.

4. Eating and drinking are not allowed in the laboratory.
In addition to not consuming food or drink in the lab, chewing gum and candy are also
prohibited. Even unopened food and beverages should not be brought into the lab.

5. Unauthorized experiments are prohibited.
No chemicals or equipment may be used by a student unless they have received permission and
instruction from the lab instructor. There are no exceptions to this rule.

6. Appropriate clothing and shoes must be worn.
When specified by the instructor, gloves, a protective apron or lab coat will be required. The
following dress is required in the laboratory: closed-toe shoes, which completely cover the feet,
long pants, shirts/blouses which cover the upper body. Clothing articles such as shorts, short
skirts, bare midriffs, tank tops, items with draping sleeves, footwear, which does not completely
cover the feet, are prohibited. In addition, long hair should be pulled back. Students who do
not meet the dress code will not be able to participate in lab, and will be asked to leave the
laboratory.

7. Mouth suction must never be used to fill pipettes, to start siphons, or for any other purpose.

8. Experiments shall not be performed when a worker is alone in a laboratory unless suitable
arrangements have been made with the course instructor.
9. All persons must wash their hands when leaving the laboratory.

Even if you did not use a hazardous chemical, it is very possible that someone who used the space before you failed to properly cleanup. Always wash your hands when you leave the lab.

10. No chemicals or equipment may be removed from the laboratory without the specific permission and supervision of the instructor.

11. All accidents and significant near-accidents must be reported to the instructor.

12. All workers must know the location and proper use of all safety equipment in the laboratory including, but not limited to safety shower, eye wash, fire blanket, and fire extinguisher.

13. All chemicals must be disposed of in the proper manner.

All chemicals and waste must be disposed of as outlined by the Messiah College Chemical and Hazardous Waste Disposal Protocol. Used chemicals must be put in an approved, labeled container. Chemicals must not be put down the drain unless specified by an instructor. Never assume that it is safe to put a chemical down the drain or in the trash.

14. If a person sustains an injury which is not incapacitating but causes bleeding, (s)he shall place a sterile bandage over the wound and go to the Engle Health Center for treatment if needed. No other person should be involved in any way which might cause her/him to contact the blood. The instructor will see that the "Laboratory Accident Procedure" is followed.

15. Broken Glass should be disposed of in an approved, labeled, cardboard container. No trash or chemicals should be discarded in this container.

16. In Case of Fire

If the fire alarm sounds, but there is no fire in the immediate vicinity, turn off burners, heating mantles, and hotplates and leave the lab as directed. If a small fire starts, such as a lab manual or beaker, alert the instructor immediately. If your clothing has caught on fire, use the safety shower or fire blanket as needed and immediately alert the instructor.

17. In Case of a Chemical Spill

If chemicals have splashed on your face wash your face to remove the chemical and immediately alert the instructor. Be careful not to wash the chemical in to your eyes. If chemicals have spilled on your clothing, remove the contaminated clothing as needed and use the safety shower as needed. Immediately alert the instructor. If chemicals have spilled on the bench top or floor, report the incident to your lab instructor and clean as directed. Remember that a spilled chemical is still hazardous; materials used to clean spills should not be disposed of in the trash. Please see the Messiah College Spill Response Plan for further details.

18. Lab Cleanup Responsibilities
All glassware should be washed and returned to your lab drawer/cabinet, or where directed by your instructor. When you are finished using a balance, you must clean the pan and surrounding area. If necessary, reset the tare and close the breeze guard doors.

19. Egregious safety violations during the course of any lab period could, at the discretion of the instructor, result in the student being expelled from the lab. A grade of zero will be recorded for all assignments associated with that laboratory project.

4.3 Safety Equipment
1. All laboratories are equipped with safety equipment including, fire blankets, eyewash stations and first aid kits.
2. Students will be instructed on the use and location of safety equipment at the start of each laboratory course.
3. Fire extinguishers are located in all laboratories. Fire evacuation plans are posted near laboratory exits.
4. All laboratories are maintained in such a way that access to emergency and safety equipment is not obstructed by laboratory equipment or storage. All eye washes and safety showers must be accessible at all times.

4.4 Safety Inspections
1. Safety inspections will be carried out regularly by the Chemical Hygiene Officer and the Campus Compliance Coordinator.
2. Weekly walkthroughs of applicable laboratories will be conducted by Laboratory Managers and the Engineering Technicians to ensure access to and functioning of safety equipment. In the event that safety equipment is non-functional steps will be taken to arrange for the repair or replacement of the equipment as soon as possible. These inspections will be documented on a form similar to that contained in Appendix D and retained.

4.5 First Aid
First Aid kits are located in all laboratories and are clearly marked. First aid for minor cuts, burns and bruises in the laboratory can be treated with the first aid kits available in the lab. It shall be up to the judgment of the instructor whether an injury requires further treatment. If further treatment is deemed necessary or advisable, the Laboratory Instructor shall have someone accompany the injured person to the College nurse, or, if necessary, phone him/her and have him/her come to the laboratory. If the injury is major, the Dispatcher's office (6565) should be phoned and the Chemical Hygiene Officer notified immediately. After these persons have been notified the Department Chair and College Safety Officer shall also be notified.

If a chemical contacts the eyes, promptly flush the eyes with copious amounts of water for at least 15 minutes and contact Dispatch (6565) and the Chemical Hygiene Officer immediately.

First aid kits are checked and resupplied if necessary at the beginning of each semester by the Department of Safety. If kits are used during the semester the appropriate lab manager or engineering assistant
should notify the Department of Safety to replenish the kit.

4.6 First Aid for Acutely Hazardous or Toxic Chemicals
See section 8.0 “Standard Operating Procedures for Chemicals of Special Concern” for specific treatments for exposure to certain hazardous chemicals used in the laboratory. If a specific treatment is not listed, consult the Safety Data Sheet for the chemical.

4.7 Fume Hoods and Glove Boxes
Laboratory hoods are provided to protect personnel from breathing vapors or dust from chemicals that are being handled or stored. Hoods provide a high degree of protection when properly used but they are secondary devices. The primary controls are proper design of experiments and careful operating techniques.

4.7.1 Fume Hood Performance
Properly operating hoods must have an average face velocity of at least 60 linear feet per minute for hoods (doors open wide) and air supply systems that are optimally designed and installed. Hoods for more demanding operations need a face velocity of 75 to 125 fpm. Higher face velocities can cause eddy currents and decreased protection. Tests have shown that hood performance is strongly affected by such factors as amount, size and placement of equipment within the hood, room drafts from open doors or windows, traffic past the hood, position of the hood door and the user’s position and actions in front of the hood. Doors may be opened wide to install tall equipment but they should be closed to the sash stop (on hoods that have it) or approximately half open whenever possible.

The average face velocity can be increased by closing the sash. For example, closing the sash to one-half of the maximum face opening approximately doubles the average face velocity. Partially closing hood doors to achieve an average face velocity of 60 fpm is not an acceptable solution for increasing face velocity of malfunctioning hoods.

4.7.2 Fume Hood Testing
Faculty and Laboratory Instructors are responsible for monitoring fume hood operation in their area and should be alert to signs of malfunction such as unusual sounds, reduced draft and odors in the room. Any suspected inadequacy should be checked immediately. It can be checked by use of a portable vanometer available from the Chemical Hygiene Officer or by requesting air flow measurements by the Office of Facilities Services. This office will check hood face velocity at yearly intervals. The tests will be performed in accordance with the ASHRAE 110-1995 testing procedure.

4.7.3 Guidelines for Fume Hood Use
1. Fume hoods must be used when using chemicals which are hazardous, flammable, corrosive or give off strong odors. SDS instructions and warnings on containers should be followed at all times.
2. Fume hoods should be kept clear of unnecessary equipment. Only equipment that requires ventilation should be
used in the fume hood.

3. Fume Hoods are not to be used for long term storage of chemicals.
4. Hazardous Waste is only to be stored in fume hoods marked “Hazardous Waste Accumulation Area.”
5. Use minimum required opening when working in the hood and close hood doors when not handling the equipment inside the hood.
6. Use traps or scrubbers as primary devices to prevent toxic and/or noxious materials from being vented.
7. Do not permit materials such as paper to enter exhaust ports, since they can lodge in the ducts or fan and reduce efficiency. Do not store items or set up apparatus in such a way that the exhaust ducting is blocked.
8. Keep all sources of emissions at least 6 inches inside the front of the hood. This greatly reduces the possibility of exposure.
9. Keep operator's face outside plane of sash, i.e., do not lean forward into the hood when working with chemicals in the hood.
10. Prepare a plan of action in case of ventilation failure, e.g., by power failure. Fume hoods should be closed completely in the event of loss of airflow to the hood.

4.7.4 Glove Boxes

Glove boxes are used in areas where procedures must be carried out in protected or inert atmospheric conditions. Often these processes involve toxic or highly reactive chemicals. Glove boxes should be inspected for signs of wear and degradation prior to use. The seal should not allow the escape of any gases. Do not use a glove box if it is damaged in any way.

4.8 Housekeeping

1. Laboratories should be maintained in a general state of cleanliness with work areas kept clear of unnecessary equipment or glassware. Work areas should be clear of spills or chemical contamination.
2. Bench tops used in student laboratories are not to be used for storage.
3. All aisles and walkways should remain clear.
4. Fume hoods should only contain the equipment required by the current procedure. Hoods are not to be used as equipment storage areas.

4.9 Working Alone

Working alone in the laboratory should be avoided if possible. As stated in the Safety Rules for Laboratories, no one should perform experiments in the laboratory when alone unless arrangements have been with the Laboratory Instructor. Faculty and staff should not work alone in the laboratory without first notifying a colleague.

In the event that it is necessary to perform laboratory work alone, the following guidelines should be used to help minimize the potential risks of working alone in the laboratory:

1. Notify an instructor of when you intend to work.
2. Do not work alone in the laboratory if using acutely hazardous chemicals, carcinogens or embryo toxins.
3. Do not work alone if using an extremely reactive chemical, a toxic gas, or a compound that...
4.0 Exposure

Every effort should be made to minimize and mitigate exposure to hazardous and/or toxic chemicals, intermediates and products in the laboratory. This can be accomplished through careful planning of experiments by faculty and laboratory instructors and the use of engineered controls, Standard Operating Procedures, administrative procedures and personal protective equipment. When possible less hazardous substances should be substituted for more hazardous ones within a procedure.

4.10 Exposure

Every effort should be made to minimize and mitigate exposure to hazardous and/or toxic chemicals, intermediates and products in the laboratory. This can be accomplished through careful planning of experiments by faculty and laboratory instructors and the use of engineered controls, Standard Operating Procedures, administrative procedures and personal protective equipment. When possible less hazardous substances should be substituted for more hazardous ones within a procedure.

4.11 Laboratory Maintenance

1. Each week, the laboratory managers and engineering technicians will conduct a walkthrough of all laboratories to ensure that access to safety equipment is not hindered.
2. Emergency eyewash stations are flushed weekly and a log maintained by the appropriate laboratory manager or engineering assistant. The caps should pop off easily with the application of water pressure. Annual inspection logs for eyewash stations and safety showers are maintained by the Office of Facilities Management.

4.12 Fire Extinguishers

Fire extinguishers are provided in all laboratories in an area that is easily identifiable and accessible. Laboratory instructors should inform students and researchers on the location of fire extinguishing equipment at the beginning of each laboratory section. In addition to general purpose extinguishers throughout campus, a Class D (flammable solids) and Class B (flammable liquids) are kept in the Lab Managers office Kline 301.

4.13 Fire Blankets

Laboratories are also equipped with fire blankets. The location and use of fire blankets should also be noted by students and researchers at the beginning of each laboratory section.

5.0 Additional Messiah College Policies

In addition to the School of Science, Engineering and Health’ Chemical Hygiene Plan, several other Messiah College Policies apply to safe laboratory work. These policies are found in the Hazard Communication Program: Chemical Safety Manual (spill response, the Safety Manual (lock out/tag out) and the Exposure Control Plan (blood/body fluid clean up). All environmental, health and safety manuals are available through FalconLink.

These policies, in combination with the Department’s Chemical Hygiene Plan serve to meet all applicable OSHA and EPA safety regulations.

5.1 Service Animals

The accommodation of service animals in laboratories provide some unique challenges and every attempt will be made to accommodate a student but the “ADA contains no blanket policy mandating
the places of public accommodation permitting service animals under all circumstances” (Kincaid, 1966, p.16). With regard to a university/college, there may be possible restrictions of service animals in clinical practicums of nursing and health sciences programs, in food services programs, or in laboratories that can pose a safety risk. These exceptions would need to be considered individually to determine whether the dog poses a possible danger, and if other reasonable accommodations can be provided.” (http://www.oit.edu/academics/ssc/disability-services/service-animals). Similarly consideration must be given to the case were the presence of such an animal would fundamentally alter the nature of the laboratory activity.

Service animals will only be permitted in laboratories covered under the Chemical Hygiene Plan if the student has an approved accommodation from the Office of Disability Services and a detailed plan for the animal’s presence is developed among that office, the student, the instructor, the appropriate laboratory manager. All service animals and their owners are required to follow the rules and regulations set forth in Messiah College’s Assist Animal Policy.

While details of each accommodation will change on a case by case basis they should follow guidance contained in relevant publications such as the American Chemical Society’s Teaching Chemistry to Students with Disabilities and the Journal of Chemical Health and Safety’s paper: Service Dogs in the Chemistry Laboratory. Both of these documents are available in the Natural Science Laboratory Manager’s office (Kline 301). In general the animal should only be allowed in a safe area which minimizes its exposure to chemicals, spills, and broken glass. The animal should not be allowed to follow the student’s movements throughout the laboratory which would pose a danger not only to the animal but also create a trip hazard for others in the laboratory. In all cases not only are the safety and health of the individual student and their animal’s needs to be considered but other participants in the lab and the general public. For example, it would be totally inappropriate to have a service animal in a BioSafety Level 2 lab.

When acceptable accommodations can’t be made reasonable efforts will be made to provide alternative assignments. At no times will emotional support animals be allowed in laboratories covered by this plan.

5.2 Demonstrations

All demonstrations involving chemicals whether they occur on campus or off campus must be carried out in a safe environment with particular attention paid not only to the safety of the presenter but also the audience. The SEH policy for such demonstrations will follow the guidance contained in “Safety Guidelines for Chemical Demonstrations” published by the American Chemical Society Division of Chemical Education. As copy of this guidance is contained in Appendix G.

5.3 Exposure Limits

The use of OSHA regulated substances will be assessed and monitored as necessary to determine if individuals using regulated substances in laboratory settings within the School of Science, Engineering and Health are exceeding, or potentially exceeding the Action Level or Permissible Exposure Limit (PEL) as defined in 29 CFR 1910 Subpart Z. The American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV) or Biological Exposure Indices (BEI) may also be used where appropriate to determine if corrective action is necessary to minimize and mitigate employee or student exposure to hazardous materials.
5.4 Monitoring
Messiah College will determine the individual exposure for any substance regulated by OSHA or for which there is a TLV, BEI or action level for each process where there is reason to believe that exposure levels regularly exceed recommended levels. Records of exposure and possible exposure will be maintained by the Chemical Hygiene Officer and the Compliance Coordinator. Monitoring will be conducted if there is reason to believe that exposure levels regularly exceed recommended levels. Should exposure to a particular substance be found in excess for a particular process or area, subsequent monitoring and/or sampling for that substance will be conducted.

5.5 Overexposure
In the event that:
- An employee or student develops signs or symptoms associated with hazardous chemical exposure which they may have encountered in the laboratory.
- Exposure monitoring reveals an exposure level routinely above the action level (or PEL, TLV or BEI).
- An event takes place in the laboratory such as a spill, leak, explosion, or other occurrence resulting in the likelihood of a hazardous exposure.
- Several employees and/or students who work in the same laboratory area have similar complaints.
- An employee or student has direct contact with a hazardous chemical, an intermediate or product that is suspected of possessing hazardous qualities.

An exposure assessment may be conducted to determine the nature and extent of the harmful exposure. The assessment is only a tool to determine the events surrounding a specific incident. It is not intended to replace the evaluation and recommendation of the Chemical Hygiene Officer in relation to necessary corrective actions.

5.6 Employee Notification
The Department of Human Resources shall be responsible for the notification of occupationally exposed individuals as to the results of any monitoring tests pertaining to the laboratories or events in which those persons may have been exposed to hazardous chemicals. Employees who may have been exposed to hazardous materials should be notified in writing within 15 days of the receipt of the monitoring results. Employee medical records shall also be maintained by the Department of Human Resources, and employees are guaranteed access to their records as described in Messiah College’s Hazard Communication Policy. Students who may have been exposed to hazardous materials as part of laboratory coursework shall be notified in writing by the Engle Health Center within 15 days of the receipt of exposure monitoring results. Student medical records are to be maintained in the Engle Health Center.

5.7 Medical Examinations
Messiah College will provide an opportunity for any employee or student to receive a medical examination (including any follow-up examinations determined by the examining physician to be necessary) in the event that any or all circumstances outlined in section 6.3 Overexposure are met. All examinations of students are to take place through the Engle Health Center. Examination of employees, including student workers, must be in compliance with College’s worker compensation requirements and use medical care from the approved Panel of Physicians.
In the event of an emergency, Emergency Services should be notified via 911. The Department of Public Safety (6005) is available to coordinate EMS on campus.

If the situation is not an emergency, but requires the immediate attention of college health care personnel, the Engle Center (6035 or 717-691-6035 after hours) should be notified of the incident by phone, and the exposed student(s) should be taken to the Engle Center without delay. Exposed employees, including student employees, should be taken to a health care provider on the Panel of Physicians (The Engle Center is not on that list.)

During the summer when classes are not in session, the Engle Center is closed and thus not available to students in need of medical attention during that period of time. If there is a need for medical attention during the summer, the Department of Safety (6565) should be contacted for assistance.

Messiah College will provide the following information to the physician:
1. The identity of the hazardous chemical(s) to which the employee or student may have been exposed.
2. A description of the conditions under which the exposure occurred including quantitative exposure data if available.
3. A description of the signs and symptoms of exposure the affected person is experiencing, if any.
4. A Safety Data Sheet (SDS), if available or, if not, the toxic effect information which is available for the chemical.

When a medical consultation or examination occurs under the above circumstances Messiah College will obtain from the attending health care provider a written opinion which will include the following:
1. Results of the medical examination and any associated tests
2. Any recommendation for further medical follow-up
3. Any medical condition which may have been revealed by the examination which may place the affected person under increased risk as a result of exposure to a hazardous chemical found in the laboratory
4. A statement that the affected person has been informed by the physician of the results of the consultation or examination and any medical condition that may require further examination or treatment

The Department of Human Resources and Compliance will maintain all employee medical records. The Engle Health Center will schedule all medical examinations and maintain all medical records for students. Medical records, the results of any examination, or any medical test results are considered confidential. The physician’s written opinion obtained by the College should not contain any information or findings not immediately related to occupational exposure.

6.0 Chemical Procurement, Distribution and Storage

6.1 Procurement of Chemicals
The objective of this procedure is to assure that proper attention is given to planning for safe handling procedures, storage and disposal of chemicals prior to purchase of the chemical. This is the responsibility of the faculty member requesting the chemical. Assistance will be provided upon request
by the Chemical Hygiene Officer.

In planning laboratory experiments, professors should choose chemicals with minimal hazard where practical. However, it is impractical to try to educate undergraduates properly in chemistry without having them perform some laboratory work involving handling some hazardous chemicals. In fact, since any students who choose chemistry as a career will eventually encounter work with hazardous chemicals, it is prudent to include an introduction to safe procedures for handling such chemicals in their education. However, it is important to assure that careful thought is given to:

1. Hazards of the chemical
2. Potential routes of exposure
3. Whether or not a less hazardous chemical could be substituted
4. The safe handling procedures that are necessary to ensure the safe use of the chemical
5. The amount of the chemical that will be needed, so as to minimize the amount which will eventually be discarded
6. How long the chemical will remain stable in storage
7. How the chemical and its waste products will eventually be discarded safely

The following procedure is designed to assure that this planning will take place prior to purchase of any chemical.

Prior to purchasing any chemical, the faculty member involved should:

1. Investigate the hazards of the chemical considered for purchase. Messiah College maintains a contract with 3E Company to provide Safety Data Sheets (SDS) for the College’s chemical inventory. Additional information about the chemical may also be available from the manufacturer.
2. Check the current chemical inventory and avoid ordering more of the chemical than is needed for the near future. This is important in order to avoid accumulating more stock and possibly more waste than necessary. Please see the Chemical Hygiene Officer for access to the chemical inventory.

The purchase of acutely hazardous, carcinogenic, embryo toxic, highly reactive or unstable chemicals must be approved by the Chemical Hygiene Officer prior to the submittal of a purchase requisition.

6.2 Receiving Chemicals

All shipments of chemicals to Messiah College are received by Central Receiving in the Lenhert Building. It is the responsibility of Central Receiving to only accept packages from chemical vendors that are labeled correctly and intact. In the event that a package from a chemical vendor is received in a damaged condition, the Chemical Hygiene Officer should be contacted immediately and an SDS obtained for the material from 3E Company.

Central Receiving must also conform to all Department of Transportation (DOT) and Environmental Protection Agency (EPA) guidelines and regulations regarding the shipping and receiving of hazardous materials. Only DOT certified and college approved personnel may sign for chemical shipments.
6.2.1 Adding New Chemicals to the Chemical Inventory. Updating the chemical inventory databases will be accomplished by the applicable laboratory manager/Engineering assistant.

All incoming chemicals must be logged into the appropriate departments Chemical Inventory database and the 3E/Verisk GHS database.

These entries will include the full name, the appropriate GHS symbol, inventory control number, date received and either the manufacturers stock number or the CAS number. In addition the stock bottle must be labelled with an inventory control number, the date received and the appropriate GHS label (if not already present).

6.3 Chemical Storage

6.3.1 Location
For the Chemistry Department, the primary chemical storage area is located in Kline Room 301A. Smaller quantities of chemical are also stored in Kline 304, Kline 316, and Jordan 361. These rooms are equipped with ventilation systems that do not recirculate air through the building. Small quantities of chemicals may be stored in designated areas in fume hoods, laboratory shelves, or designated bench tops. All chemical storage shelves must have a one inch lip.

Chemical store rooms are secure areas. Only approved employees and students should be granted access to chemical storage areas. Particular caution should be taken to limit and monitor access to areas where especially toxic, radioactive, explosive or carcinogenic chemicals are stored.

6.3.2 Baker Storage Color Code System
The college had previously used the Baker Color coding system as indicated below to identify hazard classification (See appendix E). This system has been superseded by the GHS system and all labels should conform to the GHS guidance. However, some old chemicals may still be found utilizing the color coding system. When practicable the appropriate GHS label should be affixed to those bottles.
6.4 Special Storage Considerations

6.4.1 Storage for Flammable Materials
The use of flammable materials is very common in the laboratory setting and special consideration must be given to the proper storage of large quantities of flammable materials. Flammable materials in quantities less than five liters may be stored on bench tops or designated chemical storage hoods. The storage of flammable materials in quantities greater than five liters requires an approved flammable storage cabinet. In addition, metal storage cabinets should be properly grounded.

6.4.2 Storage of Explosives and Peroxide Formers
Currently, all explosive materials and materials with the potential to degrade into explosive materials are stored in flammable storage cabinets. Certain potentially explosive materials and highly flammable materials are stored in explosion proof refrigerators located in Kline 301 and Kline 308. These refrigerators are designed to suppress sparks that may ignite flammable vapors. The storage of peroxides and peroxide forming materials in these refrigerators is done with extreme caution as the lower temperature can cause peroxides to precipitate and crystals into a more dangerous form.

See also 8.8 Explosive Materials & Peroxide Formers and 8.18 Perchloric Acid

6.4.3 Compressed Gas Cylinders
Compressed gases are used throughout the School of Science, Engineering and Health. Some of these gases are inert and others are highly flammable. The pressure at which these gases are stored can make improper handling of gas cylinders very dangerous. Compressed gas cylinders should only be moved with their safety caps in-place and using the gas cylinder hand truck which has a strap to secure the cylinders. When storing these cylinders (even empty ones), in the receiving room or at the point of use, they must be chained individually in the gas cylinder rack and with their safety caps on. The changing of regulators should only be performed by personnel who are familiar with the safe handling of compressed gases.

6.4.4 Cryogenic Liquids
The School of Science, Engineering and Health currently uses cryogenic liquids in limited quantities. Liquid nitrogen is used in the Kline 313, 214, 227, Frey 049, Jordan J364 NMR room, and Frey . The NMR is also filled with Liquid Helium. Special care should be given to the handling and transport of liquid nitrogen and other cryogenic liquids as they can cause severe burns if they contact skin. The liquid nitrogen tanks are stored in the receiving room in Kline 103 and the NMR Room. Persons transporting or dispensing liquid nitrogen should wear long pants and sleeves, a lab coat, goggles and insulated gloves. Liquid nitrogen should only be transported in an adequately insulated container such as a Dewar. Cryogenic liquids may only be stored in either the liquid nitrogen tank supplied by the vendor or an approved vacuum container. Passengers should not ride on the elevator when transporting cryogens to different floors within the building. The appropriate tag should be placed on the elevator call button on to prevent another call for the elevator. The Dewar canister should be placed on the elevator and the elevator send unmanned to the destination where it will be met by the operator to
retrieve the canister. Transportation of Liquid Nitrogen off campus in a vehicle is only permitted in an approved Dewar with a capacity less than 10 Liters. Per DOT regulations this exception is only for transporting Liquid nitrogen for use in science relate demonstration. Procurement and transportation of Liquid Nitrogen to the college is expressly forbidden. Liquid Nitrogen is contracted for and delivered from a commercial vendor under the perview of the Natural Science Laboratory Manager. All college personnel with a legitimate need should obtain liquid nitrogen through that lab manager.

6.4.5 Ethanol
In accordance with the Commonwealth of Pennsylvania regulations, large quantities of ethanol are stored in a doubly locked flammable storage cabinet in Kline 301. Access to this cabinet is extremely restricted. Only the Natural Science Department Laboratory Manager and the Asst. have keys to the ethanol cabinet. A spare key is kept in the Department of Chemistry Lock box for emergency use only. Small quantities of dilute ethanol (up to five liters) may be stored in laboratories where ethanol is in use for laboratory procedures.

6.4.6 Water Reactive Substances
Water reactive chemicals such as alkali metals are stored in a water proof storage container in the flammable storage cabinets in Kline 301. This is the only approved storage area for water reactive chemicals. These materials are distributed in limited quantities and must be kept in sealed, water proof containers at all times. Storage containers may only be opened to remove the amount needed to carry out the current procedure.

6.5 Safety Data Sheets
Messiah College has contracted with 3E Company to provide SDS information for all chemicals in the college’s possession. 3E Company may be contacted at any time 24 hrs a day to receive current SDS information. 3E Company can also provide Exposure Control information and Poison Control Advice in the event of an accident. If a chemical is no longer present and there is no immediate need to reorder that chemical, the SDS should be “archived” in the 3E database. The Laboratory Manager or the Compliance Officer will ensure this occurs.

6.6 Annual Audit
Once a year, the entire chemical inventory will be audited to ensure that all chemicals in the possession of the School of Science, Engineering and Health are accounted for. A copy of that audit will be maintained by the Chemical Hygiene Officer in a Microsoft Excel Database. During the annual audit the chemical inventory will be evaluated based on anticipated use, storage container integrity, label legibility and shelf life. If during the audit, it is discovered that:

1. The original bottle/container is damaged, corroded, does not seal properly or is leaking, the bottle should be discarded according the Chemical Waste Disposal Policy (See Section 13) or the container shall be replaced and a new label affixed to it.
2. The original label is illegible, damaged, errant, or coming off of the container, it shall be replaced with a label that contains all necessary information including, but not limited to, chemical name, chemical formula, common name (if known) CAS number, date received,
NFPA hazard information, and quantity.

3. The Baker Storage Color Code sticker has fallen off; it shall be replaced with the appropriate GHS sticker according to the “Most Extreme Hazard” of the chemical.

4. Large quantities of old chemicals (date received > 10 years) shall be disposed of according to the Chemical Waste Policy (Section 13) to limit the chemical inventory only to what is needed for current procedures.

5. Chemicals being stored beyond their usable shelf they shall be disposed of in accordance with the Messiah College Hazardous Waste Disposal Policy (See Section 13).

Unused or unwanted department chemicals may be redistributed to other areas of campus provided that:

(a) The chemical(s) has not passed its expiration date (if any).
(b) The chemical is used in accordance with the Chemical Hygiene Plan for that department and any relevant Standard Operating Procedures.
(c) The Messiah College Hazard Communication is updated to inform the appropriate employees and students outside of the School of Science, Engineering and Health who may use or come in contact with the reused chemical.
(d) The chemical is ultimately disposed of properly according to the guidelines in the Chemical Waste Disposal Protocol.

The annual audit is intended to identify chemicals that are no longer useful to store and to correct any discrepancies in the database that may have developed throughout the year. The chemical inventory database is maintained in such a way that it is an up-to-date and accurate inventory at any time of the year. Every effort should be made by students, faculty, staff and administrators to keep the inventory current by removing depleted chemical supplies from the database and updating chemical locations.

6.7 Labels

All chemicals stored in the original bottles should maintain the manufacturer’s label which contains all the necessary information including, but not limited to, chemical name, chemical formula, common name (if known), CAS number, date received, GHS hazard information, and quantity. Damaged or partial labels that render important information illegible should be replaced immediately. Labelling with only a chemical formula is not permissible.

6.7.1 Secondary Labels

OSHA has two standards that cover the required labeling of secondary containers. The Hazard Communication standard (HCS 2012), 29 CFR1910.1200 which covers most of the campus and the OSHA Laboratory Standard, 29 CFR 1910.1450 which covers those laboratories within School of Science, Engineering, and Health which are covered by this CHP as delineated in Paragraph 2.1 above. All secondary labels for items in storerooms or teaching laboratories should include the chemical name, date, appropriate hazard warning and the identification of the individual who created the container. If numerous containers are needed for teaching labs for the period of a particular experiment, an acceptable alternative is to post the name and appropriate GHS symbol on a poster prominently displayed in the laboratory. Likewise, long-term storage of biological samples in a preservative should have that preservative either individually labeled or appropriate signage containing the name and hazard.
All materials stored in research labs for continuing use should likewise contain the chemical name, date, appropriate hazard warning and personal identification. However, the OSHA Laboratory Standard does allow some flexibility here: “For experimental materials where the items are stored and retained within a laboratory where the properties of materials are likely to be well understood, only sample identification and names are needed.” With this statement in mind, research materials and reactions vessels should be marked as to be clear to workers in the lab and a reaction in process sign indicating components should be posted if the reaction vessels are being held for longer than one working session. As above, labeling with only the chemical formula is not considered adequate.

6.8 Distribution
The distribution of chemicals is monitored by the Natural Sciences Laboratory Program Manager. Chemicals are assigned to a specific location and must be signed out using the reagent sign out sheets posted by the doors of each chemical storage room. Reagent bottles that are removed from their assigned storage areas must be labeled with a room identification sticker. Chemicals taken from store rooms must be returned promptly.

Chemicals may not be transported throughout the building without secondary containment. It is recommended that chemicals are transported using a cart with secure secondary containment to hold any spills. Small quantities of chemicals being transported may be placed in a plastic bucket for transport.

6.9 Off Campus Transportation of Chemicals
Messiah College is not a registered hazardous material transporter. Therefore, chemicals cannot be transported off campus by employees driving either private of Messiah College vehicles. The U.S. Department of Transportation does permit exceptions for small quantities of chemicals for educational demonstrations (see section 4.16) and research. In those cases, small quantities of chemicals can be transported by individuals if they are properly labeled and packaged. Transportation by public convenience is not permitted along with prohibitions against: acutely toxic substances, biological hazards, radioactive materials, compress gas cylinders. In addition, 49 CFR 172-101 contains quantity limits on specific substances. Any member of the School of Science, Engineering and Health wishing to transport any chemical off campus must obtain report it to the Chemical Hygiene Officer for review, guidance and approval. Hazardous Waste may not be transported off campus by any individual under any condition.

7.0 Standard Operating Procedures for Chemicals of Special Concern

7.1 Introduction
In the laboratory setting there are a multitude of chemicals that may be in use at any one time. It is possible that many of these chemicals have specific health hazards that are unknown or undocumented. Intermediate and unknown research products may also have hazards not documented within chemical literature. For this reason it is impossible to develop Standard Operating Procedures for all hazardous chemicals that may be encountered in the laboratory. It is recommended that all chemicals in the laboratory be handled as though they are hazardous to protect laboratory workers from unnecessary
skin contact and inhalation of potentially hazardous chemicals. The Standard Operating Procedures included here are written for general classes of chemicals and are not intended to be complete guidelines for use of specific substances. Individuals may need to develop additional procedures and precautions when using hazardous materials in a particular laboratory. In the event that additional procedures are necessary, the supervising faculty member and the Chemical Hygiene Officer should be consulted prior to using the hazardous substance. Ultimately, it is the responsibility of the individual(s) using the chemical(s) to ensure that all necessary safety precautions are followed.

Generally, the principle that should govern the handling of all hazardous substances is limiting exposure. This can be accomplished through the use of Personal Protective Equipment, laboratory fume hoods, glove boxes, respirators, or other administrative or engineered controls.

7.2 Acutely Hazardous Chemicals and Particularly Hazardous Substances (PHS)

7.2.1 Designated Areas

Acutely hazardous chemicals and particularly hazardous substances may only be used in designated areas and under the supervision of a faculty member. (See Section 9.0 Signs)

7.2.2 Record Keeping

Faculty and staff should maintain records of the names of students or employees using acutely hazardous materials under their direction, as well as the name of the chemical, the amount used, and the time spent exposed to the chemical. For assistance in monitoring exposure, the Compliance Coordinator should be contacted.

7.3 Carcinogens

Several organizations including the Occupational Safety and Health Administration (OSHA), the American Council for Governmental Industrial Hygienists (ACGIH), the National Toxicology Program (NTP) and the International Agency for Research on Cancer (IARC) maintain lists of known or suspected carcinogens. These lists are not exhaustive; therefore it is possible that chemical carcinogens used in the laboratory do not appear on the list. However, the list has been compiled from the most up-to-date research available. The list will be updated periodically as new information becomes available.

7.3.1 Select Carcinogens

A substance is a select carcinogen if:
- It is regulated by OSHA as a carcinogen in a specific standard
- Listed as “known to be a carcinogen” or “reasonable anticipated to be a carcinogen” by the National Toxicology Program (NTP)
- Or, it is listed as “carcinogenic to humans” or “probably or possibly carcinogenic to humans” by the International Agency for Research on Cancer.

These materials are strong carcinogens and should be handled as particularly hazardous substances. All guidelines, including record keeping and designated areas for use, outlined for acutely hazardous or particularly hazardous substances must be observed when using select carcinogens. Access to areas where carcinogens are in use should be restricted.
7.4 Embryo and Reproductive Toxins

Embryo and reproductive toxins are substances that alter normal reproductive functions. They include materials that are potentially harmful to men, women and fetuses. This category of chemicals includes toxins that cause mutations, chromosomal damage, birth defects, fetal deformities and fetal death. These substances are regulated by the Toxic Substance Control Act with information about specific hazards available in the SDS for that substance. The most extensive list of suspected Embryo and Reproductive toxins is maintained by the State of California under Proposition 65 and is referenced by both the State of Pennsylvania and the Federal government. This list can be found at: https://oehha.ca.gov/proposition-65/proposition-65-list. It should be noted that this list is under constant review. The current SDS for a given chemical should be consulted for the latest information.

Due to the potential harm these toxins can cause, every precaution should be taken to preclude exposure. In general these substances should not be used in freshman and sophomore level laboratories. In upper class laboratories or research where use of these substances may be required, the instructor will advise students of the risk, ensure that appropriate safety equipment is used and that proper laboratory techniques are observed. If a student is pregnant, lactating or expresses concern about being exposed to these substances an alternative assignment may be developed, if alternative assignments are requested for less than 10% of the experiments in a semester. In courses (BIOL 386 Human Anatomy and CHEM 347 Advanced Synthesis for example) with routine and repeated exposure to such hazards an alternative assignment may not result in the same educational outcome. In these courses, students who are pregnant, lactating, or who express concern will be allowed to take the course only with the specific written approval of their medical doctor.

7.5 Radioactive Materials

All procedures, demonstrations, research studies and other uses involving radioactive materials are subject to the approval of the Chemical Hygiene Officer and the Radiation Safety Officer. The Physics Department within the School of Science, Engineering and Health does maintain “exempt” radiation sources. Those sources should be managed under the guidance provided by section 24 of the College Safety Policy. The Radiation Safety Officer will monitor that compliance. In addition, all purchases of radioactive materials must first be approved by the Radiation Safety Officer.

7.6 Flammable Substances

Flammable liquids are any liquids that form a combustible or explosive mixture in air. The liquid itself does not burn, but rather the vapors released by the liquid. For this reason it is important to note the flashpoints of several common laboratory materials, as they have very low flashpoints and will combust readily in the presence of an ignition source. Care should be taken to use flammable materials only in areas that are free of ignition sources such as electric motors, open flames and hot surfaces. Avoid static electricity sparks by grounding metal containers. When using significant quantities of flammable materials, you must carry out the procedure in a fume hood to prevent the buildup of flammable vapors.

7.7 Hydrofluoric Acid

Hydrofluoric acid is an extremely toxic substance that poses particular health risks due to the fact that it deeply penetrates the skin and body tissue causing severe chemical burns. These burns can be excruciating, painful, long lasting and disfiguring. Once in the body, the fluoride ion can spread quickly
causing multiple organ toxicity. The Chemical Hygiene Officer must be consulted prior to working with hydrofluoric acid.

When working with hydrofluoric acid it is necessary to use neoprene gloves, goggles or a face mask, and a rubber or plastic apron. All procedures with hydrofluoric acid must be carried out in the hood. A supply of calcium gluconate gel must be readily available in the event of exposure. Any suspected exposure must be rinsed immediately with copious amounts of water and treated with calcium gluconate gel. Medical attention should be sought as soon as possible.

7.8 **Explosive Materials and Peroxide Formers**
Explosives are materials that are sensitive to heat, friction, impact, sparks, and other forms of ignition. They react violently when exposed to such conditions. Many of the explosive materials used in the laboratory come in the form of organic peroxides and peroxide forming compounds. As a class, organic peroxides are low power explosives, but their unpredictable and sensitive nature makes them one of the most dangerous classes of chemicals handled in the academic laboratory. These compounds are also light sensitive and highly reactive when exposed to strong oxidizing or reducing agents. The use of explosive materials and peroxides in the laboratory should be discussed with the Chemical Hygiene Officer prior to use, and appropriate Personal Protective Equipment should be provided.

Some peroxides used in the laboratory are commercially available, but many compounds form dangerous mixtures of peroxides by autoxidation. Special care should be given to the use and storage of the following classes of compounds:

- Aldehydes including acetaldehyde and benzaldehyde
- Ethers with primary and/or secondary alkyl groups, including acyclic and cyclic ethers, acetals, and ketals. Examples include, diethyl ether, diisopropyl ether, dioxane, dimethoxyethane, tetrahydrofuran, ethyl vinyl ether and alcohols protected as tetrahydropyranyl ethers. Isopropyl alcohol also frequently forms peroxides upon storage.
- Hydrocarbons with allylic, benzylic or propargylic hydrogens. Examples of this class of peroxide formers include cyclohexane, cyclooctene, methyl acetylene, isopropylbenzene (cumene) and tetralin (tetrahydronaphthalene).
- Conjugated dienes, enynes and diynes, among which divinylacetylene is particularly hazardous.
- Saturated hydrocarbons with exposed tertiary hydrogens; common peroxide formers include decalin (decahydronaphthalene) and 2,5-dimethylhexane.

Precautions for work with peroxide forming materials:

- Store peroxide forming materials away from heat and light.
- Protect peroxidizable compounds from physical damage, heat and light.
- Date peroxidizable containers with date of receipt and date of opening.
- Use or dispose of peroxides within the time limits recommended on the label or SDS.
- Test for peroxidizables before distilling or evaporating peroxidizable solvents for research purposes. Do not distill for research purposes without treating to remove peroxides. It is illegal to evaporate or treat a regulated waste to avoid disposal of that material. All waste materials should be disposed of as outlined in Section 14 Chemical
Waste Disposal.

- If crystals are visibly present on the container or lid, or if the container is open but has not been tested, do not open. Contact the Chemical Hygiene Officer to arrange for disposal.
- Immediately rinse empty containers that once held peroxidizables. Do not let residues evaporate.
- Do not store peroxidizables at such a low temperature that the peroxide may freeze or precipitate. The material is very dangerous in this form.

Source: Massachusetts Institute of Technology Chemical Hygiene Plan Template Revision 2

7.8.1 Test for Peroxides

Since peroxides can react violently, even at low concentrations, it is important to be able to determine whether or not peroxides are present in a solution that could potentially form them. If peroxides are suspected testing should be conducted using approved peroxide test strips or iaw the following American Chemical Society recommended procedure.

1. Mix a 1-3 mL aliquot of the solution with an equal volume of glacial acetic acid.
2. Add a few drops of aqueous potassium iodide solution and shake.
3. The appearance of a yellow/brown color indicates the presence of peroxides.

7.9 Corrosive Materials

For this Standard Operating Procedure, corrosive materials are considered to be any material, solid, liquid or gas that can rapidly damage human tissue, metal or other compounds by chemical action. The primary considerations when using corrosive materials are the use of Personal Protective Equipment and compatible containers and materials for procedures. Individuals using corrosives should wear rubber or neoprene gloves, goggles or a face shield and a rubber apron. Corrosive materials should only be used in areas with eye wash and safety shower stations. In case of exposure, flush with water and seek medical attention immediately.

7.10 Mercury and Mercury Compounds

Mercury is a heavy, silvery white, shiny metal which is liquid at ordinary room temperatures. It has an atomic weight of 200.61, melting point of -38.9°C, boiling point of 356.9°C and a specific gravity of 13.595. It is insoluble in water. It's vapors are colorless, odorless and tasteless.

7.10.1 Use

Metallic mercury has been almost completely eliminated in laboratory instruments; however some still exist. Mercury compounds are used in many laboratory experiments. Mercury thermometers should not be used where alcohol thermometers are satisfactory.

7.10.2 Toxicology

Metallic mercury and mercury compounds can be absorbed into the body by inhalation, ingestion or contact with the skin. It is a subtle poison, the effects of which are cumulative and not readily reversible. The maximum exposure level (Time-Weighted Average) for metallic mercury compounds is 0.05 mg/m³. The TWA for organic mercury compounds is 0.001 ppm.
Mercury poisoning from chronic inhalation exposure produces a variety of symptoms. The characteristic effects are emotional disturbances, unsteadiness, inflammation of the mouth and gums, general fatigue, memory loss and headaches. Kidney damage may also occur. In most cases of chronic inhalation exposures, the symptoms of poisoning usually disappear when the source of exposure is removed. However, improvement may be slow and complete recovery may take years. Skin contact with mercury compounds produces irritation and various degrees of corrosion. Absorption into the body through the skin may be great enough to produce mercurialism (Mercury poisoning). Rapid absorption of dimethylmercury through disposable gloves onto skin has caused a laboratory fatality at another university.

7.10.3 Storage, Use and Spill Prevention
Every effort should be made to prevent spills, since spilled mercury is extremely difficult and time-consuming to pick up. Droplets get into cracks and crevices, under table legs and under and into equipment. If spills are frequent and mercury is added to the general air level, the combined concentration may exceed the allowable limits.

Containers of mercury should be kept closed and stored in a well-ventilated area. If the container is glass, a secondary container should be provided. Waste mercury should be stored under water or in a special reclamation vessel. When using instruments or apparatus containing mercury and when breakage is a possibility, the equipment should be placed in a metal or plastic tray or pan which can be easily cleaned and is large enough to contain the mercury. Transfers of mercury from one container to another should be carried out in a hood, over a tray or pan to confine any spills.

7.11 Ethidium Bromide
Ethidium bromide is a carcinogen commonly used in the staining of electrophoresis gels. Ethidium bromide solutions and electrophoresis gels containing ethidium bromide should not be handled without taking precautions to limit exposure. Appropriate Personal Protective Equipment is adequate in most cases. However, concentrated ethidium bromide solutions should only be handled in a fume hood. Used staining solutions and electrophoresis gels are hazardous wastes and should be disposed of according to Section 14.0 Chemical Waste Disposal.

7.12 Allergens
Certain laboratory chemicals can cause individuals to develop allergic reactions after repeated exposure. Common laboratory allergens include diazomethane, chromium, nickel, formaldehyde, isocyanates, aryldrazines, benzylic and allyllic halides, and many phenolic compounds. As with all hazardous substances these substances should not be exposed to skin.

7.13 Compounds with Specific Health Risks
Many compounds used in the laboratory pose health risks to specific organs or body systems. These compounds include: (a) hepatotoxins, (substances that produce liver damage such as nitrosamines and carbon tetrachloride); (b) nephrotoxins (agents causing damage to the kidneys such as certain halogenated hydrocarbons); (c) neurotoxins (substances which produce their primary toxic effects on the nervous system such as mercury, acrylamide, and carbon disulfide); (d) agents which act on the
hematopoietic system (such as carbon monoxide and cyanides which decrease hemoglobin function and deprive the body tissues of oxygen); and (e) agents which damage lung tissue such as asbestos and silica.

Source: Massachusetts Institute of Technology Chemical Hygiene Plan Template Revision 2

### 7.14 Compounds with Acute Toxicity

29 CFR 1910.1200 Appendix A of the OSHA regulations provides the classifications for toxic and acutely toxic substances as follows:

<table>
<thead>
<tr>
<th>Test</th>
<th>Toxic</th>
<th>Highly Toxic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral LD(_{50})</td>
<td>50-500 mg/kg</td>
<td>&lt;50 mg/kg</td>
</tr>
<tr>
<td>(albino rats)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skin Contact LD(_{50})</td>
<td>200-1000 mg/kg</td>
<td>&lt;200 mg/kg</td>
</tr>
<tr>
<td>(albino rabbits)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhalation LC(_{50})</td>
<td>200-2000 ppm/air</td>
<td>&lt;200 ppm/air</td>
</tr>
<tr>
<td>(albino rats)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Several compounds in use in the laboratory setting may be classified as having a high degree of acute toxicity. Some examples include:

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

The above list is not exhaustive, and as with all laboratory procedures, it is the responsibility of the faculty member, laboratory instructor, or researcher to investigate the specific hazards associated with the chemicals in use in the laboratory.

### 7.15 Perchloric Acid

Perchloric Acid is a very strong acid that reacts violently with organic solvents and other substances. Hoods and Bench tops are not designed for working with Perchloric Acid. This substance has been removed from inventory and should not be found within the department.
7.16 Nitric Acid

Special care must be taken with nitric acid since it an extremely strong oxidizer. Numerous explosions have occurred in organic waste bottles when nitric acid waste was inappropriately added. In labs where there are both organic waste and solutions containing nitric acid present, extra precautions must be taken to ensure those waste streams are not mixed. For example: waste bottles could be segregated in designated hoods. Instructors must make a special effort in those labs to point out this hazard and closely monitor the disposal of waste.

7.17 Guidelines for Implementing Standard Operating Procedures

As noted throughout the Chemical Hygiene Plan, it is the responsibility of faculty member, laboratory instructor or researcher to investigate and plan for any and all potential hazards in the laboratory for which they are responsible. Prior to commencing any laboratory procedure, the following steps should be completed:

1. Determine the specific hazards and toxicities of the chemicals to be used in the laboratory.
2. Determine the most likely routes of exposure (i.e. inhalation, skin exposure, ingestion, etc.) based on the intended use and/or chemical properties of the materials to be used.
3. Determine necessary controls (i.e. the use of fume hoods, Personal Protective Equipment, etc.)
4. Plan for disposal of hazardous materials
5. Prepare for accidents and/or emergencies

The Chemical Hygiene Plan includes guidelines for use of the most common classes of hazardous materials used in the laboratory. If you require additional assistance in determining what Standard Operating Procedures are necessary for the materials being used in your laboratory, the Chemical Hygiene Officer and/or the Compliance Coordinator are available for consultation.

8.0 Signs

8.1 Safety Signage

All laboratories requiring Personal Protective Equipment are marked with safety signs. Signs may read “Goggles Required” or “Glove Required” and are not intended to be exhaustive in terms of what PPE may be necessary for a given procedure. Laboratory instructors will give specific instructions regarding PPE that may not be included on posted signs. Certain areas with specific hazards, such as those around autoclaves, are also marked with signs warning of the dangers and indicating what safety equipment is necessary.

8.2 Designated Areas

Certain chemicals, such as select carcinogens, reproductive and embryo toxins, and radioactive materials require special signs indicating areas where these chemicals may be in use. These signs are necessary for alerting individuals, who may or may not be directly involved with the current procedure,
of potential dangers.

Signs within the School of Science, Engineering and Health also designate areas for Hazardous Waste Accumulation and Chemical Storage Areas in fume hoods. Areas that are not designated for waste accumulation or chemical storage may not be used for those purposes.

8.3 Emergency Signs
In the event of an emergency, the location of first aid equipment is posted on the door of every laboratory. In the event of a fire or other incident requiring the evacuation of a laboratory, evacuation maps and plans can be found posted by the door on the inside of each laboratory. Emergencies should be reported immediately to the Department of Safety by calling Dispatch (x6565). The emergency number for 3E Company, which provides SDS information, is posted on every phone.

9.0 Spills
It is the policy of Messiah College to respond safely and appropriately to an accidental release or spill of hazardous materials. Any spill within the School of Science, Engineering and Health should be responded to as set forth in Section 8 of the Hazard Communication Program: Chemical Safety Manual. A copy of that procedure is available in all chemistry labs within Kline/Jordan.

10.0 Emergency Procedures
Emergency procedures for the School of Science, Engineering and Health are governed by the Compliance Coordinator and the Messiah College Emergency Action Plan found in the Messiah College Safety Manual available on FalconLink.

11.0 Employee Information and Training
The Compliance Coordinator shall oversee the training and retraining of employees. Internal and specific School of Science, Engineering and Health training and retraining for students and new faculty will be coordinated by the appropriate departmental chair, the School’s Chemical Hygiene Officer, and the appropriate departmental laboratory manager who will also maintain a record of student assistant training. Laboratory specific training and recording thereof for student research assistants is the responsibility of the applicable research director.

12.0 Personal Protective Equipment (PPE)

12.1 Safety Goggles
As noted in the Safety Rules for Laboratories, the only acceptable eye protection for laboratory use are goggles. Safety glasses do not provide adequate protection from splashes that can occur in the laboratory. Safety goggles should cover the eyes completely and have impact resistant lens to prevent debris from damaging the eyes in the event of an explosion.

12.2 Gloves

12.2.1 Scope
This procedure provides information and guidance for the selection and use of chemical resistant gloves. It does not apply to gloves for mechanical or electrical work or thermal protection.

12.2.2 Selection

No single glove material will effectively resist all chemicals. In selecting the proper glove for a specific use, several factors must be considered:

1. Chemical and physical properties of the chemical
2. Toxicological effects on the skin
3. Nature and severity of the exposure
4. Required duration of protection
5. Physical performance requirements
6. Length of glove needed

In many small scale laboratory operations carried out in Messiah College chemical laboratories chemicals of limited hazard by skin absorption are handled for a short time and no skin contact will occur if recommended procedures are followed. Gloves are worn for protection only in case some small contact does occur in which case the chemical can be washed off immediately. In such cases use of non-reusable gloves of poly(vinyl chloride), chloroprene or latex may be acceptable even though they would not be recommended for long term contact with the chemical. Such gloves are not acceptable for chemicals which are highly hazardous by skin absorption. Whenever a chemical is spilled on non-reusable gloves, the gloves should be removed immediately and the hands washed well with soap and water.

Each faculty member or laboratory instructor responsible for a laboratory will make the judgment of what type of glove is needed for the application. If disposable latex gloves are used, another type must be available for any worker who is allergic to natural rubber latex.

In case of possible contact with a chemical highly hazardous by skin absorption, potential long term contact with a chemical, or cleanup of a significant spill, recommended gloves for that particular chemical must be used. Provision of gloves for these situations is the responsibility of the professor overseeing the laboratory work. In most of the cases encountered in Messiah College laboratories, neoprene gloves will be satisfactory for these situations.

12.2.3 Care of Gloves

Before putting on gloves, the user should examine them for punctures or tears. If defects are found, they should be replaced. Periodically, reusable gloves should be tested for leaks by inflating with air and immersing in water. Bubbles will indicate leakage. An alternate test involves spinning the gloves by holding the cuff between the hands and, when full of air, twist the cuff to seal. Loss of pressure will indicate leakage.

Reusable gloves which are impervious to water should be cleaned after each use, and before removing, by rinsing thoroughly with water. Reusable gloves should always be stored in a clean and accessible area. Never store contaminated gloves.
13.0 Chemical Waste Disposal

13.1 Policy
The Messiah College Waste Manual governs the disposal of all chemical wastes generated by the School of Science, Engineering and Health. Below are items of particular concern to laboratories operating under this CHP. However, all personnel involved should be familiar with the governing policies contained in the Waste Manual. The Waste Manual also contains the latest version of local township regulations pertaining to what may be placed in the sanitary Sewage System.

13.2 Hazardous Waste Identification
Each hazardous waste accumulated for disposal must be assigned an EPA hazardous waste code as outlined by the Resource Conservation and Recovery Act (RCRA). These codes identify the characteristic and/or source of the waste. RCRA numbers will be assigned by the Chemical Hygiene Officer prior to disposal of the waste. The RCRA number will be assigned based on the hazardous waste log that is maintained at the point of generation for each waste container.

13.3 Hazardous Waste Labels
Every container used to accumulate or store hazardous waste must have a red label with the words “Hazardous Waste.” No other designation may be used for waste containers. Each waste container is assigned a number that is recorded in the Hazardous Waste Inventory maintained by the Chemical Hygiene Officer and which corresponds to the Hazardous Waste Log for that container. Each time waste is added to that container it must be recorded in the Hazardous Waste Log. Abbreviations and/or chemical formulas may not be used to label Hazardous Waste containers or record the contents of a Hazardous Waste container in the Hazardous Waste Log. (Example: Ethanol must be fully written out – not EtOH). Chemicals that are intended to be reused may not be labeled as waste. Hazardous Waste labels are available from the Chemical Hygiene Officer.

13.4 Containers
Hazardous waste generated by the School of Science, Engineering and Health is predominately stored in two liter or four liter glass bottles. Solid hazardous waste is most often stored in 1 Kg plastic bottles. All waste containers must be sealable and remain closed at all times except when adding waste to them. Wastes must be separated according to compatibility and stored in compatible containers.

13.5 Accumulation and Storage
While not regulated as a small waste generator, within SSEH those regulations will still be used to regulate storage. Hazardous Waste may be accumulated at or near the point of generation in properly designated areas with signs labeled “Hazardous Waste Satellite Accumulation Areas.” Up to 55 gallons of hazardous waste or one quart of acutely hazardous waste may be accumulated at a Satellite Accumulation Area (SAA) before it must be removed. Only one container per waste stream is permitted at an SAA. Once a Hazardous Waste container is full, the date that the container was filled must be placed on the label. The Chemical Hygiene Officer should be contacted immediately to pick up the container and provide a new one if necessary. It is important that Hazardous Waste containers are not filled all the way to the top; some space must be left in the top of the container. The Chemical Hygiene Officer will arrange for the transportation of full containers to the Central Accumulation...
Area by the Waste Coordinator.

SAA’s are to be inspected by the Chemical Hygiene Officer on a weekly basis to ensure that all containers are labeled, sealed properly, and that each waste stream has the appropriate waste log. It is the ultimate responsibility of the person in charge of the laboratory where the SAA is located to oversee its daily use, but the Chemical Hygiene Officer will be available for consultation regarding the SAA’s and their proper use. If it becomes apparent during a weekly inspection that an SAA is not being used or maintained properly, the Chemical Hygiene Officer will assist the personnel in charge of the SAA in correcting the issue.

13.6 Incompatible Wastes

Wastes must be segregated according to category and special care must be taken to not mix incompatible wastes. Examples of incompatible wastes are given below (the list is not exhaustive). Mixing incompatible wastes could result in a serious explosion or fire. Incompatible wastes must be segregated by distance or secondary containers.

<table>
<thead>
<tr>
<th>Group 1-A</th>
<th>Group 1-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetylene sludge</td>
<td>Acid sludge</td>
</tr>
<tr>
<td>Akaline caustic liquids</td>
<td>Acid and water</td>
</tr>
<tr>
<td>Akaline cleaner</td>
<td>Battery acid</td>
</tr>
<tr>
<td>Akaline corrosive liquids</td>
<td>Chemical cleaners</td>
</tr>
<tr>
<td>Akaline corrosive battery fluid</td>
<td>Electrolyte, acid</td>
</tr>
<tr>
<td>Caustic wastewater</td>
<td>Etching acid liquid or solvent</td>
</tr>
<tr>
<td>Lime sludge and other corrosive alkalines</td>
<td>Pickling liquor and other corrosive acids</td>
</tr>
<tr>
<td>Lime wastewater</td>
<td>Spent acid</td>
</tr>
<tr>
<td>Lime and water</td>
<td>Spent mixed acid</td>
</tr>
<tr>
<td></td>
<td>Spent sulfuric acid</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group 2-A</th>
<th>Group 2-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>Any waste in Group 1-A or 1-B</td>
</tr>
<tr>
<td>Beryllium</td>
<td></td>
</tr>
<tr>
<td>Calcium</td>
<td></td>
</tr>
<tr>
<td>Lithium</td>
<td></td>
</tr>
<tr>
<td>Magnesium</td>
<td></td>
</tr>
<tr>
<td>Potassium</td>
<td></td>
</tr>
<tr>
<td>Sodium</td>
<td></td>
</tr>
<tr>
<td>Zinc powder</td>
<td></td>
</tr>
<tr>
<td>Other reactive metals and metal hydrides</td>
<td></td>
</tr>
</tbody>
</table>

School of Science, Engineering and Health Chemical Hygiene Plan 2014-2015 (revised 1/11, 1/12, 5/13, 6/14, 7/17, 6/17, 6/18) 35
Potential consequences: Fire or explosion; generation of flammable hydrogen gas.

<table>
<thead>
<tr>
<th>Group 3-A</th>
<th>Group 3-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohols</td>
<td>Any concentrated waste in</td>
</tr>
<tr>
<td>Groups 1-A or 1-B</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>Calcium</td>
</tr>
<tr>
<td>Lithium</td>
<td></td>
</tr>
<tr>
<td>Metal hydrides</td>
<td></td>
</tr>
<tr>
<td>Potassium</td>
<td></td>
</tr>
<tr>
<td>Other water-reactive waste</td>
<td></td>
</tr>
</tbody>
</table>

Potential consequences: Fire, explosion, or heat generation; generation of flammable or toxic gases.

<table>
<thead>
<tr>
<th>Group 4-A</th>
<th>Group 4-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohols</td>
<td>Concentrated Group 1-A or</td>
</tr>
<tr>
<td>1-B</td>
<td>wastes</td>
</tr>
<tr>
<td>Aldehydes</td>
<td>Group 2-A wastes</td>
</tr>
<tr>
<td>Halogenated hydrocarbons</td>
<td></td>
</tr>
<tr>
<td>Nitrated hydrocarbons</td>
<td></td>
</tr>
<tr>
<td>Unsaturated hydrocarbons</td>
<td></td>
</tr>
<tr>
<td>Other reactive organic compounds and solvents</td>
<td></td>
</tr>
</tbody>
</table>

Potential consequences: Fire, explosion, or violent reaction.

<table>
<thead>
<tr>
<th>Group 5-A</th>
<th>Group 5-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spent cyanide and sulfide solutions</td>
<td>Group 1-B wastes</td>
</tr>
</tbody>
</table>

Potential consequences: Generation of toxic hydrogen cyanide or hydrogen sulfide gas.

<table>
<thead>
<tr>
<th>Group 6-A</th>
<th>Group 6-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorates</td>
<td>Acetic acid and other organic acids</td>
</tr>
<tr>
<td>Chlorine</td>
<td>Concentrated mineral acids</td>
</tr>
<tr>
<td>Chlorites</td>
<td>Group 2-A wastes</td>
</tr>
<tr>
<td>Chromic acid</td>
<td>Group 4-A wastes</td>
</tr>
<tr>
<td>Hyphochlorites</td>
<td>Other flammable and combustible wastes</td>
</tr>
<tr>
<td>Nitrates</td>
<td></td>
</tr>
<tr>
<td>Nitric acid, fuming</td>
<td></td>
</tr>
<tr>
<td>Perchlorates</td>
<td></td>
</tr>
<tr>
<td>Permanganates</td>
<td></td>
</tr>
<tr>
<td>Peroxides</td>
<td></td>
</tr>
<tr>
<td>Other strong oxidizers</td>
<td></td>
</tr>
</tbody>
</table>
Potential consequences: Fire, explosion, or violent reaction.

13.7 Wastes Requiring Special Procedures

13.7.1 Unknown Waste
By law, unknown wastes may not be disposed of without first performing an analysis to determine the composition of the waste and any associated hazards. If the generator of the unknown waste is unable to determine its composition the generator must contact the Chemical Hygiene Officer to arrange for analysis.

13.7.2 Gas Cylinders
Compressed gas cylinders are to be returned to the supplier. Lecture bottles are not accepted for return by many compressed gas suppliers, and therefore, the purchase of these items is discouraged.

13.7.3 Radioactive Waste
The disposal of radioactive materials is the responsibility of the Radiation Safety Officer. Contact the Radiation Safety Officer for assistance with disposal.

13.7.4 Sharps Waste – Chemically Contaminated
Sharps waste such as broken glassware or syringes that are chemically contaminated are considered hazardous wastes. These materials must be packaged in a sharps proof container and disposed of as hazardous waste.

13.7.5 Sharps Waste – Clean
Broken glassware that is not chemically contaminated may be disposed of in the broken glass disposal boxes provided in each laboratory. Any syringes should be placed in a sharps container for disposal.

Definitions

Action level means a concentration designated in 29 CFR part 1910 for a specific substance, calculated as an eight (8)-hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

Assistant Secretary means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

Carcinogen (see select carcinogen).

Chemical Hygiene Officer means an employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. This definition is not intended to place limitations on the position description or job classification that the designated individual shall hold within the employer's organizational structure.
Chemical Hygiene Plan means a written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices that (i) are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace and (ii) meets the requirements of paragraph (e) of this section.

Combustible liquid means any liquid having a flashpoint at or above 100 deg. F (37.8 deg. C), but below 200 deg. F (93.3 deg. C), except any mixture having components with flashpoints of 200 deg. F (93.3 deg. C), or higher, the total volume of which make up 99 percent or more of the total volume of the mixture.

Compressed gas means:
(i) A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70 deg. F (21.1 deg. C); or
(ii) A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130 deg. F (54.4 deg C) regardless of the pressure at 70 deg. F (21.1 deg. C); or
(iii) A liquid having a vapor pressure exceeding 40 psi at 100 deg. F (37.8 C) as determined by ASTM D-323.

Designated area means an area which may be used for work with "select carcinogens," reproductive toxins or substances which have a high degree of acute toxicity. A designated area may be the entire laboratory, an area of a laboratory or a device such as a laboratory hood.

Emergency means any occurrence such as, but not limited to, equipment failure, rupture of containers or failure of control equipment which results in an uncontrolled release of a hazardous chemical into the workplace.

Employee means an individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments.

Explosive means a chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

Flammable means a chemical that falls into one of the following categories:
(i) Aerosol, flammable means an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame protection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;
(ii) Gas, flammable means:
(A) A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent by volume or less; or
(B) A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12 percent by volume, regardless of the lower limit.
(iii) Liquid, flammable means any liquid having a flashpoint below 100 deg F (37.8 deg. C), except any mixture having components with flashpoints of 100 deg. C or higher, the total of which make up 99 percent or more of the total volume of the mixture.
(iv) Solid, flammable means a solid, other than a blasting agent or explosive as defined in § 1910.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate
greater than one-tenth of an inch per second along its major axis.

**Flashpoint** means the minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested as follows:
(i) Tagliabue Closed Tester (See American National Standard Method of Test for Flash Point by Tag Closed Tester, Z11.24 - 1979 (ASTM D 56-79)) - for liquids with a viscosity of less than 45 Saybolt Universal Seconds (SUS) at 100 deg. F (37.8 deg. C), that do not contain suspended solids and do not have a tendency to form a surface film under test; or
(ii) Pensky-Martens Closed Tester (See American National Standard Method of Test for Flashpoint by Pensky-Martens Closed Tester, Z11.7 - 1979 (ASTM D 93-79)) - for liquids with a viscosity equal to or greater than 45 SUS at 100 deg. F (37.8 deg. C), or that contain suspended solids, or that have a tendency to form a surface film under test; or
(iii) Setaflash Closed Tester (see American National Standard Method of test for Flash Point by Setaflash Closed Tester (ASTM D 3278-78)).

Organic peroxides, which undergo autoaccelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified above.

**Hazardous chemical** means 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.

Appendices A and B of the Hazard Communication Standard (29 CFR 1910.1200) provide further guidance in defining the scope of health hazards and determining whether or not a chemical is to be considered hazardous for purposes of this standard.

**Laboratory** means a facility where the "laboratory use of hazardous chemicals" occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.

**Laboratory scale** means work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safety manipulated by one person. "Laboratory scale" excludes those workplaces whose function is to produce commercial quantities of materials.

**Laboratory-type hood** means a device located in a laboratory, enclosure on five sides with a movable sash or fixed partial enclosed on the remaining side; constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory; and allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms.

Walk-in hoods with adjustable sashes meet the above definition provided that the sashes are adjusted during use so that the airflow and the exhaust of air contaminants are not compromised and employees do not work inside the enclosure during the release of airborne hazardous chemicals.

**Laboratory use of hazardous chemicals** means handling or use of such chemicals in which all of the following conditions are met:
(i) Chemical manipulations are carried out on a "laboratory scale;"
(ii) Multiple chemical procedures or chemicals are used;
(iii) The procedures involved are not part of a production process, nor in any way simulate a production process; and
(iv) "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

**Medical consultation** means a consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examinations or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.

**Organic peroxide** means an organic compound that contains the bivalent \(-O-O-\) structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.

**Oxidizer** means a chemical other than a blasting agent or explosive as defined in § 1910.109(a), that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

**Physical hazard** means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer pyrophoric, unstable (reactive) or water-reactive.

**Protective laboratory practices and equipment** means those laboratory procedures, practices and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective, in minimizing the potential for employee exposure to hazardous chemicals.

**Reproductive toxins** means chemicals which affect the reproductive chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

**Select carcinogen** means any substance which meets one of the following criteria:
(i) It is regulated by OSHA as a carcinogen; or
(ii) It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP)(latest edition); or
(iii) It is listed under Group 1 ("carcinogenic to humans") by the International Agency for research on Cancer Monographs (IARC)(latest editions); or
(iv) It is 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:
(A) 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/m(3);
(B) After repeated skin application of less than 300 (mg/kg of body weight) per week; or
(C) After oral dosages of less than 50 mg/kg of body weight per day.

**Unstable (reactive)** means a chemical which is the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature.

**Water-reactive** means a chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

*School of Science, Engineering and Health Chemical Hygiene Plan 2014-2015 (revised 1/11, 1/12, 5/13, 6/14, 7/17, 6/17, 6/18)*
1 http://www.osha.gov
Appendix A

OSHA PEL’s and ACGIH TLV’s


Appendix B

Table of Known and Suspected Carcinogens

For the most up-to-date information on known and suspected carcinogens, consult the following agencies.


Appendix C

OSHA Laboratory Safety Standard 29 CFR 1910.1450

## Appendix D

### Inspection Checklists

#### Laboratory Weekly Inspection Checklist

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**Corrective Actions:**

**Date of Completion:**

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**APPENDIX E**

**Cross Reference Baker System to GHS**

In accordance with Federal Law we are transitioning to the Globally Harmonized System (GHS). This chart provides a cross reference between the existing Baker Color Code system and the GHS system. All newly stocked chemicals will be labeled with the GHS labels.

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<td>Oxidizer</td>
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<td>Acutely Toxic (Severe)</td>
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<td>Carcinogen, Reproductive Hazards</td>
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Appendix F

Safety Guidelines for Chemical Demonstrations

American Chemical Society Division of Chemical Education

Appropriate physical and chemical demonstrations in the classroom or in a public venue have both educational and motivational value and are a long-standing pedagogy in chemical education. Individuals planning chemical demonstrations have a responsibility to follow and document safe laboratory practices for each demonstration. These guidelines have been created based on current best practices and provide a checklist of key issues for demonstrators to assure that chemical demonstrations are conducted safely and without incident. Because no such set of guidelines can address all possible issues, only persons who have appropriate education and experience in chemistry and chemical safety should perform chemical demonstrations. Accordingly, these guidelines are intended for use only by experienced chemical practitioners.

Before the Demonstration

1. Always follow a tested, written procedure that includes comprehensive safety precautions. Plan the demonstration at the smallest scale possible for the location and viewers.
2. Review the safety precautions which will help you identify the potential hazards involved in the demonstration and understand the risks due to exposure and/or improper handling of a chemical, process, or procedure. Effective safety precautions provide easy-to-follow instructions to minimize risk and prevent unplanned incidents that could result in injury or property damage.
3. If a written procedure is not available, or safety precautions are not clear, perform an independent hazard and risk assessment to identify the possible hazards and evaluate the risks. In the risk assessment, consider the pedagogical value compared to the risk. Write the demonstration procedure with appropriate safety precautions to protect against the hazards and reduce risk. Refer to these guidelines as you write the demonstration procedure, and retain the procedure on file for future use.
4. Always practice a demonstration before presenting it before students or an audience for the first time.
5. Ensure that all demonstrations are appropriate for the room being used and the available safety equipment. Keep all exit paths clear. Check the ventilation in the demonstration area to ensure that participants and audience members will not be exposed to harmful quantities of toxic gases or chemical vapors. The use of a fume hood is required for any demonstration that uses or produces a substance with a TLV less than 50 ppm (check the SDS for the TLVs of all chemicals).
6. Consult current Safety Data Sheets (SDS) and review the safe handling information for all chemicals used in the demonstration.
7. Prepare and follow a safety checklist for all combustion demonstrations involving the use of a flammable liquid. Dispense only the amount of the liquid required BEFORE beginning the demonstration. Cap the solvent bottle and REMOVE it from the demonstration area before applying the ignition source. NEVER add more flammable liquid to a combustion demonstration once it is underway.
8. Ensure that observers will be a safe distance (10 feet or more) or are protected by a physical barrier, such as a polycarbonate shield, from the demonstration area when working with flammable, corrosive or toxic substances. In a small setting such as a classroom or lab, all participants and observers must wear appropriate eye protection at all times.
9. Ensure there is an appropriate fire extinguisher on hand whenever the slightest possibility of fire exists and that you have the knowledge, experience and training to use it properly in the event of an emergency.
10. Keep a spill kit nearby to contain, absorb, and neutralize any spilled chemicals.
11. Plan for appropriate handling or disposal of reaction byproducts or excess chemicals in accordance with institutional policies.
During the Demonstration

12. Wear appropriate personal protective equipment (PPE) for the level of risk as determined by the assessment, such as chemical splash goggles, chemical-resistant gloves, and a lab coat, to protect against the hazards. Active participants must also wear appropriate PPE.

13. Provide safety shield protection whenever there is the slightest possibility that a container, its fragments or the contents could be propelled with sufficient force to cause exposure and/or personal injury.

14. Warn members of the audience to cover their ears if a loud noise is anticipated.

15. Participants and spectators must not taste any food or non-food substances used in the demonstration.

16. Do not perform demonstrations in which parts of the human body will be placed in danger (such as placing dry ice in the mouth or dipping hands into a hazardous liquid).

Special Notes for Outreach or Public Demonstrations

17. Ensure proper packaging and secondary containment for the safe transport of all chemicals to and from off-site locations. Materials of Trade (MOT) exceptions to Department of Transportation requirements allow for the transport of certain hazardous materials without a license or shipping papers provided certain guidelines are met. There are strict limits on the amounts of material, depending on the hazard. Visit the links below for more information about hazard classes, packaging requirements, and restrictions on the amounts of chemicals.

https://hazmatonline.phmsa.dot.gov/services/publication_documents/MOTS05.pdf
http://www.acs.org/content/dam/acsorg/about/governance/committees/chemicalsafety/safetypractices/transporting-chemicals.pdf

18. Notify security and/or administrators that you will be performing demonstrations. If public space will be used for demonstrations involving fire, contact the local fire department to determine if the demonstrations meet local fire and building use codes.

19. Provide a written demonstration procedure, including comprehensive safety precautions and risk assessments, whenever the audience will be encouraged to conduct the demonstration at another time.

References
U.S. Chemical Safety Board: Key Lessons for Preventing Incidents from Flammable Chemicals in Educational Demonstrations http://www.csb.gov/key-lessons-for-preventing-incidents-from-flammable-chemicals-in-educational-demonstrations/

Disclaimer: The guidance in this document has been compiled by recognized authorities from sources believed to be reliable and to represent the best practices on the subject. These guidelines are intended to serve only as a starting point for good practices and do not purport to specify minimal legal standards or to represent the policy of the American Chemical Society. No warranty, guarantee, or representation is made by the American Chemical Society or the ACS Division of Chemical Education as to the accuracy or sufficiency of the information contained herein, and neither the Society nor the Division assume any responsibility in connection therewith. October, 2016