Lane Community College

Science, Mathematics, and Engineering Division

Chemical Hygiene Plan

2nd Edition

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Oregon Occupational Safety and Health Administration

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INTRODUCTION

With the promulgation of the OSHA Laboratory Standard (29 CFR 1910.1450), a culture of safety consciousness, accountability, organization, and education has developed in industrial, governmental, and academic laboratories. Safety and training programs have been implemented to promote the safe handling of chemicals from ordering to disposal and to train laboratory personnel in safe practices.

The objective of this Chemical Hygiene Plan (CHP) is to meet legislative requirements of OAR 437-02-1910, Occupational Exposure to Hazardous Chemicals in Laboratories (Appendix A), and to protect the employees of Lane Community College Science, Math, Engineering Division from health hazards associated with hazardous chemicals. The plan is based on the Occupational Safety and Health Administration (OSHA) compliance laws, American Chemical Society (ACS) chemical safety recommendations, the National Fire Protection Association (NFPA) standard on fire protection for laboratories using chemicals, and the State of Oregon Department of Environmental Quality (DEQ) guidelines for handling of hazardous waste. This program will function through fundamental rules, standard operating procedures, and facility maintenance. The success of the program will be dependent on management support and employee cooperation.

Laboratory personnel must realize that the welfare and safety of each individual depends on clearly defined attitudes of teamwork and personal responsibility. Learning to participate in this culture of habitual risk assessment, experiment planning, and consideration of worst-case possibilities—for oneself and one's fellow workers—is as much part of a scientific education as learning the theoretical background of experiments or the step-by-step protocols for doing them in a professional manner.

A crucial component of chemical education for all personnel is to nurture basic attitudes and habits of prudent behavior so that safety is a valued and inseparable part of all laboratory activities throughout their career. In order to perform their work in a prudent manner, laboratory personnel must consider the health, physical, and environmental hazards of the chemicals they plan to use in an experiment. However, the ability to accurately identify and assess laboratory hazards must be taught and encouraged through training and ongoing organizational support. This training must be at the core of every good health and safety program. For management to lead, personnel to assess worksite hazards, and hazards to be eliminated or controlled, everyone involved must be trained.

Locations of this plan

1. Locations on file server:
    a. Use the following link and log in with your L-number:

        https://filr.lanecc.edu/

    b. Navigate to one of the following locations to find the CHP:
        i. Net Folders > Science > Division Records > Safety > Plans & Programs > Chemical Hygiene Plan

ii. Net Folders > Science > Divisions Records > Chemical Hygiene Officer > Chemical Hygiene Plan

2. Google Drive > SME Division Resources > Safety & CHO > Chemical Hygiene Plan

   Link: https://drive.google.com/drive/folders/1nfevXQlZJwX3icU59sI_YnfcrrkUNafi

3. A **Printed Copy** is available in the office of the Chemical Hygiene Officer.

SCOPE

This Chemical Hygiene Plan (CHP) applies to all employees working on laboratory scale operations involving use of hazardous chemicals at Lane Community College's Science, Mathematics, and Engineering Division. Much of the CHP can be extended to employees who conduct science field trips and who use hazardous chemicals and other hazardous materials for their work. It is designed to serve as a guide to safely working in laboratories, classrooms, and stockrooms containing and using chemicals. It shall also serve as a notice of the College's policies and contains descriptions of best practices that should be followed in a laboratory environment.

This CHP is not sufficiently detailed to address every laboratory practice, process, procedure, or piece of equipment used in each laboratory. More detailed Standard Operating Procedures (SOPs) should be written and maintained readily available for specific potentially hazardous laboratory processes, procedures, and major pieces of equipment used.

The CHP is a living document that shall be altered/updated as new information regarding safety, laboratory best practices, regulations, and procedures is discovered and as materials, processes, and equipment are added to, changed, or removed from a laboratory.

ACRONYMS and DEFINITIONS

Commonly Used Acronyms

ACC: Acceptable Ceiling Concentration

ACS: American Chemical Society

ANSI: American National Standards Institute

CAR: Center for Accessible Resources

CFR: Code of Federal Regulations

CHO: Chemical Hygiene Officer

CHP: Chemical Hygiene Plan

COPPS: College Online Policy and Procedure System

DEQ: Oregon Department of Environmental Quality

DOT: Department of Transportation

EPA: Environmental Protection Agency

fpm (cubic) feet per minute

GHS: Globally Harmonized System of Classification

HAZMAT: Hazardous Materials

HEPA: High-efficiency Particulate Air

LD50: Lethal Dose, 50%

NIOSH: National Institute for Occupational Safety and Health

NFPA: National Fire Protection Association

OAR: Oregon Administrative Rules

OSHA: Occupational Safety and Health Administration

PEL: Permissible Exposure Limit

PPE: Personal Protective Equipment

RCRA: Rescue Conservation and Recovery Act

SAA: Satellite Accumulation Area

SAP: Science Administrative Procedures

SDS: Safety Data Sheet

SOP: Standard Operating Procedure

SME: Science, Math, and Engineering

STEL: Short Term Exposure Limit

TVL: Threshold Limit Value

TWA: Time Weighted Average

UL: Underwriters Laboratories

Definitions

Action Level - A concentration designated in OSHA regulations for a specific substance, calculated as an 8-hour time weighted average (TWA), that initiates certain required activities.

Bloodborne Pathogen - Pathogenic micro-organisms that are present in human blood and can cause disease in humans. These pathogens include, but are not limited to, Hepatitis B Virus (HBV) and Human Immune Deficiency Virus (HIV).

CHP – Chemical Hygiene Plan, a written program developed and implemented that sets forth procedures, equipment, personal protective equipment and work practices that are capable of protecting employees from the health hazards presented by hazardous chemicals used in the laboratory.

Combustible - A material that has a Flash Point at or above 140° F.

Contractor - An individual who is on site to complete a contracted responsibility and whose direct compensation is not being paid by.

Chemical whose toxic properties are unknown -- A chemical for which there is no known statistically significant study conducted in accordance with established scientific principles that establishes its toxicity.

Designated Area - An area that may be used for work with select carcinogens, reproductive toxins or substances that 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.

Employee - An individual paid by LCC who is employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments. This may include faculty, classified staff, and student workers.

Flammable Liquid - A material that has a flashpoint below 140° F and a vapor pressure not exceeding 40 pounds per square inch, absolute (psia) at 100° F.

Hazardous Chemical Per OSHA Laboratory Standard: any chemical which is classified as a health hazard or simple asphyxiant in accordance with the Hazard Communication Standard 1910.1200. 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 that are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents that act on the hematopoietic systems and agents that damage the lungs, skin, eyes or mucous membranes.

Health Hazard - Per OSHA Laboratory Standard: a chemical that is classified as posing one of the following hazardous effects: Acute toxicity (any route of exposure); skin corrosion or irritation; serious eye damage or eye irritation; respiratory or skin sensitization; germ cell mutagenicity; carcinogenicity; reproductive toxicity; specific target organ toxicity (single or repeated exposure); aspiration hazard. The criteria for determining whether a chemical is classified as a health hazard are detailed in appendix A of the Hazard Communication Standard (§1910.1200) and §1910.1200(c) (definition of "simple asphyxiant").

Laboratory - A workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.

Laboratory Scale - Work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person (also may be called Bench Scale).

Laboratory Standard - The procedures and standards encompassed by OAR 437-002-0360

Laboratory Use of Hazardous Chemicals - Handling or use of such chemicals in which all of the following conditions are met:

1. Chemical manipulations are carried out on a laboratory scale.
2. Multiple chemical procedures or chemicals are used.

3. The procedures involved are not part of a production process nor in any way simulate a production process.
4. Protective laboratory practices and equipment are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

Permissible Exposure Limit (PEL) - For laboratory uses of OSHA regulated substances, the employer shall assure that employees' exposures to such substances do not exceed the permissible exposure limits specified in 29 CFR Part 1910, Subpart Z.

Physical Hazard – Per OSHA Laboratory Standard: a chemical that is classified as posing one of the following hazardous effects: explosive; flammable (gasses, aerosols, liquids, or solids); oxidizer (liquid, solid, or gas); self-reactive; pyrophoric (gas, liquid or solid); self-heating; organic peroxide; corrosive to metal; gas under pressure; in contact with water emits flammable gas; or combustible dust. The criteria for determining whether a chemical is classified as a physical hazard are in appendix B of the Hazard Communication Standard (§1910.1200) and §1910.1200(c) (definitions of "combustible dust" and "pyrophoric gas").

Reproductive Toxins - Chemicals that affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogens); any substance described as such in the applicable SDS. For example: Any substance identified as a reproductive toxin by the Oak Ridge Toxicology Information Resource Center (TIRC), (615) 576-1746; or for teratogens only: Any substance identified as such in Thomas H. Shepard, " Catalog of Teratogenic Agents," 6th ed., John Hopkins Press, 1989.

Select Carcinogen - Any substance that meets one of the following criteria:

It is defined as such in 29 CFR 1910.1450 and regulated by OSHA as a carcinogen, or

It is listed under the category "Known to be Human Carcinogens", in the latest Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition) or

It is listed under Group 1 (carcinogenic to humans) by the International Agency for Research on Cancer Monographs (IARC) (latest editions) or

It is listed in either Group 2A or 2B by IARC or under the category "Reasonably Anticipated To Be Human Carcinogens" by NTP or

It is described as such in the applicable SDS.

Shall/Should -- In this document, "shall" indicates a required condition or action; "should" indicates a preferred laboratory practice or condition.

Substance with a high degree of acute toxicity -- Any substance for which the LD50 data described in the applicable SDS causes the substance to be classified as a "highly toxic chemical" as defined in ANSI Z129.1.

Visitor -- An individual on the LCC campus not defined as an employee, who is on site by invitation and is not present in a contractual capacity.

RIGHTS AND RESPONSIBILITIES

Employee Rights

The College is required to advise employees of their rights regarding the CHP. It is to an employee's advantage to read and understand the LCC CHP and to understand their legal rights.

1. Employees shall receive training on the hazards associated with chemicals and on measures they can take to protect themselves from those hazards.
2. Employees who may be exposed to hazardous chemicals shall have access to the following information upon request:
    - Chemical exposure information
    - Workplace chemical inventory
    - Safety Data Sheets
    - Standard Operating Procedures
3. The employer shall provide employees with appropriate PPE free of charge.
4. Employees who have been exposed to hazardous chemicals shall have access to:
    - Medical Consultation and Examinations
    - Records of their Medical Consultations and Examinations
    - Results of Exposure Monitoring

    Employees have a right to file a complaint against the College regarding alleged violations of the Laboratory Standard (OAR 437-002-0360) without fear of retribution.

Questions about employee rights or any part of the CHP should be directed to the CHO or SME Dean.

Responsibilities

All Laboratory Staff (including Faculty and Student Assistants)

- Read, understand, and follow all safety rules and regulations that apply to the work area.
- Plan and conduct each operation in accordance with the institutional chemical hygiene procedures.
- Promote good housekeeping practices in the laboratory or work area.
- Notify the supervisor of any hazardous conditions or unsafe work practices in the work area.
- Use PPE as appropriate for each procedure that involves hazardous chemicals.

Laboratory Coordinators

The Laboratory Coordinators have overall responsibility for chemical hygiene in the laboratories, including responsibility to:

- Ensure that laboratory personnel comply with the departmental CHP and do not operate equipment or handle hazardous chemicals without proper training and authorization.

- Always wear personal protective equipment (PPE) that is compatible with the degree of hazard of the chemical.
- Follow all pertinent safety rules when working in the laboratory to set an example.
- Review laboratory procedures for potential safety problems before assigning them to other laboratory personnel.
- Ensure that visitors follow the laboratory rules and assume responsibility for laboratory visitors.
- Ensure that PPE is available and properly used by each laboratory employee and visitor.
- Maintain and implement safe laboratory practices.
- Provide regular, formal chemical hygiene and housekeeping inspections, including routine inspections of emergency equipment.
- Ensure that all equipment, whether leased, rented or owned outright is maintained in good condition.
- Monitor the facilities and the chemical fume hoods to ensure that they are maintained and function properly and contact the appropriate person, as designated by the department chairperson, to report problems with the facilities or the chemical fume hoods.

Chemical Hygiene Officer

- Establish and maintain this document (the CHP) and revise it at least annually as needed.
- Provide assistance, information, or instruction to employees regarding safety issues, identification of hazards or potential hazards.
- Ensure employees comply with the Occupational Health and Safety Act and that they carry out all prescribed safety measures and procedures.
- Ensure proper facilities, equipment, protective devices or services are provided and maintained in good order for safe handling, storage and disposal of chemicals and biological materials or wastes.
- Maintain a list of all hazardous materials used in the lab and verify Safety Data Sheets are available for all chemical compounds used.
- Ensure compliance with legislative requirements hazardous chemicals or reagents, biological materials or wastes.
- Ensure employees are familiar with the Chemical Hygiene Plan and comply with all its requirements.
- Recommend proper procedures in chemical handling, storage, dispensing and transportation within the lab and any bulk chemical storage rooms, as appropriate.
- Ensure all new employees are properly trained and adequately familiarized with all aspects of lab safety.
- Be involved in clean-up of significant lab chemical spills and ensure proper procedures and precautions are carried out. Carry out all required reporting of spills or releases.

- Ensure that waste is disposed of in an appropriate manner.
- Conduct regular inspections of the laboratories, preparations rooms, and chemical storage rooms, and submit detailed laboratory inspection reports to administration.
- Maintain inspection, personnel training, and inventory records.
- Create and/or revise safety rules & procedures as appropriate.
- Notify employees of the availability of medical attention under the following circumstances:
    - Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory;
    - Where exposure monitoring reveals an exposure level routinely above the action level for an Occupational Safety and Health Administration–regulated substance for which there are exposure monitoring and medical surveillance requirements;
    - Whenever a spill, leak, explosion, or other occurrence resulting in the likelihood of a hazardous exposure occurs, a medical consultation to ascertain if a medical examination is warranted.

Science Safety Committee

- Review accident reports in the Science Department and make appropriate recommendations to the Dean regarding proposed changes in the laboratory procedures.
- Evaluate the Science Department's safety and health training practices and recommend to the Dean procedures to ensure that all department employees are trained to perform their work in a safe manner.
- Conduct quarterly inspection of Science Building to locate, identify, and document safety and health hazards.
- Review and approve changes to the CHP.

Science, Math, and Engineering Division Dean

- Assume complete responsibility for the Chemical Hygiene Plan (CHP), implementation of the CHP, and compliance with the CHP within the Science, Math, Engineering Division.
- Provide the chemical hygiene officer (CHO) with the support necessary to implement and maintain the CHP.
- After receipt of laboratory inspection reports from the CHO, meet with laboratory coordinators to discuss cited violations to ensure timely actions to protect trained laboratory personnel and facilities and to ensure that the department remains in compliance with all applicable federal, state, college, local and division codes and regulations.
- Provide budgetary arrangements to ensure the health and safety of Division personnel, students, and visitors.

EMERGENCY PROCEDURES & PLANS

It is the policy of LCC and the SME Division to do all that is reasonable to prevent injury to persons and damage to property and to protect the employees, students, facility, the environment, and the public from injury, fire or other damage. In order to achieve these goals, LCC has instituted safety and emergency preparedness programs. The college's administration urges the active cooperation and commitment of all departments and employees. The SME Division's management supports these programs in its promotion of employee safety and health.

These facets of the LCC safety program are also incorporated by reference via links into this Chemical Hygiene Plan. Aspects of the overall safety program include:

College-wide:

Health and Safety: https://inside.lanecc.edu/employees

Safety Policies and Procedures – SafeLane: https://www.lanecc.edu/administration/safe-lane

Accident Incident Reporting Procedures:

https://inside.lanecc.edu/copps/documents/accident-reporting

Accident Incident Reporting Forms:

Employee: employee_accident_or_incident_analysis_form.pdf (lanecc.edu)

Non-Employee: 250.5 accident-incident report form.indd (lanecc.edu)

Emergency Plan: https://inside.lanecc.edu/copps/documents/emergency-plan

Public Safety: https://inside.lanecc.edu/psd

Safety Education and Training: (Log in with L# required) https://lanecc-or.safecolleges.com/login

SME Specific:

Emergency Plan Addendum for SME - Main Campus, Bldg 16

SME Chemical Spill Response Plan

SME Fire Prevention Plan

Fire Emergency

1. Immediately call Public Safety at x5555 or (541) 463-5555 and report the location of the fire and answer all pertinent questions.

2. If the fire is small and you have training, evacuate the area and use an official fire extinguisher to confine or control the fire if possible and if safe to do so. Use an appropriate extinguisher as follows:
    a. CO2 extinguisher for flammable liquids (class B) or electrical (class C) fires.
    b. Dry Chemical extinguisher for paper or wood and all fires.
    c. Yellow "Class D" extinguishers for metal (sodium, etc.) fires.
    d. NOTE: Use common sense. A solvent fire in a beaker is easily extinguished by covering the beaker and depriving the fire of oxygen. Using a fire extinguisher on the same beaker may cause the solvent to spill, thus increasing the hazard.
    e. After a fire extinguisher has been used, ensure that it is recharged. Contact the CHO and/or Lab Coordinator when a replacement is needed.
3. If the fire is large or you do not have training, pull the fire alarm to evacuate the building.
4. Turn off gas supplies, if safe to do so.
5. Help anyone in need of assistance.
6. Contain fire by closing as many doors as possible as you evacuate.
7. Meet the emergency personnel at a safe distance and give them any relevant information.
8. Complete an Accident / Incident Report and submit to your supervisor and to Human Resources.

Medical Emergency

1. Immediately provide the minimum help to prevent further injury to the victim; if appropriate, use PPE to prevent exposure to potentially infectious body fluids.
2. Avoid leaving the victim except to summon help.
3. If injury/illness is severe or life threatening, call Public Safety's emergency line ext. 5555 or (541) 463-5555.
4. If injury /illness is not life threatening, call Public Safety's non-emergency line ext. 5558.
5. Do not move a person, unless they are in danger.
6. Render first-aid or CPR if trained and qualified.
7. Wait with the victim until Public Safety arrives.
8. If you have been exposed to another's body fluids, inform Public Safety when they arrive.
9. Complete an Accident/ Incident Report and submit to your supervisor and to Human Resources.

Chemical Emergency

1. Refer to the **SME Chemical Spill Response Plan** (see Emergency Procedures and Plans section) and/or specific chemical SOPs for greater detail.
2. Chemical emergencies such as large spills, spills involving highly hazardous or flammable materials, releases of toxic or corrosive gasses or substances should be treated as other types of emergencies.

a. Call Public Safety at x5555 or (541) 463-5555 and give them any relevant information about the nature of the emergency and chemicals involved.

b. If there are injured victims, provide the minimum necessary first aid only if there is no danger to yourself. If providing assistance will endanger you, do not attempt intervention. Wait for emergency response personnel to arrive.

c. If chemicals have splashed into the victim's eyes, flush the eyes at an eyewash station for at least 15 minutes or until emergency medical personnel arrive and evaluate the accident.

d. If chemicals have splashed onto the victim's body, drench the victim with water at a safety shower for at least 15 min, while removing any contaminated clothing. Have a clean lab coat available to protect the modesty of the victim.

3. For small, low hazard spills, restrict access to the area and notify surrounding personnel. Use appropriate personal protective equipment and use suitable spill clean-up equipment and products that are designed for the type of spilled chemical. Refer to the SME Chemical Spill Response Plan and/or specific SOPs for details.

4. Complete an Accident / Incident Report and submit to your supervisor and to Human Resources.

GENERAL PROCEDURES FOR SAFE LABORATORY PRACTICE

Behavior in the Laboratory

1. Employees should act in a professional manner at all times.
2. Employees should follow assigned work schedules unless a deviation is authorized by the Division Dean.
3. Employees should not conduct potentially dangerous experiments while alone.
4. Employees should not perform unauthorized experiments. Authorization of new experiments requires completion of a Laboratory Hazard Assessment and review by Lab Coordinator, CHO, and Division Dean.
5. Unauthorized visitors are not allowed in the laboratory: Do not bring your children, spouses, friends, or others into the lab.
6. Employees shall do the following while conducting unattended operations:
    a. Leave lights on.
    b. Place an appropriate sign on the door or other appropriate location.
    c. Provide for containment of hazardous substances in the event of failure of a utility service (such as cooling water).
    d. Label all containers of ongoing experiments with chemical contents, your name, and experiment start date.
    e. Any biological materials should be treated the same way.
7. Accommodations: If students have an accommodation from the Center for Accessible Resources (CAR) at Lane College, ensure that appropriate safety measures are undertaken to create a safe lab environment for all participants.

Personal Habits in the Laboratory

1. Eating, drinking, and cosmetic application are not permitted in laboratories.
2. Do not store food, beverages, cups and other drinking and eating utensils in areas where hazardous chemicals are handled/stored or use laboratory refrigerators, ice chests, cold rooms, and ovens for food storage or preparation.
3. Do not use ice produced by laboratory ice machines for beverages, food, or food storage.
4. No glassware or utensils used for laboratory operations shall be used for storage, handling, or consumption of food or beverages.
5. Wash hands before using the restroom and before eating, smoking, or applying cosmetics. Wash areas of exposed skin, e.g., forearms, frequently if there is potential for contact with chemicals.
6. Wear closed-toe shoes at all times in the laboratory. Closed, low heeled, rubber soled shoes constructed of solid material are recommended.
7. Wear long pants or the equivalent to protect your skin from splashes, spills and drips.
8. Confine long hair, loose clothing, and dangling jewelry.

9. Cover all cuts, abrasions, open sores and bruises with waterproof tape or disposable gloves.
10. Read all labels and warning signs, and always read the SDS and container label before using a chemical; SDSs can be found online at https://lanecc.kha.com/
11. Wear appropriate PPE in the laboratory as necessary.
12. Eye protection shall be worn by employees whose jobs expose them to eye hazards. Refer to Section on PPE.
13. Use engineering controls (e.g., hoods, centrifuge rotor hoods) appropriately to minimize chemical exposure. See Section on PPE.
14. Keep materials stored in hoods to those that will be used immediately and do not allow them to block vents or airflow.
15. Keep your lab coat buttoned while working in the laboratory. Lab coats should not be worn outside of the lab or work. Remove laboratory coats immediately upon significant contamination.
16. Clean up any spills on work surfaces as soon as possible to prevent chemical residue accumulation. See SME Chemical Spill Response Plan in the Appendix.
17. Employees shall be alert to unsafe conditions and inform others thereof and shall ensure that such conditions are corrected when detected.
18. Acquaint yourself with local procedures in case of fire, accident, explosion or other emergency, by learning the layout of your building and the location of the emergency exits, emergency phones, fire-fighting equipment (and how it works) and first aid equipment. See Appendix for additional information.
19. Report all injuries, accidents, incidents, near misses, and spills/ releases of hazardous materials.
20. Notify others of health issues. Let your Lab Coordinator and/or CHO know if you have chemical sensitivities, allergies, or other needs that are not being addressed.
21. Follow Standard Operating Procedures and published Safety Instructions. If you are unable to find the applicable SOP or Safety Instructions, ask your Lab Coordinator or CHO.
22. Contact the Lab Coordinator and/or CHO with all safety questions or concerns.

Avoidance of Routine Exposures

1. Avoid skin contact with chemicals.
2. Do not smell or taste chemicals.
3. Use a vacuum or pipette bulb. Do not use mouth suction for pipetting or starting a siphon.
4. Vent any experiment that may discharge toxic or noxious chemicals into a local exhaust device (e.g., a chemical fume hood).

5. Flammable, corrosive, or toxic volatile materials shall be vented or trapped when they are evaporated, for example with rotary evaporators or similar devices.
6. Water aspirators are not to be used when trapping hazardous chemicals, including common flammable solvents.
7. Plan operations, equipment, and protective measures based on knowledge of the chemicals in use.
8. Employees shall be aware of the location and proper operation of lab safety/emergency equipment (first aid kit, fire extinguisher, chemical spill kit, eyewash, etc.).
9. Employees shall report unsafe laboratory practices or conditions to the Lab Coordinator and/or CHO. The Lab Coordinator and/or CHO should correct unsafe practices or conditions immediately.

Housekeeping

1. Each employee is responsible for maintaining a clean and uncluttered workspace. This will help to prevent spillage, breakage, personal injuries, and unnecessary contact with chemicals.
2. Lab workers are jointly responsible for common areas of the laboratory.
3. Spills shall be cleaned up immediately from work areas and floors.
4. Doorways and walkways within the lab shall not be blocked or used for storage.
5. Windows in lab doors shall not be covered. Windows allow for emergency response personnel to be able to see into the room to assess the situation without entering.
6. Access to exits, hallways, emergency equipment, and utility controls shall not be blocked.
7. Equipment and instrumentation shall be cleaned to remove spillage and contamination before repair or calibration service is requested, and service personnel shall be informed of any hazardous contamination prior to servicing.

Laboratory Equipment

Glassware

1. Handle and store laboratory glassware with care to avoid damage; do not use damaged glassware.
2. Improper use of glassware is a frequent cause of injuries and accidents in the laboratory. Always carefully inspect glassware for flaws and cracks before use. Damaged items should be discarded.
3. Broken glassware, syringes, and other "sharp objects" must be disposed of properly. Such waste should be separated from other trash and stored for pickup in clearly marked containers.
4. Hand protection and forceps should be used when picking up larger pieces of broken glass. Small pieces should be swept up with a brush into a dustpan.
5. Use equipment only for its designed purpose.

Electrical Equipment

1. Always read the instructions before attempting to assemble apparatus or to operate it.
2. All equipment must be U.L. approved and have three prong plugs.

3. All electrical equipment should be grounded and kept in good condition.
4. Do not use cords with worn insulation. Replace connections immediately when there is any sign of thinning insulation.
5. Make sure the wire is dry before plugging it into any circuit.
6. Electrical units which are to be operated in an area where flammable vapors may be present should be explosion proof.
7. Disconnect all electrical equipment before servicing. Electrical service supply should be well grounded with adequate circuit protection.
8. Bench tops made of conducting material e.g. (stainless steel) should be grounded.
9. No connections to the main service lines should be made by anyone but a licensed electrician.
10. Multiple adapters which can lead to overloading and bad connections should never be used.
11. Fuses or circuit breakers of the correct rating should be used on all equipment at all times but "ground" connections must never be fused.
12. Labs should have sufficient outlets, suitably spaced to allow for convenient connection of each item of electrical equipment likely to be used at one time.
13. The following signals are indicative of electrical hazards and should be corrected if found:
    a. Shock received when touching any part of electrical equipment.
    b. Power receptacles which are the non-grounded type (two wire instead of three wire) or are cracked or do not hold the plug securely.
    c. Power plugs having only two prongs which are connected to a receptacle through a "cheater" (grounding plug to non-grounded receptacle adapter) or have bent or broken pins.
    d. Power cords which are frayed, burned, nicked, cracked, or otherwise damaged or are so short that they require an extension cord.
    e. Power cords running across the floor where personnel must walk. Power cords having lengths in excess of the distance between the equipment and the electrical outlet must be neatly coiled.
    f. Equipment which is dirty or shows evidence of fluid spillages or has been obviously damaged.
    g. Multiple electrical equipment attached to an adaptor.
    h. Wet or moist surfaces on electrical equipment.

Thermal Equipment

1. Heating baths - be sure the thermoregulator works properly. Water baths must be checked daily for temperatures and water level.
2. Autoclaves/ovens - avoid steam and heat burns by being familiar with good operating techniques.
3. Outlets - should be checked for grounding using a circuit tester.

Centrifuges

1. Centrifuges should be securely anchored either by strong suction cups or wheel brakes and should be located where vibration will not cause items to fall off nearby shelves.

2. Any centrifuge should have an interlocking device to prevent: (1) the lid from being opened while the centrifuge is still in motion and; (2) the head from spinning while the lid is open. If it does not, it must have a sign affixed to it or near it stating:
    i. "DO NOT OPEN LID WHILE CENTRIFUGE HEAD IS IN MOTION"
    ii. "DO NOT START CENTRIFUGE WHILE LID IS OPEN"
3. Centrifuges are dangerous unless operated correctly. Proper operating procedure shall be followed.

CHEMICAL PROCUREMENT, DISTRIBUTION, STORAGE, and DISPOSAL

Procurement

1. Whenever possible, plan to use less hazardous chemicals and practice "green chemistry."
2. Purchase chemicals in the smallest quantities and containers that are practical for lab use.
3. Before purchasing any new chemical, the chemical's SDS shall be reviewed and the following information considered:
    a. Proper storage and handling procedures
    b. Proper disposal procedures
    c. Presence of adequate facilities to handle and store the material safely
    d. Adequate training for personnel handling the material
4. No chemical container should be accepted without an adequate label.

Chemical Container Labels

1. All chemical containers shall have a legible label in plain English, firmly attached showing the name of contents and hazard information. If dispenser bottles are very small, at least the chemical name and appropriate GHS hazard symbols shall identify contents on the container.
    - See Appendix II for GHS symbols & definitions
2. Original labels on containers of incoming hazardous chemicals shall not be removed or defaced.
3. Containers of chemical "unknowns" prepared for instructional purposes shall be labeled with a Lab code and identifier that is referenced on a list of unknown codes held by the Lab Coordinator.
4. No extremely hazardous substances should ever be stored as chemical "unknowns."
5. Chemical substances produced in the laboratory for use outside of the laboratory shall be properly labeled with provisions of the OSHA Hazard Communication Standard met (OAR 437-002-0360).

Hazardous Chemical Inventory

1. SDSs for all hazardous chemicals shall be maintained in an electronic database accessible through

    https://lanecc.kha.com/

2. A chemical inventory listing can be obtained for any area in the Physical Sciences or Life Sciences stockroom areas by doing the following:
    a. Go to the website https://lanecc.kha.com/
    b. Under "Binders to look in" select the appropriate binder in the dropdown menu.
    c. Click on "Search for SDS."
    d. A list of every chemical with an SDS will be displayed for that area (binder).
    e. Click on "Product Name" in the column headers to get an alphabetized listing.
    f. To get a printed list, scroll to the bottom of the first page and click on the green "Print Preview" button in the lower right corner, then use print command.
3. Employees shall be informed of how to access SDSs electronically.
4. The SDS database shall be updated as chemicals are acquired or removed from the laboratory.
5. Complete chemical inventory shall be done at least annually.

Storage

1. Stored and working amounts of hazardous chemicals shall be kept to a minimum.
2. Storage of hazardous chemicals at the lab bench, in hoods, and other work areas shall be minimized.
3. Chemicals shall be stored in containers with which they are chemically compatible.
4. Liquids shall have chemically resistant secondary containment.
5. Chemical reagents shall be kept in closed containers when not in use.
6. Compressed gas cylinders shall be properly secured at all times:
    a. Cylinder caps in place on cylinders when not in use,
    b. Straps, chains, or stands used to support the cylinders,
    c. Straps or chains firmly attached to a permanent structure and at the correct height for the cylinder that is being secured (i.e., in the top third of the cylinder but below the cylinder's shoulder).
7. Incompatible chemicals shall be segregated:
    a. Acids, bases, flammables, and oxidizers shall be segregated within the laboratory.
    b. Water reactive materials shall be separated from all other chemicals.
    c. Oxidizers shall be separated from flammable, combustible, and organic material.
8. Highly toxic materials should be stored in a secure manner.
9. Glass chemical containers shall not be stored on the floor.

10. Flammable storage cabinets shall be used for storage of flammable or combustible liquids; no corrosive liquids shall be stored in these cabinets.
11. Safety cans used for flammable liquids > 4 gallons should be kept in UL approved safety containers having a spring-loaded cap and flame arrester.
12. See Appendix III for maximum allowable container sizes and types for flammable and combustible liquid storage.
13. Stored chemicals shall be inspected at least quarterly for expiration, deterioration, and container integrity.
14. Expired chemicals shall be properly disposed of.
15. It is recommended that rooms in which chemicals are used or stored be secured to prevent unauthorized access.

Hazardous Waste and Its Disposal

The intention of the waste disposal program in the SME Division is to minimize the quantity of hazardous chemical waste (as defined in 40 CFR 261.3 and 49 CFR 171.8) and to dispose of laboratory waste in a manner that ensures minimal harm to people, other organisms, and the environment. To meet this objective, reclamation or neutralization will be part of the laboratory protocol whenever possible.

1. Waste disposal procedures for chemicals, sharps, and other hazardous wastes shall be consistent with the requirements of the EPA and DEQ and are contained within the SME Safety Instructions Library.
    a. See the EPA's Introduction to Hazardous Waste Identification (40 CFR Parts 261).
    b. See the DEQ Small Quantity Hazardous Waste Generator Handbook.
2. Each laboratory operation shall include plans and procedures for waste reclamation or disposal.
3. All chemical waste containers shall be labeled "Hazardous Waste."
4. See SOP for Hazardous Waste and SOPs for specific chemical categories for disposal information.

Disposal of Materials of Uncertain Composition ("Chemical Unknowns")

All unknown materials have to be treated as if they are potentially hazardous. A general profile of the unknown must be generated for proper disposal. Given that the cost of disposal is high, the obvious goal is to reduce the number of "unknowns" to zero by labeling all chemical containers, disposing of all old, outdated and questionable chemicals and samples, recycling unneeded chemical reagents, and maintaining separate waste containers for different classes of chemical wastes. This will reduce the number of unknowns and shall be considered standard laboratory practice.

PERSONAL PROTECTIVE EQUIPMENT

Hierarchy of Controls

The hierarchy of controls prioritizes intervention strategies based on the premise that the best way to control a hazard is to systematically remove it from the workplace, rather than relying on employees to reduce their exposure. The types of measures that may be used to protect employees (listed from most effective to least effective) are:

1. **Engineering controls** such as chemical fume hoods, physically separate the employee from the hazard.
2. **Administrative controls** such as employee scheduling, are established by management to help minimize the employees' exposure time to hazardous chemicals.
3. **Work practices:** Work practice controls are tasks that are performed in a designated way to minimize or eliminate hazards.
4. **Personal Protective Equipment (PPE):** PPE and apparel are additional protection provided under special circumstances and when exposure is unavoidable.

Responsibilities

Supervisor Responsibilities

- Supervisors or instructors should consult with the CHO or another qualified person to assess hazards in areas where they or their employees work. A determination will be made as to which areas require the use of personal protective equipment and the type and quality of the necessary equipment.
- Supervisors and instructors are responsible for ensuring that workers, students, and visitors wear the protective equipment as specified.
- Supervisors are responsible for training their employees so they are able to identify situations that require the use of personal protective equipment and know how to properly use, care for and maintain the equipment. Employees should be advised on the proper selection, use and limitations of PPE before they are required to use the equipment as defined in appropriate SOPs.

Employee Responsibilities

Employees are required to wear PPE when determined necessary. Personal protective equipment, excluding safety glasses and shoes, should be removed before leaving work areas.

Hazard Assessment

In order to decide which intervention strategy is best used and which PPE is necessary, risks must be considered prior to the processes in which the risks arise. When planning a new lab or lab-related activity work involving hazardous chemicals and procedures, a Hazard Assessment Form shall be completed and approved before beginning the activity. See section on Prior Approval and Hazard Assessment.

Eye Protection

1. Appropriate eye protection shall be provided to and worn by employees whose jobs expose them to eye hazards.

2. All employees and students who are participating in activities which may involve hazardous chemical or biological materials, caustic or explosive materials, hot liquids or solids, dusts, injurious dusts or radiations, impact particles, or any other hazards should wear industrial quality eye protective devices:
    a. ANSI certified goggles with shielded ventilation ports, OR
    b. Safety glasses that meet or exceed current ANSI Z87.1 standards containing permanently attached top AND side shields COUPLED with a full-face shield which also meets current ANSI Z87.1 standards.
3. Before each use, eye and face protection equipment should be inspected for damage, (i.e., cracks, severe scratches, debris). If deficiencies are noted, the equipment should be cleaned, repaired or replaced before use.

Lasers:

Due to the variety of wavelengths emitted by lasers, no set of eyewear can offer the user complete protection unless it is opaque. Follow the SOP of the relevant laser wavelengths in use and wear the recommended laser eye protection.

Ultraviolet Radiation:

Persons using unprotected and/or uncovered sources of UV radiation for prolonged periods should wear UV blocking eyewear or a UV blocking face shield.

Contact Lenses:

The use of contact lenses in the laboratory is not recommended for the following reasons:

- They can create a visual problem if suddenly displaced.
- Contact lenses are difficult to remove should chemicals get into the eyes and they tend to prevent the removal of contaminants by natural eye fluids.
- Soft contact lenses present special hazards. They discolor when they come into contact with many laboratory chemicals and can absorb chemicals and chemical vapors, causing extensive corneal damage before the wearer is aware of the problem.

Gloves

1. Chemical resistant gloves shall be worn whenever the potential for hazardous skin contact exists. See Appendix III for glove selection.
    - The SDS for the substance or glove compatibility charts provided by the glove manufacturer should be referenced.
    - SOPs should specify glove requirements.
2. Contaminated gloves shall be removed before touching surfaces outside the work area.
3. Before each use, gloves designated for reuse are to be tested by air inflation (do not inflate by mouth) for the absence of pin hole leaks. Defective gloves should be replaced.

4. Heat resistant gloves shall be used for handling hot objects. Asbestos containing gloves shall NOT be used and shall be disposed of.

5. Abrasion resistant gloves (e.g., leather) should be worn for handling broken glass and other similar materials but should not be used to handle chemicals.

Apparel

1. When engaging in hazardous chemical activities wear a high necked, calf- or ankle-length, chemical- and fire-resistant laboratory apron or coat when appropriate.

2. Always wear long-legged clothing.

3. Always wear shoes with fully covering "uppers"; do not wear shoes with open toes or with uppers constructed of woven materials.

Hearing Protection

Hearing protection (noise attenuating ear muffs or plugs) is required whenever employees are exposed to 85 decibels (dBA) or greater as an eight-hour time weighted average.

Respiratory Protection

1. Employees should wear respirators whenever it is possible that engineering controls or work practices could become or are ineffective and that the employees might be exposed to vapor or particulate concentrations greater than the PEL, action level, TVL, or similar limit, whichever is the lowest.
2. The requirements of 29 CRF 1910.134 should be followed, including in particular:
   a. Written standard operating procedures governing the selection and use of respirators.
   b. An employee who needs to use a respirator must be fitted for the respirator, trained in its proper use, inspection, and maintenance. (See "NIOSH Guide to Industrial Respiratory Protection'" DHHS Publ. No. 87 - 0116, NIOSH, Cincinnati, 1987, for details.)
   c. Voluntary use of respirators.

STANDARD OPERATING PROCEDURE and HAZARD ASSESSMENT

The general practices outlined in the CHP do not provide sufficient protection for employees handling specific types of hazardous chemicals or engaging in specific hazardous laboratory processes. Standard Operating Procedures (SOPs) shall be developed for use of specific classes of hazardous chemicals and hazardous processes, especially when regulatory elements are present.

1. SOPs that give detailed description of safe work practices should be written for all commonly repeated procedures using hazardous chemicals and/or laboratory processes.
2. An SOP shall be based on a Laboratory Hazard Assessment outlining specific restrictions and the selection and use of personal protective equipment (see next section).
3. An SOP should be written in a standard format with the following components:
   a. Purpose
   b. Hazard identification
   c. Engineering controls and PPE

    d. Special handling and storage requirements (for hazardous chemicals)
    e. Spill and area decontamination procedures
    f. First aid and personal decontamination procedures
    g. Waste disposal procedures
    h. Details of process
    i. Required training
    j. References
4. An SOP shall require approval of two knowledgeable reviewers (in most cases these should be the Lab Coordinators), the CHO, and the SME Dean.
5. Approved SOPs should be posted on the SME internal website: https://inside.lanecc.edu/sme/documents/standard-operating-procedures-sop-hazardous-materials

6. Location of SOPs shall be made known to employees.

PRIOR APPROVAL and LABORATORY HAZARD ASSESSMENT

Prior Approval

The OSHA Laboratory Standard requires that if a particular laboratory operation, procedure, or activity requires prior approval from the employer or any supervisor, the circumstances and the approval procedure must be described in the plan.

Following are operations requiring prior approval from the Lab Coordinator and CHO:

1. Use of
    a. Explosive or highly reactive materials
    b. Carcinogenic chemicals
2. Working alone

If approval is obtained, a Hazard Assessment shall be done.

Hazard Assessment

When planning a new lab or lab-related activity work involving hazardous chemicals and procedures or when a change in hazardous procedure needs to be made, a Laboratory Hazard Assessment shall be done:

1. Obtain a Laboratory Hazard Assessment form from the CHO or on the SME internal website: https://inside.lanecc.edu/sme/documents/hazard-assessment

2. Use the Laboratory Hazard Assessment Tool attached to the form to help identify hazards, then fill in the form Summary.
3. Submit the form to the Lab Coordinator for review and approval.
4. After approving, the Lab Coordinator submits the form to the CHO for review and approval.

GENERAL CHEMICAL PROPERTIES, DEFINITIONS, AND HAZARDS

Guidelines on Identification and Classification of Hazardous Chemicals

Determine the specific chemicals you are working with and the type of hazards they present. The best source of this information is the chemical's SDS.

Many of the substances encountered in the laboratory are known to be toxic or corrosive, or both. Compounds that are explosive and/or are highly flammable pose another significant type of hazard. New and untested substances that may be hazardous are also encountered. It is essential that all laboratory workers understand the types of toxicity, recognize the routes of exposure, and are familiar with the major hazard classes of chemicals. The most important single generalization regarding toxicity in chemical research is to treat all compounds as potentially harmful, especially new and unfamiliar materials, and work with them under conditions to minimize exposure.

When considering possible toxicity hazards while planning an experiment, it is important to recognize that the combination of the toxic effects of two substances may be significantly greater than the toxic effect of either substance alone. Because most chemical reactions are likely to contain mixtures of substances whose combined toxicities have never been evaluated, it is prudent to assume that mixtures of different substances (e.g., chemical reaction mixtures) will be more toxic than the most toxic ingredient contained in the mixture. Furthermore, chemical reactions involving two or more substances may form reaction products that are significantly more toxic than the starting reactants.

Flammable Liquids

Since flammable liquids can be found in most laboratories, knowledge of the properties of flammable liquids is important for all laboratory personnel. Flammable liquids are volatile and it is the vapor of these flammable chemicals, not the liquid, which ignites and burns. The vapors are often heavier than air and tend to settle on the floor and to flow down stairways, air ducts, elevator shafts, etc. Frequently, ignition of this vapor trail with its resultant flashback can occur at some distance from the source of the vapor. Common sources of ignition are electrical equipment, open flames, hot surfaces, cigarettes and static electricity, etc. Since flammable liquids such as carbon disulfide are immiscible in and denser than water, they can settle in the bottom of drains, e.g. the U section of a sink drain, and be ignited not only by the above sources of ignition, but also by certain chemicals such as perchloric and nitric acid.

Certain flammable solvents such as ethyl ether, isopropyl ether, dioxane, tetrahydrofuran will form peroxides which explode if allowed to concentrate by evaporation or by distillation. Improper handling of most flammable liquids can lead to a variety of health hazards including skin reactions and inhalation illnesses.

The meaning of certain words should be understood by everyone who works with flammable chemicals.

Flammable liquid is a liquid which has a flash point of less than 37.8°C, e.g., acetone, ethyl alcohol and xylene.

Combustible Liquid has a flash point equal to or greater than 37.8° C but not exceeding 93.3° C, e.g., fuel oil, kerosene and petroleum distillate.

Flash point is the temperature at which a liquid gives off vapors sufficient to form an ignitable mixture with the air near the surface of the liquid. For example, the flash points of acetone, diethyl ether and xylene are approximately -15°C, -45°C and 24°C respectively. A good source for flash point information is NFPA 325M (National Fire Protection Association, Batterymarch Park, Quincy, MA).

Ignition temperature is the temperature to which a mixture must be raised to initiate combustion. Only a small part of a flammable vapor-air mixture needs to be heated to the ignition temperature to result in self-sustained combustion. A static electric spark lasting only a fraction of a second is sufficient. Some organic solvents have dangerously low ignition temperatures, e.g., diethyl ether 185°C; carbon disulfide 100°C, etc.

A type B portable fire extinguisher is the extinguisher of choice for putting out fires involving flammable solvents. The discharge should be directed at the base of the fire, but care must be exercised not to spread the burning flammable liquid.

See the SOP for Flammable Liquids for storage and handling instructions.

Corrosive Chemicals

Corrosive chemicals are substances that cause visible destruction or permanent changes to materials including human tissue and metals. Corrosive chemicals can be liquids, solids, or gasses and can affect the eyes, skin, and respiratory tract.

The major classes of corrosive chemicals are strong acids, bases, dehydrating agents, and oxidizing agents. Liquid corrosive chemicals are those with a pH of 4.0 or lower or a pH of 9.0 or higher. A highly corrosive chemical has a pH of 2 or lower or a pH of 12.5 or higher.

- **Examples:**
    - Strong acids: hydrochloric acid, nitric acid, phosphoric acid
    - Strong bases: sodium hydroxide, potassium hydroxide, ammonium hydroxide
    - Strong dehydrating agents: phosphorous pentoxide, calcium hydroxide, sulfuric acid
    - Strong oxidizing agents: hydrogen peroxide (≥30%), sodium hypochlorite
    - Corrosive solids: phenol, phosphorous
    - Corrosive gases: chlorine, ammonia
    - Special cases: Because of their special hazards, hydrofluoric acid, perchloric acid, picric acid, aqua regia, or piranha solution do not fit into the class of chemicals known as corrosives. These chemicals should be used with extreme caution and only after special training.

Concentrated acids and bases must be added to water to minimize the possibility that the heat of reaction will cause eruption of the corrosive. Never add water to a concentrated acid or base as the water will layer on the top of the more densely concentrated acid or base. The extreme heat produced may boil and project the upper layer.

Since the fumes of concentrated corrosives can cause severe external and internal burns, these solutions should be handled in a fume hood with the employees wearing rubber gloves, rubber apron and safety glasses.

If a spill occurs, neutralize spills of concentrated acid with dry sodium carbonate or bicarbonate, and neutralize spills of concentrated alkali with citric, boric, or dilute acetic acid. Keep a supply on hand.

Drips of acids or alkalis on the sides of containers are best cleaned off with paper towels. Plastic stoppers are better than glass stoppers for glass bottles holding an alkaline solution. Alkalis tend to bind glass to glass making it sometimes impossible to remove a glass stopper. For safe transportation of corrosives, protective packaging should be used. When a corrosive chemical is to be disposed of as long as the chemical is not mixed with other hazardous chemicals and doesn't pose any additional hazards, it should first be neutralized before being flushed down the drain with large volumes of water. If a chemical or mixture will still be hazardous after neutralization, neutralization will occur on a case-by-case basis and disposal must be in compliance with waste disposal policies as well as state and local regulations.

See the SOP for Corrosives for storage and handling instructions.

Compressed Gasses

A variety of compressed gasses could be used in the laboratory, from flammable gasses to highly toxic gasses. Because these materials are under tremendous pressure, special handling of the cylinder and regulators must be observed.

- All gas cylinders must be secured with straps or chains to prevent falling over.
- Gas cylinder storage must be located in a cool, dry area away from flammable/corrosive fumes or chemicals, direct or localized heat, open flames or sparks.
- The cylinders that are empty must be labeled "Empty" and stored separately from full cylinders.
- Flammable or toxic gasses should not be stored in basements.
- Incompatible gasses must be segregated.
- When gas cylinders are not in use, the valve cap must be securely in place to protect the valve stem and valve.
- A hand truck and securing chain should be used to transport cylinders.
- For specific toxicity and handling procedures refer to the SDS that pertains to the compressed gas.

See the SOP for Compressed Gasses for storage and handling instructions.

Explosive Chemicals

Explosive chemicals are those which cause a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

Rarely should an explosive chemical be acquired for laboratory use, and if it is, it shall be purchased in very small quantities with the Lab Coordinator's and CHO's approval. There are a number of chemicals, however, that can become unstable and/or potentially explosive over time due to contamination with air, water, other materials such as metals, or when the chemical dries out.

Picric acid should always be purchased and stored in water. Additionally, the CHO and/or Lab Coordinator must be consulted upon purchasing request. Dried out picric acid is a more sensitive explosive than T.N.T. Since dried picric acid is extremely dangerous, e.g., shock or heat will detonate it, the CHO and/or Lab Coordinator must be contacted if any picric acid is discovered to be dried out.

Ethyl ether, isopropyl ether, dioxane, tetrahydrofuran, etc. will react with atmospheric oxygen to form unstable peroxides which may detonate when concentrated by evaporation or by distillation. For this reason, the above chemicals should be purchased in the smallest practical size. The time limits for keeping opened containers of the above ethers are one week for uninhibited grades and three to six months for inhibited grades. To do this effectively, the dates of receipt, of opening and of proposed disposal must be clearly written on the container. The presence of ether peroxides should be tested in newly opened containers and periodically in opened containers. A convenient way of testing is to use an ether peroxide Quant paper strip.

Toxic or Highly Toxic Substances

Guidelines for classification of toxic or highly toxic substances based on the LD50 in albino rats are as follows:

- Oral LD50
  - Toxic: 50-500 mg/kg
  - Highly toxic: <50mg/kg
- Skin Contact LD50
  - Toxic: 200-1000 mg/kg
  - Highly toxic: <200 mg/kg
- Inhalation LD50
  - Toxic: 200-2000 ppm/air
  - Highly toxic: <200 ppm/air

For additional information, consult the CHO or Laboratory Coordinator for special details concerning materials suspected to be toxic.

Reproductive Toxins

Mutagens and reproductive toxins are chemicals that affect the reproductive capabilities including causing chromosomal damage (mutations) and adverse effects on fetal development (teratogenesis).

As defined by the Globally Harmonized System of Classification and Labeling of Chemicals (GHS), reproductive toxins are designated by one or more of the following H codes:

H340 May cause genetic defects

H341 Suspected of causing genetic defects

H360 May damage fertility or the unborn child

H361 Suspected of damaging fertility or the unborn child

H362 May cause harm to breast-fed children

Radioactive Materials

Radioactive uranium-containing mineral specimens and samples such as older Fiestaware, Coleman lantern mantles, and clock hands are kept for instructional demonstration purposes.

Radioactive specimens shall be kept appropriately shielded with lead or other effective material in a locked cabinet with radiation warning signage posted on it.

Access to the cabinet should be limited to the Physical Sciences Lab Coordinator and CHO.

Guidelines for use of radioactive materials

1. Radioactive materials shall be used only in a demonstration setting. Students should not be handling radioactive materials.
2. Minimize time exposure to radioactive materials by planning demos in advance.
3. Check out radioactive materials through the Physical Sciences Lab coordinator for the time period required and return immediately after use.
4. Follow safe practices to prevent personnel and facility contamination and spills:
    a. Lead aprons and disposable gloves should be worn when handling these materials.
    b. Use radioactive materials only on smooth, cleanable surfaces.
    c. Do not engage in activities that would create radioactive dust out of these materials.
    d. Wash all surfaces that come into contact with radioactive materials immediately after use including any body parts such as hands that may have incidentally come in contact with the materials or surfaces contaminated by them.

Biohazards

Biological hazards can arise from biological agents such as bacteria, viruses, fungi, other microorganisms and their associated toxins. They have the ability to adversely affect human health in a variety of ways, ranging from relatively mild, allergic reactions to serious medical conditions—even death.

Standard SME Microbiological Practices

1. Access to the microbiological reference collection should be at the discretion of the Laboratory Coordinator.
2. Work surfaces where microbiological operations were performed shall be decontaminated with a bleach-based surface disinfectant after any spill and at the end of each day.
3. All contaminated liquid or solid waste shall be decontaminated by autoclaving before disposal.
4. Mechanical or automatic pipetting devices must be used; mouth pipetting is prohibited.
5. Eating, drinking, smoking and applying cosmetics are not permitted in the work area.
6. Lab workers shall wash their hands with a disinfectant soap or detergent after they handle viable materials and before leaving the area.
7. All procedures should be performed so as to minimize the creation of aerosols.

8. Laboratory coats, gowns, or uniforms should be worn over street clothes while working in the laboratory. These should not be worn away from the laboratory.
9. Contaminated materials that are to be decontaminated at a site away from the laboratory shall be placed in a durable, leak proof container which is closed before being removed from the laboratory.
10. No flammable or combustible solvents shall be placed in the freezer.

Allergens

Certain substances may cause allergic reactions in some individuals. These include diazomethane, dicyclohexylcarbodiimide, formaldehyde, various isocyanates, benzylic, and allylic halides, and certain phenol derivatives.

A chemical allergy is an adverse reaction by the immune system to a chemical. Such allergic reactions result from previous sensitization to that chemical or a structurally similar chemical. Once sensitization occurs, allergic reactions can result from exposure to extremely low doses of the chemical. Allergic reactions can be immediate, occurring within a few minutes after exposure. Anaphylactic shock is a severe immediate allergic reaction that can result in death if not treated quickly. Allergic reactions can also be delayed, taking hours or even days to develop. The skin is usually the site of such delayed reactions, in which cases it becomes red, swollen, and itchy.

It is important to recognize that delayed chemical allergy can occur even some time after the chemical has been removed. Contact with poison ivy is a familiar example of an exposure that causes a delayed allergic reaction.

To protect individuals prone to allergic reaction, use such allergens as follows:

- If this is likely to be a hazard for a planned experiment, advice on emergency response should be obtained.
- Conduct all aerosol producing activities in a fume hood.
- Use appropriate PPE in the laboratory for handling these chemicals (e.g., lab coat, safety goggles, and gloves).
- Select suitable gloves based on the chemical resistance to prevent hand contact.
- Remove personnel from exposure if allergic reactions appear and seek medical advice.

WORK WITH CARCINOGENS

A listing of current carcinogens regulated by OSHA is given in Appendix IV.

The following safeguards shall be used for all work with “Select Carcinogens:”

1. Prepare SOPs for all laboratory operations that involve substances that require designated areas for use. The SOPs shall include provisions for appropriate signs and labels.
2. Laboratory protocol must be reviewed by the CHO and Lab Coordinator before purchase of a regulated carcinogen.
3. A “designated area” should be established where carcinogens shall be isolated and access to that area shall be restricted to designated staff or students.

4. The “designated area” must be posted with appropriate signs stating the specific health hazard and restriction to “authorized personnel only.
5. The use of carcinogens should be limited in the lab so that isolation techniques or a glove box provide controlled access.
6. Keep records for the amounts of these materials on hand and the names of the workers using them.
7. Records of personnel working with carcinogens shall be kept and maintained for thirty years.
8. Specific training shall be provided regarding the cancer-causing possibilities of the substance, as well as decontamination procedures, emergency procedures, and the employees' role in recognizing situations that might result in the release of these substances. Documentation of such training should be available.
9. Procedures for the prevention of spills and accidents, as well as emergency response, shall be implemented and understood by workers.
10. Procedures for decontamination or disposal of wastes and decontaminating the designated area shall be contained within the SOP.

WORK WITH REPRODUCTIVE TOXINS, AND HIGHLY TOXIC MATERIALS

The same safeguards practiced with carcinogens should be used for handling substances that have a high degree of acute toxicity.

1. Designated areas: A hood, glove box, or portion of a laboratory room designated as the only area where work shall be conducted with quantities of potentially harmful chemicals in excess of the specified limit.
2. Designated areas shall be posted and their boundaries clearly marked.
3. Only those persons trained to work with such chemicals will work with them in a designated area. All such persons will:
    a. Use the smallest amount of chemicals that is consistent with the requirements of the work to be done.
    b. Use HEPA filters or high-efficiency scrubber systems to protect vacuum lines and pumps.
    c. Store such chemicals in locked and enclosed spaces with slight negative pressure compared to the rest of the building or dispose of them in compliance with waste disposal policies as well as state and local regulations.
    d. Decontaminate a designated area when work is completed.
    e. Prepare wastes from work with such chemicals for waste disposal in accordance with specific disposal procedures consistent with the Resource Conservation and Recovery Act (RCRA).
    f. Because the decontamination of jewelry may be difficult or impossible, do not wear jewelry when working with highly toxic substances.
    g. Wear long-sleeved disposable clothing and gloves known to resist permeation by the chemicals to be used when working in designated areas.

VENTILATION AND FUME HOODS

Laboratory ventilation is a key factor in controlling employee exposure to hazardous substances. Ventilation is provided in two ways: through the facility's heating and air conditioning system, and through fume hoods

utilized in the laboratory. OSHA defines a fume hood as a "device located in the laboratory which is enclosed on five sides with a moveable sash or fixed particle enclosure on the remaining side.

General Guidelines

1. General laboratory ventilation including both areas where chemicals will be used as well as biologicals such as fungal, bacterial, or viral specimens shall provide negative pressure within the laboratory creating air flow into the laboratory from non-laboratory areas and out to the exterior of the building.
2. Emergency exhaust fans are recommended to quickly vent harmful vapors in case of chemical spill.
3. Laboratory doors should remain closed, except for entry and egress.
4. Use of noxious, corrosive, or volatile chemicals and all reactions that produce potentially hazardous fumes, vapors, and gasses shall be performed within a fume hood.
5. Fume hoods shall not be used as a substitute for Biological Safety Cabinets (laminar flow hoods).
6. The fume hood sash should remain closed when the hood is not in use.
7. Materials or equipment should not be stored in the back of the hood causing baffle blockage nor at the hood opening.
8. When adjustments need to be made to laboratory equipment or operations within the hood while chemical emissions are being produced, the hood sash should not be raised past the sash height indicated by the line on the inspection tag.
9. Controls, discharge, outlets, fans and ducts of hoods exhausting pathogenic or highly toxic materials shall be clearly marked to prevent shutdown of service without notification of hood users and personnel responsible for safety and health.

Fume Hood Use

1. Daily hood function check should be done by the employee before use:
    a. Visually inspect the hood area for storage of materials and baffle blockages.
    b. Check the flow monitor for airflow > 100 fpm. If a hood does not have a flow monitor, place a 1-inch wide by 6- inch piece of soft tissue paper at the hood opening to ensure there is flow into the hood.
    c. If the hood is not operating properly, notify the Lab Coordinator and/or CHO and suspend use until proper function has been restored.
2. Work should be performed as far inside the hood as possible without blocking baffles and with the sash at the height indicated by the line on the inspection tag.
3. The working surface inside the hood should be kept uncluttered.

Fume Hood Performance, Maintenance, and Inspection

Following are requirements applying to fume hoods in the laboratory:

- Ventilation will not be obstructed or modified except by qualified mechanical engineers.

- Ventilation in areas where noxious fumes or flammable liquids are handled should provide a minimum of six air changes per hour.
- Anytime a fume hood's air handling system is altered or serviced, the hood must be inspected before being placed in service.
- Any new fume hoods installed must be inspected by the contracted engineer before being placed in service.
- Toxic fumes: Whenever toxic substances, corrosive aerosols, carcinogens, mutagens or teratogens are handled in a fume hood, the minimum face velocity must be 100 cubic feet per minute (fpm). For hoods not meeting this requirement, the velocity may be increased by lowering the sash. If the velocity cannot be increased, the hood may not be used for the aforementioned materials.
- Fume hood inspections shall be performed and documented at least annually by the Lab Coordinator and/or CHO or a qualified, contracted engineer.
    - Hood face velocity shall be checked with a calibrated device.
    - Performance of 100 fpm shall be verified. A fume hood not performing between 90 – 120 fpm must be serviced by a licensed contractor.
    - Inspected hoods shall have a sign affixed to them stating last inspection date, average face velocity, location of the fan that serves the hood, and the inspector's name.
- Other annual inspection items should include:
    - Sash functional check: Sash should move easily, be unobstructed, and have adequate clarity.
    - Operation of flow monitor if the hood has one.
    - Operation of alarm if the hood has one.
    - Airflow visualization: Airflow visualization can be done with smoke tubes to determine airflow patterns and currents.

Local Ventilation

Local exhaust hoods should be used to prevent the release of harmful vapors into the laboratory. Such devices include student station exhaust hoods, portable hoods on lab equipment, and biological safety cabinets. These should be checked for proper function before use.

SIGNS AND SYMPTOMS OF CHEMICAL EXPOSURE

The OSHA Laboratory Standard requires the Chemical Hygiene Plan to describe the conditions under which the employer is required to provide laboratory employees who work with hazardous chemicals the opportunity to receive medical attention and any follow-up examinations which the examining physician determines to be necessary. The three conditions under which medical consultation and medical examinations must be provided without cost, without loss of pay, and at a reasonable time and place are as follows:

- Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory.
- Whenever an event takes place in the work area such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure.

- Whenever exposure monitoring reveals an exposure level routinely above the permissible exposure limit (PEL) or action level for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements.

Safety Data Sheets, labels, and various reference materials describe potential signs and symptoms of exposure to chemicals. See Appendix VI for a partial summary of symptoms or signs which can be indicative of overexposure to hazardous materials.

If chemical exposure has occurred you should:

- Seek prompt medical attention at LCC Health Clinic or a local hospital and
- Contact the Division front office, CHO and/or LCC Public Safety.
- If a workplace injury has been identified as a result of the exposure, college Human Resources should be contacted for further guidance.

EXPOSURE MONITORING

1. The CHO shall be responsible for chemical exposure monitoring.
2. Employee exposures to any substance regulated by an OSHA standard shall be measured when there is reason to believe that exposure levels routinely exceed the action levels specified in 29 CFR 1910, Subpart Z. 3.
3. Employee exposures to OSHA regulated substances shall not exceed the permissible exposure limit (PEL) specified in 29 CFR 1910, Subpart Z.
4. PPE and engineering controls should be used to prevent employee exposure.
5. Trained laboratory workers should wear a fitted respirator suitable for protection against a suspect chemical until measurements of the concentration of the suspect vapor in the air show that the limit is not exceeded. Under this circumstance, and if there is no reason to anticipate an increase in the concentration of the chemical, and if the CHO approves, the respirator can be removed and the work may continue.
6. Monitoring results shall be provided to the employee, their supervisor, and Human Resources.

MEDICAL PROGRAM

1. An opportunity for medical surveillance, including medical consultation and follow-up, shall be provided under the following circumstances:
    a. Where exposure monitoring is over the action level for an OSHA regulated substance that has medical surveillance requirements.
    b. Whenever an employee develops signs or symptoms that may be associated with a hazardous chemical that the employee may have been exposed to in the laboratory.
    c. Whenever a spill, leak, or explosion results in the likelihood of a hazardous exposure, as determined by the CHO or by Public Safety.

d. To all employees required to wear a respirator.

e. To all emergency response team members.

2. All examinations shall be provided by or under the supervision of a licensed physician preferably experienced in occupational medicine, at no cost to the employee, without loss of pay, and at a reasonable time and place.
3. Each laboratory should have a first aid kit or ready access to one that shall be maintained and checked for expired or missing items.
4. Medical assistance, if required, is available by calling Public Safety.
5. Where medical consultations or examinations are provided, the examining physician shall be provided with the following information:

    a. The identity of the hazardous chemical(s) to which employees may have been exposed.

    b. A description of the conditions under which the exposure occurred including quantitative exposure data, if available.

    c. A description of the signs and symptoms of exposure that the employee is experiencing, if any.

    d. For examinations or consultations provided to employees, a written opinion from the examining physician shall be provided to the employee.

LABORATORY EMERGENCY EQUIPMENT

Safety Eyewashes and Showers

1. In laboratories and any other locations where employees handle substances that may injure their eyes or get onto their bodies, safety eyewashes and showers must be provided and placed at a location accessible within 10 seconds.
2. Access to eyewash fountains and safety showers shall never be restricted or blocked by temporary storage of objects.
3. The function of eyewash fountains and safety showers shall be checked weekly for adequate flow as specified in ANSI Z358.1. Prompt repair of any facility shall be done that does not meet the water flow requirements of ANSI Z358.1.

Fire Extinguishers

1. In general, fire extinguishers should be 5-lbs., dry chemical type (at least 10BC rating) suitable for class ABC fires. For chemical storage rooms a 10-lb ABC extinguisher is recommended.
2. Refer to 29 CFR 1910.157 and/or Oregon Fire Code regulations to verify compliance with requirements for other materials.

    a. For example, a #570 Class D fire extinguisher is required where materials such as sodium metal and magnesium metal turnings are stored.

3. Placement should be at the exit of each room, or as required permanently attached to a wall, cupboard or similar feature. There should be approximately one extinguisher located every 30 feet with discretion used in sharing between one or more rooms.
4. Access to fire extinguishers shall be maintained at all times.
5. Quarterly inspection of fire extinguishers should be done by the Science Safety Committee to ensure that the pressure gauge needle is in the green area.
6. Annual inspection by a qualified professional shall be done on all fire extinguishers.

Fire Blankets

1. Fire blankets should be available in areas containing open flames, flammable liquids, flammable gasses and corrosive chemicals rated as fire hazards.
2. Blankets should be located at exits or adjacent to fire extinguishers and should be permanently attached to the wall.
3. Travel routes should be free from obstruction and travel distance no greater than 70 feet.

Chemical Spill Kits

1. Each laboratory or area in which hazardous chemicals are used shall maintain a spill kit that is suitable for the types and volume of chemicals present.
2. Refer to the SME Chemical Spill Response Plan and specific SOPs for spill response.

RECORDS AND RECORD KEEPING

Accident / Incident Reports

Accident/Incident records (not including medical records) shall be retained by Human Resources. This should include near-miss reports.

Monitoring, Exposure, and Medical Record Retainment Requirements

1. As required by the OSHA Laboratory Standard (29 CFR 1910.1450), records of air concentration monitoring results, exposure assessments, medical consultations, and examinations shall be maintained for at least 30 years and kept accessible to employees or their representatives.
2. Medical records shall be retained by the employee undergoing medical surveillance and the attending physician's office.

Other Documents

The following documents should be maintained for at least 5 years:

1. Lost work time: Specific records may be required in the event of lost work time resulting from an exposure or accident on the job. Use OSHA Form 200 to record lost workdays that occur. Contact your local OSHA office for details.
2. Employee training forms and records

3. Prior approval forms
4. Job / laboratory work hazard assessment forms (for 5 years past the time period during which a particular job / lab procedure is used)
5. PPE inspection records where applicable
6. Safety and other equipment inspection records
7. Fume hood inspection records
8. Repair and maintain records for control systems
9. Hazardous waste manifests
10. Major safety suggestions from employees
11. Complaints from employees
12. Regulatory reports: The EPA and other Federal and state agencies have special record keeping requirements. For example: Record keeping of allegations and the reporting of suspected hazards from the adverse effects of chemical exposure are required under Sections 8 (c) and 8 (e) of the Toxic Substances Control Act; see 4- CFR 716 and 717.
13. Any other safety related reports

EMPLOYEE TRAINING

Training

1. All employees shall receive general onboarding safety and emergency training at the time of their initial assignment through the SME Division and Human Resources. General onboarding safety training should include:
    a. Emergency response and evacuation
    b. Fire training: prevention and response
    c. Accident reporting
    d. Hazard Communication
2. Additionally, job-specific training shall be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present. The aim is to ensure that all individuals at risk are adequately informed about the work in the laboratory, its risks, and what to do if an accident occurs. Training shall also be provided prior to assignments involving new exposure situations, equipment, and chemicals. The training shall be coordinated through the CHO and/or Lab Coordinator.
    a. A document showing job-specific safety training requirements assignments shall be maintained and available for employees' reference.
3. Content of training for employees who will be working with hazardous materials should include:
    a. Handling hazardous chemicals

b. Exposure signs and symptoms
c. Interpretation of SDSs
d. Personal protective equipment
e. Hazardous waste disposal
f. Contents and availability of the CHP
g. Applicable SOPs
h. Review of PELs
i. Laboratory hazards specific to work area if necessary
j. Respirator protection and fit testing program if necessary

4. The required training or equivalents are administered and documented through Moodle-based SME Division Safety Training modules and SafeColleges/Vector LMS courses. Job-specific training courses are assigned through these platforms.

    a. Moodle login: https://classes.lanecc.edu/

        Look for ***Science, Math, Engineering Division Safety Training***.

    b. SafeColleges (Vector LMS) login: https://lanecc-or.safecolleges.com/login

        Look for assigned courses. A wide range of safety courses are available as a resource.

5. A tour of the lab facilities and orientation session will be provided by the Laboratory Coordinator and/or CHO where employees will be apprised of chemical hazards in their work area. Information will include the location of the Chemical Hygiene Plan, access to safety data sheets, location of SOPs, and other hazardous chemical reference materials. These references include lists of toxic effects of chemical substances, and permissible exposure limits for OSHA regulated substances or recommended exposure limits for other hazardous chemicals (when there is no applicable OSHA standard).

REFERENCE MATERIALS and LINKS

Emergency Plan

Emergency Plan in COPPS

Emergency Plan Addendum for SME – Main Campus Bldg 16

Emergency Plan Addendum for SME

Accident Reporting

Accident Reporting/Forms in COPPS

Chemical Spill response Plan for SME

SME Chemical Spill Response Plan

Fire Prevention Plan for SME – Main Campus Bldg 16

SME Fire Prevention Plan

Safety Data Sheets

https://lanecc.kha.com/

Standard Operating Procedures

Location to access Standard Operating Procedures:

1. SME internal website: https://inside.lanecc.edu/sme

   See ***Standard Operating Procedures*** for:

   Alkali Metals

   Carcinogens

   Corrosives

   Compressed Gasses

   Flammable Liquids

Lasers

Radioactive Materials

2. File Server – Science:
3. Google drive -

Safety Instructions Library

SME Internal Website: https://inside.lanecc.edu/sme

See ***Safety Instructions*** for a range of specific health and safety topics.

OSHA Standards

29 CFR 1910 – Occupational Safety and Health Standards - https://www.osha.gov/laws-regs/regulations/standardnumber/1910

29 CFR 1910.1200 - Hazard Communication: https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.1200

29 CFR 1910.1450 - Occupational exposure to hazardous chemicals in laboratories: https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.1450

29 CFR 1910.132 Subpart I – Personal Protective Equipment – General Requirements: https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.132

29 CFR 1910.134 – Respiratory protection: https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.134

2019 Oregon Fire Code, Chapter 38 – Higher Education Laboratories: https://codes.iccsafe.org/content/OFC2019P1/chapter-38-higher-education-laboratories

Federal Regulations – 40 CFR – Protection of Environment

40 CFR Part 261 – Identification and Listing of Hazardous Waste: https://www.ecfr.gov/current/title-40/chapter-I/subchapter-I/part-261

Introduction to Hazardous Waste Identification (40 CFR Parts 261), EPA: https://www.epa.gov/sites/default/files/2015-09/documents/hwid05.pdf

Federal Regulations – 49 CFR – Transportation

49 CFR Part 171 – General Information, Regulation, and Definitions: https://www.ecfr.gov/current/title-49/subtitle-B/chapter-I/subchapter-C/part-171

State of Oregon Department of Environmental Quality (DEQ)

Small Quantity Hazardous Waste Generator Handbook: https://www.oregon.gov/deq/FilterDocs/SQGHandbook.pdf

APPENDIX I: Metric / English Conversion Charts

TEMPERATURE

From C to F F = 1.8 X C + 32

From F to C C = 0.556 X F - 17.8

VOLUME

1 ml	= 0.0338 fluid ounces	1 oz	= 29.573 ml
1 liter	= 2.1134 pints	1 pint	= 473.166 ml
1 liter	= 1.0567 quarts	1 quart	= 946.332 ml
1 cc	= 0.06102 cubic inches	1 ci	= 16.3872 cc

WEIGHT

1 gram = 0.03527 ounces

1 oz = 28.3495 g

1 kilogram = 35.274 ounces

1 oz = 0.0283 kg

APPENDIX II: Globally Harmonized System and Hazard Pictograms

Globally Harmonized System (GHS)

OSHA is proposing to modify the current Hazard Communication Standard (HCS) to align with the provisions of the Globally Harmonized System of Classification and Labeling of Chemicals (GHS). The HCS requires that chemical manufacturers and importers evaluate the chemicals they produce or import and provide hazard information to downstream employers and workers by putting labels on containers and preparing safety data sheets. Under the current HCS all employers must have a hazard communication program for exposed workers, including container labels, safety data sheets, and training.

The GHS provides a single set of harmonized criteria for classifying chemicals according to their health and physical hazards and specifies hazard communication elements for labeling and safety data sheets.

GHS Pictograms

	**Health Hazard:** Carcinogen, Mutagenicity, Reproductive Toxicity, Respiratory Sensitizer, Target Organ Toxicity, Aspiration Toxicity
	**Skull and Crossbones:** Acute Toxicity (fatal or toxic)
	**Corrosion:** Skin Corrosion/Burns, Eye Damage, Corrosive to Metals
	**Exclamation Mark:** Irritant (skin and eye), Skin Sensitizer, Acute Toxicity (harmful), Narcotic Effects, Respiratory Tract Irritant
	**Flame:** Flammables, Pyrophorics, Self-Heating, Emits Flammable Gas, Self-Reactives, Organic Peroxides
	**Flame over Circle:** Oxidizers

	**Exploding Bomb:** Explosives, Self-Reactives, Organic Peroxides
	**Gas Cylinder:** Gasses under Pressure
	**Environment:** Aquatic Toxicity (non-mandatory)

For specific chemicals these classifications can be found on the containers holding the chemicals or on the Safety Data Sheet for the chemical.

Example:

A specific chemical may fit into more than one of these categories. For example,

Nitric Acid is listed in both Corrosive  and Oxidizing  classifications.

To further assess these hazards, OSHA has required 3 more identifying statements to go along with the pictogram. These are:

- **A signal word:** a single word used to indicate the relative level of severity of hazard and alert the reader to a potential hazard on the label. The signal words used are "danger" and "warning." "Danger" is used for the more severe hazards, while "warning" is used for less severe hazards.
- **A hazard statement:** a statement assigned to a hazard class and category that describes the nature of the hazard(s) of a chemical including, where appropriate, the degree of hazard.

- **A precautionary statement:** a phrase that describes recommended measures to be taken to minimize or prevent adverse effects resulting from exposure to a hazardous chemical, or improper storage or handling of a hazardous chemical.

For Nitric Acid

- The signal word is “Danger”.
- The hazard statements are:
    - H272 May intensify fire; oxidizer.
    - H314 Causes severe skin burns and eye damage.

- The precautionary statements are:
    - P210 Keep away from heat.
    - P220 Keep/Store away from clothing/combustible materials.
    - P221 Take any precaution to avoid mixing with combustibles.
    - P264 Wash skin thoroughly after handling.
    - P280 Wear protective gloves/protective clothing/eye protection/ face protection.
    - P301 + P330 +P331 IF SWALLOWED: rinse mouth. Do NOT induce vomiting.
    - P303 + P361 + P353 IF ON SKIN (or hair): Remove/Take off immediately all contaminated.

APPENDIX III: GLOVE SELECTION CHART

Reference: OSHA Personal Protective Equipment Table 4 - http://www.osha.gov/Publications/osha3151.pdf

Chemical and Liquid-Resistant Gloves

Chemical-resistant gloves are made with different kinds of rubber: natural, butyl, neoprene, nitrile and fluorocarbon (Viton); or various kinds of plastic: polyvinyl chloride (PVC), polyvinyl alcohol and polyethylene. These materials can be blended or laminated for better performance. As a general rule, the thicker the glove material, the greater the chemical resistance but thick gloves may impair grip and dexterity, having a negative impact on safety. Some examples of chemical-resistant gloves include:

- **Butyl gloves** are made of a synthetic rubber and protect against a wide variety of chemicals, such as peroxide, rocket fuels, highly corrosive acids (nitric acid, sulfuric acid, hydrofluoric acid and red-fuming nitric acid), strong bases, alcohols, aldehydes, ketones, esters and nitro compounds. Butyl gloves also resist oxidation, ozone corrosion and abrasion, and remain flexible at low temperatures. Butyl rubber does not perform well with aliphatic and aromatic hydrocarbons and halogenated solvents.

- **Natural (latex) rubber gloves** are comfortable to wear, which makes them a popular general-purpose glove. They feature outstanding tensile strength, elasticity and temperature resistance. In addition to resisting abrasions caused by grinding and polishing, these gloves protect workers' hands from most water solutions of acids, alkalis, salts and ketones. Latex gloves have caused allergic reactions in some individuals and may not be appropriate for all employees. Hypoallergenic gloves, glove liners and powderless gloves are possible alternatives for workers who are allergic to latex gloves.
- **Neoprene gloves** are made of synthetic rubber and offer good pliability, finger dexterity, high density and tear resistance. They protect against hydraulic fluids, gasoline, alcohols, organic acids and alkalis. They generally have chemical and wear resistance properties superior to those made of natural rubber.
- **Nitrile gloves** are made of a copolymer and provide protection from chlorinated solvents such as trichloroethylene and perchloroethylene. Although intended for jobs requiring dexterity and sensitivity, nitrile gloves stand up to heavy use even after prolonged exposure to substances that cause other gloves to deteriorate. They offer protection when working with oils, greases, acids, caustics and alcohols but are generally not recommended for use with strong oxidizing agents, aromatic solvents, ketones and acetates.

The following table from the U.S. Department of Energy (Occupational Safety and Health Technical Reference Manual) rates various gloves as being protective against specific chemicals and will help you select the most appropriate gloves to protect your employees. The ratings are abbreviated as follows:

VG: Very Good; G: Good; F: Fair; P: Poor (not recommended). Chemicals marked with an asterisk (*) are for limited service.

Chemical	Neoprene	Latex/ Rubber	Butyl	Nitrile
Acetaldehyde*	VG	G	VG	G
Acetic acid	VG	VG	VG	VG
Acetone*	G	VG	VG	P
Ammonium hydroxide	VG	VG	VG	VG
Amy acetate*	F	P	F	P
Aniline	G	F	F	P
Benzaldehyde*	F	F	G	G
Benzene*	P	P	P	F
Butyl acetate	G	F	F	P
Butyl alcohol	VG	VG	VG	VG
Carbon disulfide	F	F	F	F
Carbon tetrachloride*	F	P	P	G
Castor oil	F	P	F	VG
Chlorobenzene*	F	P	F	P

Chloroform*	G	P	P	F
Chloronaphthalene	F	P	F	F
Chromic acid (50%)	F	P	F	F
Citric acid (10%)	VG	VG	VG	VG
Cyclohexanol	G	F	G	VG
Dibutyl phthalate*	G	P	G	G
Diesel fuel	G	P	P	VG
Diisobutyl ketone	P	F	G	P
Dimethylformamide	F	F	G	G
Dioctyl phthalate	G	P	F	VG
Dioxane VG G G G	VG	G	G	G
Epoxy resins, dry	VG	VG	VG	VG
Ethyl acetate*	G	F	G	F
Ethyl alcohol	VG	VG	VG	VG
Ethyl ether*	VG	G	VG	G
Ethylene dichloride*	F	P	F	P
Ethylene glycol	VG	VG	VG	VG
Formaldehyde	VG	VG	VG	VG
Formic acid	VG	VG	VG	VG
Freon 11	G	P	F	G
Freon 12	G	P	F	G
Freon 21	G	P	F	G
Freon 22	G	P	F	G
Furfural*	G	G	G	G
Gasoline, leaded	G	P	F	VG
Gasoline, unleaded	G	P	F	VG
Glycerin	VG	VG	VG	VG
Hexane	F	P	P	G
Hydrazine (65%)	F	G	G	G
Hydrochloric acid	VG	G	G	G
Hydrofluoric acid (48%)	VG	G	G	G
Hydrogen peroxide (30%)	G	G	G	G
Hydroquinone	G	G	G	F
Isooctane	F	P	P	VG
Kerosene	VG	F	F	VG
Ketones	G	VG	VG	P
Lacquer thinners	G	F	F	P
Lactic acid (85%)	VG	VG	VG	VG

Lauric acid (36%)	VG	F	VG	VG
Lineolic acid	VG	P	F	G
Linseed oil	VG	P	F	VG
Maleic acid	VG	VG	VG	VG
Methyl alcohol	VG	VG	VG	VG
Methylamine	F	F	G	G
Methyl bromide	G	F	G	F
Methyl chloride*	P	P	P	P
Methyl ethyl ketone*	G	G	VG	P
Methyl isobutyl ketone*	F	F	VG	P
Methyl metharcrylate	G	G	VG	F
Monoethanolamine	VG	G	VG	VG
Morpholine	VG	VG	VG	G
Naphthalene	G	F	F	G
Napthas, aliphatic	VG	F	F	VG
Napthas, aromatic	G	P	P	G
Nitric acid*	G	F	F	F
Nitric acid, red and white fuming	P	P	P	P
Nitromethane (95.5%)*	F	P	F	F
Nitropropane (95.5%)	F	P	F	F
Octyl alcohol	VG	VG	VG	VG
Oleic acid	VG	F	G	VG
Oxalic acid	VG	VG	VG	VG
Palmitic acid	VG	VG	VG	VG
Perchloric acid (60%)	VG	F	G	G
Perchloroethylene	F	P	P	G
Petroleum distillates (naphtha)	G	P	P	VG
Phenol	VG	F	G	F
Phosphoric acid	VG	G	VG	VG
Potassium hydroxide	VG	VG	VG	VG
Propyl acetate	G	F	G	F
Propyl alcohol	VG	VG	VG	VG
Propyl alcohol (iso)	VG	VG	VG	VG
Sodium hydroxide	VG	VG	VG	VG
Styrene	P	P	P	F
Styrene (100%)	P	P	P	F
Sulfuric acid	G	G	G	G

Tannic acid (65)	**VG**	**VG**	**VG**	**VG**
Tetrahydrofuran	**P**	**F**	**F**	**F**
Toluene*	**F**	**P**	**P**	**F**
Toluene diisocyanate (TDI)	**F**	**G**	**G**	**F**
Trichloroethylene*	**F**	**F**	**P**	**G**
Triethanolamine (85%)	**VG**	**G**	**G**	**VG**
Tung oil	**VG**	**P**	**F**	**VG**
Turpentine	**G**	**F**	**F**	**VG**
Xylene*	**P**	**P**	**P**	**F**

APPENDIX IV: Flammable & Combustible Liquids Allowable Container Size

NFPA 45 Standard Maximum Allowable Container Size (2019 Edition)

Container Type	Flammable Class IA	Flammable Class IB	Flammable Class IC	Combustible Class II	Combustible Class IIIA
Glass	500 mL (1 pt)*	1 L (1 qt)*	4 L (1 gal)	4 L (1 gal)	4 L (1 gal)
Metal (other than DOT/UN drums) or approved plastic	4 L (1 gal)				
Safety cans	10 L (2.6 gal)	20 L (5 gal)	20 L (5 gal)	20 L (5 gal)	20 L (5 gal)
Metal container (DPT/UN specification)	4 L (1 gal)	20 L (5 gal)	20 L (5 gal)	227 L (60 gal)	227 L (60 gal)
Polyurethane (DOT Specification 34, UN 1H1, or as authorized by DOT special permit	4 L (1 gal)	20 L (5 gal)	20 L (5 gal)	227 L (60 gal)	227 L (60 gal)
Pressurized liquid dispensing container	20 L (5 gal)	227 L (60 gal)	227 L (60 gal)	227 L (60 gal)	227 L (60 gal)

*Glass containers as large as 4 L shall be permitted to be used if needed, if the required purity would be adversely affected by storage in a metal or an approved plastic container, or if the liquid would cause excessive corrosion or degradation of a metal or approved plastic container.

NFPA Flammable & Combustible Liquids Classification Definitions

Class	Flash Point	Boiling Point	NFPA Rating
IA	< 73°F (22.8°C)	< 100°F (37.8°C)	4
IB	< 73°F (22.8°C)	> 100°F (37.8°C)	3
IC	> 73°F (22.8°C) and < 100°F (37.8°C)	--	3
II	> 100°F (37.8°C) and <140°F (60°C)	--	2
IIIA	> 140°F (60°C) and < 200°F (93°C)	--	1
IIIB	> 200°F (93°C)	--	0

APPENDIX V: Carcinogen Lists

Currently regulated as carcinogenic

- 2-Acetylaminofluorene
- Acrylonitrile
- 4-Aminodiphenyl
- Asbestos
- Benzene
- Benzidine
- Bis-chloromethyl ether
- 1,2-Dibromo-3-chloropropane

- 3,3'-Dichlorobenzidine (+ salts)
- 4-Dimethylaminoazobenzene
- Ethylene oxide
- Ethyleneimine
- Inorganic arsenic
- Methyl chloromethyl ether
- a-Naphthylamine
- b- Naphthylamine
- 4-Nitrobiphenyl
- N-Nitrosodimethylamine
- B-Propiolactone
- Vinyl chloride

Other recognized carcinogens

- Analgesics with Phenacetin
- Azathioprine
- Myleran
- Chlorambucil
- Chromium and certain compounds
- Conjugated estrogens
- Cyclophosphamide
- Diethylstilbestrol
- Melphalan
- PUVA
- Mustard gas
- Thorium dioxide

Suspected carcinogens

- Adriamycin
- Aflatoxins
- 2-Aminoanthraquinone
- o-Aminoazotoluene
- 1-Amino-2-methylanthraquinone
- Amitrole
- o-Anisidine hydrochloride
- Benzotrichloride
- Beryllium and some compounds
- Bischloroethyl nitrosourea
- 1,3 Butadiene
- Cadmium and some compounds
- Carbon tetrachloride
- Chlorendic acid
- Chlorinated paraffins
- Chloroform
- CCNU

- 3-Chloro-2-methylpropene
- 4-Chloro-o-phenylenediamine
- C.I. Basic red 9 mono HCL
- p-Cresidine
- Cupferron
- Dacarbazine
- DDT
- 2,4-Diaminoanisole sulfate
- 2,4 Diaminotoluene
- 1,2-Dibromo-3-chloropropane
- 1,2 Dibromoethane
- 1,4-Dichlorobenzene
- 3,3'-dichlorobenzidine
- 3,3'-dichlorobenzidine HCL
- 1,2-Dichloroethane
- Methylene chloride
- 1,3-Dichloropropene
- Diepoxybutane
- Di(2-ethylhexyl)phthalate
- Diethyl sulfate
- Diglycidyl resorcinol ether
- 3,3'-Dimethoxybenzidine
- 3,3'-Dimethylbenzidine
- Dimethylcarbamoyl chloride
- 1,1-Dimethylhydrazine
- Dimethyl sulfate
- Dimethylvinyl chloride
- 1,4-Dioxane
- Direct black 38
- Direct blue 6
- Epichlorohydrin
- Estrogens (not conjugated)
- Ethyl acrylate
- Ethylene oxide
- Ethylene thiourea
- Formaldehyde gas
- Hexachlorobenzene

APPENDIX VI: Signs and Symptoms of Chemical Overexposure

This is a partial summary of symptoms or signs which can be indicative of overexposure to hazardous materials:

- Abdominal cramps
- Alopecia (loss of hair)

- Amenorrhea (stoppage of menstruation)
- Amnesia
- Analgesia (loss of sensitivity to pain)
- Anesthesia (loss of feeling)
- Angina pectoris (chest pain)
- Anorexia (loss of appetite)
- Anosmia (loss of sense of smell)
- Anuria (lack of urination)
- Anxiety
- Aphasia (inability to talk coherently)
- Apnea (breathing temporarily stopped)
- Areflexia (loss of reflexes)
- Argyria (blue colored tissue from silver)
- Arrhythmia (irregular heartbeat)
- Arthralgia (joint pain)
- Asphyxia (suffocation)
- Asthenia (loss of strength or energy)
- Asthma (difficulty in breathing)
- Ataxia (inability to walk straight)
- Athetosis (slow writhing movements of fingers)
- Atrophy (reduction in size or function of body)
- Blindness
- Blurred vision
- Bradycardia (slow heartbeat)
- Bronchitis
- Burn (tissue damage)
- Cancer (abnormal tissue growth)
- Cataracts
- Changes in body/breath odor
- Cheilitis (inflammation of the lips)
- Chemical pneumonitis (inflammation of the lungs)
- Chills
- Chloracne (reddish skin rash)
- Chorea (jerky uncontrolled movements of limbs)
- Colic (abdominal pain due to intestinal gas)
- Collapse
- Coma
- Confusion
- Conjunctivitis (inflamed and reddened eyes)
- Constipation
- Convulsions
- Coughing
- Coughing blood
- Cyanosis (blue to purple skin color)

- Dark urine
- Dehydration (excessive loss of body water)
- Delirium (mental confusion)
- Dental erosion
- Depression, mental
- Dermatitis (inflamed and reddened skin)
- Diaphoresis (profuse perspiration)
- Diarrhea
- Disequilibrium (inability to maintain balance)
- Disordered gait (change in walking pattern)
- Dizziness
- Drooling
- Drowsiness
- Dysarthria (difficulty in speaking clearly)
- Dysosmia (impaired sense of smell)
- Dysphagia (difficulty in swallowing)
- Dyspnea (difficulty in breathing)
- Dysuria (painful or difficult urination)
- Eczema (itching and burning skin)
- Edema (fluid retention, swelling)
- Emaciation (extreme low weight)
- Embolism (obstruction of a blood vessel)
- Emphysema (difficulty breathing)
- Epistaxis (nosebleed)
- Erythema (reddened skin)
- Euphoria (exaggerated feeling of well-being)
- Fasciculation (muscle twitching under skin)
- Fainting
- Fatigue
- Fever
- Fibrillation (rapid muscle contractions)
- Fluorosis (darkening of the teeth)
- Footdrop (dragging of the foot while walking)
- Frostbite
- Gangrene (tissue death)
- Gasping (difficulty catching breath)
- Gastroenteritis (inflammation of the stomach and intestine)
- Giddiness (dizziness, silliness)
- Glossitis (tongue swelling)
- Halitosis (foul-smelling breath)
- Hallucination
- Headache
- Hematuria (blood in the urine)
- Hemiparesis (paralysis of one side of the body)

- Hemorrhage (bleeding)
- Hyperemia (congestion of blood in a body part)
- Hyperkinesis (excess activity or motion)
- Hyperpigmentation (excessive coloring of the skin)
- Hyperthermia (elevated body temperature)
- Hyperventilation (sudden rapid breathing)
- Hypocalcemia (calcium deficiency of the blood)
- Hypothermia (lowered body temperature)
- Hypoxia (insufficient oxygen)
- Icterus (tissue discoloration)
- Impotence (loss of sexual ability)
- Incoordination
- Inflammation (swelling, redness)
- Inflexibility (rigidity, inability to move)
- Insomnia (inability to obtain normal sleep)
- Interstitial fibrosis (scarring of the lungs)
- Involuntary defecation
- Involuntary urination
- Iridocyclitis (inflammation of the iris)
- Irritability
- Itch
- Jaundice (yellow discoloration of skin or eyes)
- Keratosis (horny growths on skin)
- Lacrimation (excessive eye tearing)
- Lassitude (sense of weariness)
- Lesion (injury to tissue)
- Lethargy (sluggish feeling)
- Lightheadedness (dizziness)
- Lipid granuloma (inflamed lung tissue)
- Lipid pneumonia (from aspiration of oily materials)
- Malnutrition
- Melena (black tarry vomit or stools)
- Menstrual changes
- Metallic taste
- Miosis (pupil contraction)
- Miscarriage
- Myotonia (temporary muscle rigidity and spasm)
- Narcosis (stupor or uncontrolled sleeping)
- Nasal ulceration (perforation of nasal tissue)
- Nausea
- Necrosis (localized death of tissue)
- Neoplasm (abnormal tissue growth)
- Nephrotoxic (poisonous to the kidney)
- Nervousness

- Neuritis (inflammation of the nerves)
- Nocturia (excessive urination at nighttime)
- Numbness
- Ochronosis (dark spots on skin)
- Oliguria (decreased urination)
- Opisthotonos (spasms with body arched from head to heels)
- Oxide pox (dermatitis from oxide contact)
- Pallor
- Palpitations (forceful heartbeat)
- Paralysis
- Paresthesias (abnormal tingling)
- Paroxysmal (sudden recurrence of disease)
- Perforation (opening through a tissue)
- Pharyngitis (sore throat)
- Phlebitis (swollen, painful vein)
- Photophobia (inability to tolerate light)
- Photosensitization (allergic reaction to light)
- Phototoxicity (irritant reaction to light)
- Pneumoconiosis (material particles in the respiratory tract)
- Prostration (marked loss of strength)
- Proteinuria (presence of protein in the urine)
- Ptosis (drooping of upper eyelid)
- Pulmonary edema (fluid in the lungs)
- Pyorrhea (swollen, bleeding gums)
- Pyuria (pus in urine)
- Respiratory distress
- Rhinorrhea (excessive nasal discharge)
- Salivation (discharge of saliva)
- Scotoma (blind spot in field of sight)
- Seizure
- Sensitization (allergic reaction)
- Shock (depression of all bodily functions)
- Siderosis (lung and tissue damage from iron particles)
- Silicosis (lung condition from silica dusts)
- Spasms
- Stomatitis (swelling of the mouth lining)
- Strabismus (lack of coordinated eye movement, crossed eyes)
- Sweating (excessive moisture on skin)
- Swelling (of tissues)
- Tachycardia (abnormal rapid heartbeat)
- Tachypnea (increased respiratory rate)
- Tetany (intermittent muscle spasms)
- Tick (skin twitch)
- Tinnitus (ringing in the ears)

- Tracheobronchitis (coughing, difficulty breathing)
- Tremors (shaking, trembling)
- Tumor (swelling or growth)
- Ulceration (tissue destruction)
- Urticaria (skin eruption)
- Vertigo (feeling of whirling motion)
- Vesiculation (blisters)
- Vomiting
- Wheezing
- Wrist drop (inability to extend hand at wrist)