Drake University

CHEMICAL HYGIENE PLAN AND HAZARDOUS MATERIALS SAFETY MANUAL

Drake University
Environmental, Health & Safety Office
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NONDISCRIMINATION STATEMENT

The principles of equal access and equal opportunity require that all interactions within the University be free from invidious discrimination. Drake University therefore prohibits discrimination based upon race, color, national origin, creed, religion, age, disability, sex, gender identity, sexual orientation, genetic information, or veteran status.

Rev. 08.2015

Environmental Health and Safety Statement

Drake University is committed to maintaining a model Environmental Health and Safety program for its students, faculty, staff, visitors, and the surrounding community. Drake strives to foster a strong safety culture and promote environmental responsibility and protection among stakeholders and at all University facilities. In the continuous pursuit of this goal, all members of the University community should comply with all environmental health and safety laws and regulations by implementing current best practices within their work areas, promoting a healthy and viable Environmental Health and Safety culture.

As an Institution, Our Guiding Principles are:

- Every member of the community has a critical role in their own safety and the safety of those around them.
- Environmental Health and Safety concerns are an integral aspect of all operations and functions.
- Drake promotes and practices environmental responsibility.
- Members of the Drake community strive to minimize air and water emissions, as well as waste generation.
- The University shares examples of excellence in environmental health and safety with other institutions and surrounding communities.
- The institution provides education to maximize safe work practices and minimize potential for injury or loss.
- Drake endeavors to create and sustain an environment of positive collaboration among all stakeholders, including faculty, students, staff, environmental health and safety specialists, facility services, and public safety, to identify environmental health and safety issues and to find acceptable solutions to problems.

The University will promote shared responsibility for maintaining environmental health and safety by integrating EHS policy into relevant planning and decision-making processes and establishing management policies, programs, procedures, and practices that identify and address health and safety risks.

Directory of Service and Emergency Providers

Services

Environmental Health and Safety
1418 27th Street | (515) 271-3804

Unity Point Occupational Medical Centers

WEST DES MOINES	DES MOINES	ANKENY
Lakeview Medical Park	Penn Medical Place	White Birch Plaza
6000 University Ave.,	1301 Pennsylvania Ave.,	1810 SW White Birch Cir.,
Suite 124	Suite 416	Suite 111
West Des Moines, IA 50266	Des Moines, IA 50316	Ankeny, IA 50023
Phone: 515-241-2020	Phone: 515-262-7619	Phone: 515-964-6974

Methodist Hospital
Emergency Department
1200 Pleasant St,
Des Moines, IA 50309
(515) 241-6213
(24 Hour Service)

Student Health Center
3116 Carpenter Ave
Des Moines, IA 50311
515-271-3731

Emergency
Drake University Campus

Campus Security (emergency)…….	811
Fire……	911
Des Moines Police (emergency)……..	911
Ambulance…….	911

In the event of an emergency give the following information to the dispatcher:

Your name:
Location: Name of building and room number
The number of the phone you are calling from,
What is the nature of the emergency: e.g. fire, someone injured etc.
Tell what happened: chemical spill, explosion, overcome by fumes, etc.
How many people are injured?
What type of injury: are they unconscious, not breathing etc.
What are their symptoms: are they complaining their eyes burn, that they can't breathe, etc.

Stay on the phone until the dispatcher tells you to hang up.

Contents

A. Introduction

The *Drake University Chemical Hygiene Plan and Hazardous Materials Safety Manual* is designed to provide users with general health and safety information. Following the guidance outlined in this manual will help protect workers from accidents and illnesses and prevent damage to the environment.

The *Chemical Hygiene Plan and Hazardous Materials Safety Manual* meets Occupational Safety and Health Administration (OSHA) requirements for a Chemical Hygiene Plan as specified in 29 CFR 1910.1450, and outlines appropriate practices, university policies and other regulations that must be followed in laboratories. The *Chemical Hygiene Plan and Hazardous Materials Safety Manual* is not intended to be comprehensive but should supplement specific procedures developed by the person(s) responsible for unique laboratory hazards.

Laboratory personnel must have access to this manual and other health and safety documents, at all times. Contact EH&S at (515) 271-3804 or email ehs@drake.edu with questions regarding this manual.

Definition o f a Laboratory

A laboratory is defined as, but is not limited to, any location where research or teaching is conducted using hazardous chemicals, biohazardous or biological materials, radioactive materials and/or radiation producing devices, or controlled experiments on animals.

A storage room containing the above materials is considered a laboratory if the materials are stored in support of teaching or research.

The following areas are typically NOT considered laboratories under the *Chemical Hygiene Plan and Hazardous Materials Safety Manual*; however, persons working in these areas are required to follow all applicable health and safety regulations:

- shops, mechanical and custodial areas under the control of Facilities Services
- departmental storage rooms, offices, meeting rooms, and other ancillary spaces
- computer use areas containing multiple workstations, even if teaching and research is occurring, unless located inside a space that meets the definition of a laboratory
- private offices, unless contiguous with or in a space that meets the definition of a laboratory

Administrative Responsibilities

Employees are expected to follow all applicable practices and procedures contained in the *Laboratory Safety Manual,* complete designated training, and report hazardous or unsafe conditions to the lab supervisor, Principal Investigator (PI), Laboratory Safety Contact or Environmental Health and Safety.

Principal Investigators, Laboratory Supervisors and Instructors are responsible for ensuring that the policies and guidelines established in this manual are strictly followed by all employees, collaborating researchers, visitors, and students under their jurisdiction.

Department Chairs are responsible for adopting and implementing the policies within the Chemical Hygiene Plan and Hazardous Materials Safety Manual in laboratories under their administrative control. Department chairs must designate a Laboratory Safety Contact that will act as a point of contact for this effort. The department chair shall be the Laboratory Safety Contact unless otherwise designated.

The Laboratory Safety Contact assists laboratory supervisors in adapting requirements of the *Chemical Hygiene Plan and Hazardous Materials Safety Manual* to individual laboratories. Assigned duties may include acting as a point of contact with EH&S, providing information and consultation on laboratory safety requirements, disseminating information published by EH&S, facilitating laboratory surveys, and conveying departmental information and concerns to EH&S.

The Department of Environmental Health and Safety (EH&S) develops compliance assistance programs for Drake University based on federal, state and local rules and regulations. EH&S oversees the adoption and implementation of the *Chemical Hygiene Plan and Hazardous Materials Safety Manual* by individual departments, and will designate a university Chemical Hygiene Officer (CHO) to oversee

the lab safety program.

Sponsored Programs Administration ensures compliance with federal, state and local rules and regulations related to research and oversees the following compliance committees: Human - Institutional Review Board (IRB), Biohazards - Hazardous Waste Advisory Committee Animals - Institutional Animal Care and Use Committee (IACUC) and Radiation - Hazardous Waste Advisory Committee

Students are expected to observe all applicable safety practices and procedures contained in this *Chemical Hygiene Plan and Hazardous Materials Safety Manual*, complete designated trainings, and report any unsafe or hazardous conditions to the lab supervisor, PI, Laboratory Safety Contact or EH&S.

Visitors are considered to be all persons entering a laboratory other than the PIs, laboratory staff, enrolled students and authorized Drake University employees. Visitors to Drake University laboratories will be under the supervision of the host laboratory. The host is responsible for laboratory security during the visitation, visitor training and notification of potential hazards, and oversight of visitor compliance with applicable safety practices and procedures contained in the *Chemical Hygiene Plan and Hazardous Materials Safety Manual*.

Setting up a Laboratory

This manual contains regulatory requirements, university policies and prudent practices that apply to activities performed in laboratories at Drake University. The volume of these requirements can make the establishment of a laboratory a complex and confusing process. To guide Drake University researchers through this process, EH&S has developed the EHS Research Support Checklist. Using this checklist and the more specific information contained in the *Chemical Hygiene Plan and Hazardous Materials Safety Manual*, researchers will have laid the foundation for establishing a safe and compliant laboratory.

The Laboratory Check-in Form and Laboratory Check-out Form were developed as resources to help document regulatory compliance by researchers before work begins and before departure. It is recommended that departments establish a formal procedure to “check in” new researchers beginning work at Drake University and “check out” researchers leaving the university. Ask your administrative office if a formal “check in/check out” program has been established in your department.

B. Process Planning

Working safely in the laboratory does not happen by accident. Planning laboratory processes will help you identify hazards, establish hazard control measures, and ultimately keep you and other lab personnel safe.

Standard Operating Procedures

Process planning must begin with each investigator or laboratory group completing hazard assessments and developing standard operating procedures (SOPs). The purpose of a hazard assessment is to identify and evaluate all chemical, biological, radiological and physical hazards associated with laboratory operations and describe safety precautions necessary to avoid employee exposures and injuries. ***SOPs must be specific to each laboratory operation.***

SOPs must be reviewed and approved by the PI or the lab supervisor. After approval, SOPs are then incorporated into or attached to written materials and methods. Laboratory personnel must be trained on the elements of the SOP before performing an experiment or operation. At a minimum, SOPs must include the following

- ***Health and safety information for materials used*** – list and briefly describe the chemical, biological, radiological and physical hazards associated with the operation. Identify available resources like safety data sheets (SDS) and specify where they can be accessed.
- ***Hazard control measures*** – include containment devices, ventilation, specific personal protective equipment, and hygiene practices as recommended by the SDS or other authoritative guide. Evaluate whether special procedures discussed below will be required.
- ***Waste disposal practices*** – establish procedures for the safe and timely removal of laboratory waste. Reference Section H, “Waste and Recycling,” as appropriate or develop written procedures if necessary.
- ***Decontamination procedures*** – develop procedures and include required frequency and duration.
- ***Spill/release containment and clean up procedures*** – develop procedures using Section C, “Emergency Planning” of this manual.

SOPs must be readily available in the laboratory where the experiment or operation will be performed and should be reviewed and updated annually.

Special Procedures

Special procedures must be developed for work involving materials or equipment that present a significant risk of exposure or injury to the human body. Examples include carcinogens, reproductive toxins, teratogens, highly toxic substances, explosives, controlled substances, select biological agents, radioactive materials, radiation producing devices, and lasers. The following special procedures must be developed and specified on the SOP:

- ***Identify authorized personnel*** who may work with these materials or equipment. Authorized persons must receive training on the unique hazards of these materials or equipment before use.
- ***Establish a designated use area*** (e.g., fume hood, glove box, lab bench, etc.) and identify the area by signs or postings. Restrict access to this area to authorized personnel. If an entire lab is designated, then access must be restricted to authorized personnel.
- ***Specify special safety precautions*** for experiments or laboratory operations where these materials or equipment are used. Be sure to identify specialized equipment, shielding or security requirements to be used.

Note **–** Many of these materials or equipment require special authorization from EH&S or a government agency to purchase, possess and use. Refer to the "Ordering Chemical, Biological and Radioactive Materials" Section below for information on the application process for each material.

Additional Resources

Carcinogens, Reproductive Toxins and Teratogens

Laser Safety Manual

Nanotechnology

Radiation Safety Manual

Select Biological Agents

Use of Engineering Controls

Engineering controls must be implemented where possible to reduce hazards associated with the use and storage of chemical, biological and radiological materials. Engineering controls should be considered in the following order:

- substitution of less hazardous equipment, chemicals or processes
- physical isolation of the operator or process
- local and general exhaust ventilation and/or filtration (e.g., use of fume hoods, charcoal filters)

Ordering Chemical, Biological and Radiological Materials

Many materials and equipment require special authorization to purchase, use, and store. Include these ordering procedures as part of your process planning to increase laboratory safety, decrease procurement delays, and reduce potential regulatory deficiencies.

- Obtain any necessary permits, licenses or registrations prior to ordering. Refer to "Additional Resources" below for details.
- Before ordering chemical, biological or radiological materials, carefully plan and outline specific safety precautions in an SOP approved by the laboratory supervisor.
- Order only those materials for which adequate safety equipment is available.
- Order the minimum quantity of chemical, biological and radiological materials required.
- Prepare the laboratory prior to receipt of the substance (i.e., establish storage location, post appropriate signs, obtain necessary personal protective equipment, etc.).

Access the Chemical Redistribution Page for a list of free chemicals that are available.

Additional Resources

Special authorization is required to purchase, possess and use the following materials:

Biological materials – These may include human, animal or plant pathogens, animals, animal parts, plants, plant parts and soils regulated by the Centers for Disease Control and Prevention or the United States Department of Agriculture. For more information refer to the Permit Requirements web page.

Chemicals of interest – The Department of Homeland Security monitors chemicals of interest as they relate to the possibility of theft, release or sabotage/contamination.

Controlled substances – This category includes any drug or material regulated by the United States Drug Enforcement Agency. For more information refer to the Controlled Substances web page.

Explosives – These items are regulated by the United States Department of Transportation and the Bureau of Alcohol, Tobacco and Firearms.

Radioactive materials and radiation production devices – Only individuals identified as authorized personnel on an authorization may receive radioactive material or devices. For more information, visit the Radiation Section of the EH&S website.

Tax-free ethanol – Only individuals who have completed online training and submitted an application to EH&S may purchase tax-free ethanol at Drake University.

Receipt and Distribution of Chemical, Biological and Radiological Materials

In addition to ordering procedures, lab process planning must include the receipt and distribution of hazardous materials. Follow these guidelines when materials are received in the lab or are transported on campus.

- Do not accept any chemical, biological or radiological material in a damaged or improperly labeled container.
- Obtain and review a SDS or equivalent (Merck Index, Biosafety in Microbiological and Biomedical Laboratories) for all chemical, biological and radiological materials.
- Use shock-resistant carriers when transporting materials by hand.
- When transporting materials by cart, ensure the cart is stable enough to prevent tipping and provides containment of any spilled materials.
- When transporting materials on elevators. Do not accompany a compressed gas cylinder on an elevator. Place the cylinder, secured to a cart, in the elevator, attach a sign to the cylinder to let others know not to ride in the elevator with the cylinder.
- Use an appropriate hand truck or cart to transport gas cylinders and Dewar flasks (do not drag or roll), ensure the valve protection caps are in place, and handle only one container at a time.
- Do not transport chemical, biological or radiological materials in personal vehicles. Use a Drake University vehicle when transporting materials. Ensure secondary containment is used in case of a spill. If a spill occurs, immediately inform the Department of Public Safety at (515) 221-2222.
- Adhere to permit conditions when transporting permitted, licensed or registered materials.

Hazardous Material Inventory

Inventories must be submitted to EH&S annually and updated when significant changes in amount or research processes occur. Use the inventory as a tool to identify unsafe conditions such as missing labels, items nearing expiration and broken or leaking containers.

- Chemical Inventory
- Biological Inventory

Additional Resources

Biosafety Manual

Radiation Safety Manual

Shipping Laboratory Materials Off -Campus

All off-campus transport of laboratory materials must comply with university, state, federal and international shipping requirements. Laboratory materials may include chemical, biological or radiological materials, compressed gases, diagnostic specimens, refrigerants, and equipment or instruments that contain hazardous materials. Shipments of these materials must be properly classified, packaged, marked, labeled and documented. For information on how to ship hazardous materials, review the *Hazardous Materials Shipping Guide*.

Note – Ensure that the off-campus recipient has all necessary permits and/or authorizations to receive the material being shipped.

C. Emergency Planning

When planning for emergencies, be sure to communicate hazards through postings/signage and have procedures in place for personnel to follow.

Postings and Signs

Post the following information at the main entrance to each laboratory:

- Names and phone numbers of the lab supervisor and other responsible parties to be contacted in the event of an accident, fire or spill
- Special hazards that may be encountered in the laboratory (e.g. biohazardous material, cylinders, laser in use, radioactive material, etc.)
- Safety instructions for persons entering the laboratory, such as access restrictions, required protective equipment, etc.
- Restrictions (e.g., Hard Hat Area)
- National Fire Protection Association (NFPA) 704 diamond (supplied by EH&S upon request once chemical inventory is submitted)

The interior of the laboratory must be posted with the following:

- Emergency Action Plan near the exit. Development of the Emergency Action Plan will be discussed in the next section.
- Hazardous Waste Satellite Accumulation Area sign to designate the location where laboratory waste will accumulate until it is collected by EH&S. Refer to Section H, “Waste and Recycling” in this manual for details.
- Signs identifying location of safety equipment (e.g., fire extinguisher, safety shower, eyewash fountain, etc.). Refer to Section D, “Safety Equipment” in this manual for specific information on required signage and posting locations.
- Signs, labels and/or warning/caution tape identifying designated use and storage areas for materials or equipment requiring special procedures. Refer to Section B, “Special Procedures” in the manual for details.

All required signage and postings are available from EH&S upon request at (515) 271-3804 or ehs@drake.edu

Emergency Action Plan

The principal investigator and/or laboratory supervisor must develop an emergency action plan for their laboratory. An Emergency Action Plan template and sample have been developed to help address the following emergency issues:

Evacuation Procedures

Identify evacuation routes and meeting locations for emergencies such as fire, severe weather and chemical, biological or radiological releases. Building Emergency Maps are available for download on the EH&S website.

Alarm System Activation

The locations of alarm pull stations can be found on the building emergency map (i.e., fire alarm, chemical spill, severe weather). Laboratory employees must know how and when to activate alarms.

Fire Emergencies

For all fires, activate alarm, dial 911 and evacuate. Additional information is contained in the Evacuation Procedures web page and the *Fire Safety Guidelines*.

Emergency Shut Off Systems

The locations of emergency shut-off systems can be found on the building emergency map (i.e., gas, high pressure air, electrical, etc.). Laboratory employees must know how and when to utilize emergency shut off systems.

Spill/Release Containment and Cleanup Methods

Develop cleanup/response procedures for the chemical, biological, and radiological materials used in the laboratory. Incorporate any specialized neutralization and decontamination methods for the materials used (i.e., biohazardous materials, hydrofluoric acid, etc.). These procedures should be part of both the Emergency Action Plan and the laboratory standard operating procedure. The following generic spill/release procedures have been developed to provide a basis for lab-specific methods.

- Chemical Releases to the Environment
- Chemical Spill - Small
- Chemical Spill - Large
- Compressed Gas Leak Procedure
- Mercury Spills

Intruders

Establish a protocol for responding to a laboratory intruder. An intruder is any unauthorized person who makes inappropriate or unwanted entry into the laboratory. The following steps should be included in the protocol for responding to vandalism or theft:

- require all unknown laboratory entrants to state their name and purpose. Ask unauthorized persons (intruders) to leave,
- report all laboratory intruders by dialing 811,
- do not attempt to detain the intruder; note the physical description of the person,
- conduct a quick inventory of the laboratory, and
- communicate any pertinent information to the responding police officer and make necessary departmental contacts.

Vandalism or Theft

The following steps should be included in the protocol for responding to vandalism or theft

- dial 811,
- stay out of the lab (treat as a crime scene),
- beware of any remaining perpetrators or malicious devices,
- communicate any pertinent information to the responding officer, and
- make necessary departmental contacts.

Medical Emergencies

Develop a procedure for responding to medical emergencies in the laboratory. Use Treatment of Injured or Exposed Personnel as a basis for the development of lab-specific methods. Be sure the procedure includes identification of the emergency, evaluation of the scene before entering (to avoid rushing into a potentially dangerous condition or atmosphere), specialized neutralization or treatment methods for specific laboratory hazards (e.g., hydrofluoric acid, phenol, etc.), and

instructions for contacting emergency services. Refer to Section I, “Exposure Assessment and Medical Care” in this manual for more information.

Incident Reporting (Notifications)

Establish a protocol for reporting emergency incidents to all affected laboratory and department personnel. Laboratory contact information must be included in the emergency action plan. In addition, the protocol should outline how personnel will be accounted for in the event of an incident in the laboratory. Report lab-related accidents, injuries and exposures as soon as possible.

Safety Equipment and Supplies

Determine the location of appropriate safety equipment and supplies for managing spills and accidents involving chemical, biological and radiological materials. Safety equipment should include eyewash, fire extinguisher, first aid kit, PPE, safety shower, and spill control kit. Refer to Section D, Equipment for details.

Utility Outages

Develop procedures to shut down or control hazardous laboratory operations impacted by unexpected utility outages. Outage examples include electrical, lighting, heating, steam, gas, water, ventilation, etc.

Post your completed Emergency Action Plan near the laboratory exit for easy retrieval during an incident. The plan should be reviewed and updated annually. All laboratory personnel must be trained on the laboratory emergency action plan. This training shall be completed prior to working in the laboratory and must be documented.

D. Equipment

Laboratory equipment such as centrifuges, glassware, hot plate/stirrers, incubators etc., are vital parts of any teaching or research laboratory. Selecting and maintaining the proper equipment must be part of laboratory procedures. Consider the following when using laboratory equipment:

- Operate equipment according to manufacturer's instructions.
- Handle and store glassware with care and dispose of any damaged glassware by following the Sharps and Glass Disposal Guide.
- Ensure that centrifuge rotors are properly balanced.
- Ensure vacuum equipment is trapped or filtered.
- Label equipment appropriately (e.g., Do Not Store Volatile Materials in this Box, No Food, Tinted/Filtered Eye Protection Required to Operate this Equipment, etc.).
- Laboratory equipment must not be used for human food or beverage preparation or storage.

Notify EH&S prior to purchasing, installing or disposing of the following laboratory equipment:

- biosafety cabinet
- fuel burning equipment
- fume hood
- gas chromatograph
- laser
- liquid scintillation counter
- nuclear gauge
- static eliminator
- x-ray and radiation producing devices

Additional Resources

Radiation Safety Manual

Maintenance, Inspection and Disposal

All equipment used in the laboratory must function properly and safely. To ensure this, laboratories must maintain equipment according to manufacturer's specifications or established guidelines, perform routine inspections for common problems corrosion, damaged electrical cords, excessive contamination, leaks, worn parts, etc. and ensure that alarms, guards, interlocks or other safety devices have not been disconnected or disabled.

The following equipment will be inspected by Facilities Services (FS) or EH&S during the interim; laboratory personnel should also inspect these items on a monthly basis and report any issues to FS or EH&S.

- biological safety cabinets (at the researcher's expense; at least once a year)
- eyewash stations (Checked by EH&S weekly)
- fire extinguishers (serviced by FS annually; inspected monthly by either EH&S or department personnel)
- fume hoods (once annually)
- safety showers (Checked by EH&S weekly)

Disposal

Working and non-working laboratory equipment must be free of contamination and inspected by EH&S prior to disposal. Forward a completed Laboratory Equipment Disposal Form to EH&S before transfer or disposal.

Safety Equipment

Safety equipment protects personnel, ensures proper storage of hazardous materials and enables a laboratory to respond to emergencies. Each laboratory should be evaluated for adequate safety equipment during the development of an Emergency Action Plan and/or standard operating procedure and during a laboratory's annual safety survey.

Biosafety Cabinets

Biosafety cabinets are designed to protect personnel, the products being handled, and the environment from particulate hazards, such as infectious microorganisms.

Containment/Safety Shields

Appropriate containment or shielding must be used when splashing, spattering or aerosolizing of materials is anticipated. A barrier such as a blast shield should be used when working with explosive materials (Refer to Section G, "Safety Practices for Specific Hazards"). Radiation and laser shielding techniques are extremely important safety issues and are described in the *Radiation Safety Manual* and *Laser Safety Manual*.

Eyewash Fountains

An eyewash fountain must be readily accessible in all areas where corrosives, hot liquids, or other eye-irritating materials (e.g., formaldehyde) are used or stored. During development of an Emergency Action Plan, personnel must identify eyewash fountain locations, verify proper function, and determine if additional eyewash fountains are required in the laboratory. Ensure that eyewash fountain locations are marked with a sign (typically green/white, available from EH&S) posted at eye level above the fountain. Eyewash fountains should be flushed weekly by laboratory personnel. Record these tests on the "Safety Equipment Test Record" tag attached to the eyewash.

Fire Extinguisher

Each laboratory must have unobstructed access to at least one multipurpose fire extinguisher (Type ABC) located at or near the exit. During development of an Emergency Action Plan, personnel must identify fire extinguisher locations and determine if available extinguishers are appropriate for planned laboratory activities. Ensure that fire extinguisher locations are marked with a red/white "fire extinguisher" sign posted at eye level above the device. Annual extinguisher testing is performed by EH&S. Fire Safety and Extinguisher Training is required for all laboratory personnel. Additional information is contained in the university's *Fire Safety Guidelines*.

First Aid Kits

A properly stocked first aid kit shall be available to laboratory personnel. A list of recommended contents can be found in the Drake University First Aid Guidelines. Signs to mark the location of the first aid kit are available from EH&S

Flammable Safety Cabinets

Flammable safety cabinets are storage cabinets (typically metal) manufactured to isolate flammable materials from a fire that occurs in the laboratory. Safety cabinets are required for storage of flammable liquids in laboratories with aggregate quantities greater than 40 liters (~10 gal.) and are available for purchase through safety equipment suppliers.

Flammable Safety Cans

Flammable safety cans are containers (typically metal) with self-closing spouts and integral flame arresters used to store flammable liquids in single container quantities greater than four liters (~1 gal.). Safety cans must be properly labeled and are available for purchase through safety equipment suppliers. Refer to flammables in Section G, “Safety Practices for Specific Hazards” for more information.

Laboratory Fume Hoods

Fume hoods are designed to protect personnel by preventing chemical and radiological contaminants from escaping into the laboratory environment. Fume hoods also provide a physical barrier to chemicals and their reactions. Refer to the *Laboratory Hood Manual* for additional information.

Laboratory Refrigerators/Freezers

Refrigerators and freezers used for flammable liquid storage must be manufactured for that purpose. Modification of general-purpose (domestic) refrigerators/freezers for flammable liquid storage is NOT permitted. General purpose refrigerators/freezers must be labeled to prohibit storage of flammable materials (e.g., Caution: Do Not Store Volatile Materials in This Fridge).

Laboratory refrigerators and freezers must not be used to store food or beverages intended for human consumption. Affix an appropriate label to the refrigerator/freezer door (e.g., Caution: For Chemical Storage Only, No Food or Drink).

Prior to defrosting freezers used to store radioactive materials, a survey of the frost must be conducted to determine radioactive material content. To avoid the spread of contamination and minimize personnel exposure, carefully melt or remove contaminated frost and collect the water as radioactive waste.

Safety Showers

An easily accessible, drench-type safety shower shall be available within ten seconds travel time of each area where corrosive or toxic liquids are used or stored. In some buildings, laboratories may need to rely on safety showers outside the laboratory. During development of an Emergency Action Plan, personnel must identify safety shower locations and verify proper function by contacting the building area mechanic. Ensure that safety shower locations are marked with a sign (typically green/white, available from EH&S) posted at eye level below the shower.

Spill Kits

A properly stocked spill control kit shall be available in each laboratory. Spill kits are available from EHS, or safety equipment suppliers. In lieu of purchasing of kit, personnel may choose to assemble a kit. Instructions are available here.

Personal Protective Equipment (PPE)

Personal Protective Equipment (PPE) appropriate for the work conditions must be worn when working with laboratory hazards. At a minimum this must include:

- laboratory coats (or other protective clothing such as aprons, coveralls, scrubs)
- safety glasses or goggles
- gloves resistant to the material used
- fully enclosed footwear

Sandals must not be worn in the laboratory. Other protective equipment, such as aprons, face shields, hearing protection, respirators, splash goggles, or thermal or cut resistant gloves, must be worn when conditions dictate.

The PI or laboratory supervisor is responsible for conducting hazard assessments, training, and coordinating the use of PPE. Completion of a hazard assessment or standard operating procedure may allow individual laboratory PPE requirements to be determined and justified by PIs or laboratory supervisors. Document PPE selection on a standard operating procedure developed for the experiment or laboratory operation. Refer to "Standard Operating Procedures" in Section B, "Process Planning" of this manual for assistance.

Drake University's PPE Policy requires departments to provide employees with necessary PPE within the federal regulation guidelines. In a class situation, students shall purchase or obtain the necessary and approved PPE designated by the department or instructor responsible for the course. Students must be trained in the proper use and care of the PPE.

All PPE shall be thoroughly inspected for damage or worn parts before use, cleaned and sanitized after use if reusable, and properly stored away from sources of heat, sunlight, chemicals or contamination. Single use equipment (e.g., disposable coveralls, exam-type gloves, etc.) must be properly disposed of after each use or if significant contact with contaminants occur. Contaminated PPE must NOT be taken home for laundering.

The following paragraphs offer explanations of some typical PPE.

Body Protection

Body protection must be worn to protect skin from harmful contaminants (i.e., dusts, fogs, fumes, gases, mists, smokes, sprays, splashes, or vapors), limit contamination of "street clothing," and aid the decontamination process. Lab coats shall constitute minimum body protection when working in laboratories. Elastomeric equipment (such as acid-resistant aprons) used for chemical resistance must be constructed of elastomers resistant to the material used. Wearing shorts or short skirts in laboratories is strongly discouraged. The required lab coat or non-permeable apron must cover the knees.

Eye and Face Protection

Eye and face protection with filtered lenses designed to protect against light radiation are required when working with lasers, UV lamps, welding, or other sources of light radiation.

Select the appropriate lens shade or filter for the operation performed.

Face Shields

Face shields are required where there is potential face exposure to chemicals, projectiles and UV sources. Use of a face shield is not a substitute for eye protection.

Hand Protection

Hand protection must be worn to prevent skin absorption of harmful substances through/ via cuts, lacerations, abrasions, chemical burns, punctures or, thermal burns from harmful temperature extremes. Elastomeric gloves used for chemical resistance must be constructed of elastomers resistant to the material used. Selection is based on elastomer thickness, permeation breakthrough time (in minutes), permeation rate and resistance to degradation.

Hearing Protection

Hearing protection is recommended when laboratory operations produce noise levels of 85 decibels or greater and is required when noise levels of 90 decibels or greater are encountered.

Respiratory Protection

Respiratory protection may be required to prevent exposure to airborne contaminants when engineering controls (i.e., biological safety cabinets, fume hoods, etc.) prove inadequate. A medical exam, fit test and specialized training are required before using a respirator. Drake University employees whose job description requires them to wear respiratory protection, including dust masks, according to their job description must participate in the Drake Respiratory Protection Program.

Safety Glasses

Safety glasses with side shields protect the eyes from flying projectiles and constitute minimum eye protection when working in laboratories.

Safety Goggles

Safety goggles (unvented or indirectly vented) are required in laboratory operations where there is potential for chemical vapors, splashes, mists, sprays or airborne dust exposure to the eyes.

These minimum requirements apply to labs with minimal hazards.

Contaminated or potentially contaminated PPE must be properly disposed of or disinfected and stored prior to leaving the laboratory.

Additional Resources

Hearing Conservation Manual Respirator
Protection Program Manual PPE Policy
PPE webpage

E. Training

Principal Investigators and/or laboratory supervisors are responsible for ensuring that all personnel are properly trained before they begin work in a laboratory and that they receive additional training when new hazards or procedures are introduced. At minimum, laboratory employees are required to complete training through Online Training Program as outlined in the Safety Training Curriculum for Laboratory Personnel.

Lab Specific Training

In addition to general EH&S training, all laboratory personnel, including students, must receive laboratory- specific training on the following topics:

- location and content of the *Chemical Hygiene Plan and Hazardous Materials Safety Manual*
- physical, chemical, biological, laser and radiation hazards in the work area, including signs and symptoms of exposure and allowable exposure limits
- location of references describing hazards and safety practices associated with laboratory materials (e.g. Biosafety in Microbiological and Biomedical Laboratories, Merck Index and SDS, etc.)
- protective measures necessary to avoid exposure or injury, as specified in the laboratory's Standard Operating Procedures
- procedures for responding to laboratory emergencies (chemical spill(s), fire, severe weather, etc.) as outlined in the laboratory's Emergency Action Plan
- methods to detect the presence of contamination or the release of chemical, biological and radioactive materials
- procedures for obtaining medical care in the event of exposure/injury
- proper waste management and disposal procedures
- proper record keeping

Document laboratory-specific training on the Site-Specific Training form.

Refresher Training

Retraining intervals for EH&S provided courses are identified in each course description and on course certificates. Intervals are determined by regulations, the EH&S Training Program, and performance and course evaluations (ANSI Standard E6.1.5). For courses without a specific regulatory refresher cycle, EH&S recommends refresher training every three years. Ultimately, a supervisor must carefully monitor employee understanding and skill. If an employee exhibits lack of knowledge, or if work conditions and tasks change, retraining is required.

Documentation

Departments and/or laboratory supervisors must maintain safety training records for all laboratory personnel. Acceptable records include Site-Specific Training forms, Laboratory Safety Training History, training certificates, and/or copies of employee "Transcript" from the Online Training Program. Employee training records must be retained for at least one year after termination of employment.

F. General Laboratory Safety Practices

The following general safety practices apply to all laboratories at Drake University, regardless of the type of research or work performed.

Safe Laboratory Practices

The following minimum conditions or practices must be observed in the laboratory.

- Ensure laboratory access is controlled at all times (lock doors when lab is unoccupied). Ask unknown persons to identify themselves and state their purpose. Ask unauthorized persons to leave. Report the unauthorized entry to Drake University Public Safety at (515) 271-2222 or 911 and departmental contacts.
- Keep corridor doors (fire doors) closed.
- Avoid working alone in the laboratory, but when unavoidable, follow the Drake University Working alone in Labs policy.
- Keep hands and other items away from the mouth and eyes as well as any open skin wounds.
- Food, drink, tobacco products, gum, medications or cosmetics are not allowed in areas where chemical, biological or radioactive materials are used or stored.
- Food not intended for human consumption (i.e. research) must be labeled ***"Not for Human Consumption."***
- Keep all work areas and aisles clean and unobstructed.
- Keep music at a moderate level and refrain from using ear buds or head phones.
- Avoid practical jokes or other disruptive behavior.
- Confine long hair and loose clothing.
- Sink hoses must be cut off above sink rim unless a back flow prevention device is installed on faucet.
- Ensure hand soap (preferably liquid) and towels are available at the laboratory sink.
- Wash hands and other exposed skin after using chemical, biological and radiological materials and before leaving the laboratory.

Proper Labeling for Chemical, Biological and Radioactive Materials

All containers used to store chemical, biological, or radiological material in the laboratory must be labeled to ensure hazard information is readily available to employees, visitors, and emergency response personnel. The label must include the following components:

- Proper chemical or common name of contents in English. Chemical formulas, symbols or acronyms alone are not acceptable. Mixtures or solutions must include a list of constituents and their concentrations.
- Signal word (danger or warning)
- Associated hazard statement(s), (e.g., Fatal if swallowed, flammable liquid and vapor, etc.)

Additional information, such as dates received, prepared or opened, storage location, and owner or user of the material, should also be included.

Additional Resources

Biosafety Manual

Radiation Safety Manual

Safe Storage of Chemical, Biological and Radioactive Materials

Below are some general guidelines for the safe storage of chemical, biological and radiological materials:

- Store materials according to the manufacturer's specifications in a designated location.
- Ensure that all stored containers are in good condition, closed and properly labeled.
- Store all hazardous materials in containers, cabinets or on shelving compatible with the associated hazard or material.
- Segregate chemicals by hazard class (e.g., flammable liquids, organic acids, oxidizers, etc.). Chemicals that belong in the same hazard class may be stored alphabetically.
- Use secondary containment for all liquid hazardous materials to prevent release into the environment.
- Secure all storage shelves and cabinets to prevent tipping.
- Ensure that storage locations are dry, adequately vented and away from heat sources.
- Store hazardous liquids below a height of five feet. All other chemicals should be stored below five feet when possible.
- Provide inventories of hazardous materials stored in the laboratory annually to EH&S. Update the inventory upon significant changes in amounts or processes.

Additional requirements for specific hazardous materials are described in Section G "Safety Practices for Specific Hazards" or may be obtained from the SDS, container label or laboratory SOP.

Additional Resources

Biological Materials Inventory Chemical Inventory

Chemical Storage Guidelines SDS

Safe Use of Chemical, Biological, and Radioactive Materials

Below are some general guidelines for the safe use of chemical, biological and radiological materials:

- Before use, review the hazard information found on the container label, in an SDS or equivalent (e.g. Biosafety in Microbiological and Biomedical Laboratories, Merck Index).
- Follow safety precautions as specified in the approved Standard Operating Procedure (SOP).
- Use the appropriate equipment for processes that release hazardous vapors, fumes, particulates or aerosols. To determine the appropriate equipment, refer to the *Laboratory Hood Manual*.
- Separate incompatible materials.
- Do not leave hazardous processes unattended.
- Do not pipette or siphon by mouth.
- Do not smell or taste chemical, biological or radiological materials.
- Ensure that all containers are properly sealed when not in use.
- Remove from storage only the amount of materials needed for a procedure.
- Wear appropriate personal protective equipment. Refer to "Personal Protective Equipment" in

Section D, “Equipment” of this manual for more details.

- Avoid working alone in the laboratory, especially if using hazardous materials. When unavoidable, make arrangements with the PI, laboratory supervisor or a colleague to periodically check on your status.

Additional requirements for specific hazardous materials are described in Section G, “Safety Practices for Specific Hazards” or may be obtained from the SDS, container label or SOP.

Safety Surveys

Perform the required internal laboratory inspections using the appropriate Safety Survey Form. Documentation of completed inspections must be maintained by each laboratory or department for three years.

EH&S has a formal Laboratory Safety Survey program. Surveys are performed annually and assistance is provided to help protect workers from accidents and illnesses and prevent damage to the environment.

G. Safety Practices for Specific Hazards

The following additional safety practices apply to Drake University laboratories where specific hazardous materials are used.

Biohazardous Materials

Biohazardous materials are of biological origin and may cause harm to humans, domestic or wild animals, or plants. When using these materials refer to the *Biosafety Manual* for details.

- Use laboratory facilities appropriate to the required biosafety level.
- Use appropriate containment equipment such as biological safety cabinets.
- Prevent or minimize the creation of aerosols.
- Limit use of needles, syringes and other sharps to avoid unnecessary exposure. For disposal, follow the requirements of the Sharps and Biohazardous Waste Procedure.
- Ensure proper biohazard disposal and decontamination.
- Complete autoclave performance checks monthly.
- Ensure only properly trained personnel handle biohazardous materials.
- Restrict access to Select Biological Agents to authorized personnel.

Additional Resources

Laboratory Hood Manual

Compressed and Liquefied Gasses

Compressed and liquefied gases pose significant chemical and physical hazards to laboratory users. Refer to the *Gas Cylinder Safety Guidelines* for more information.

- Ensure gas cylinders and Dewar flasks are secured and away from heat sources at all times and capped when not in use.
- Ensure hazardous gas (corrosive, flammable and toxic) quantities are below maximum allowed volumes and are stored in a ventilated cabinet when required.
- Transport cylinders and Dewar flasks on freight-only elevators where possible to avoid potential exposure to passengers.
- Do not ride with gas cylinders in elevators.
- Use an appropriate hand truck or cart to transport gas cylinders and Dewar flasks (do not drag or roll), ensure the valve protection caps are in place, and handle only one container at a time.
- Ensure proper maintenance and use of regulators, manifolds and safety valves.
- Always wear safety goggles when performing any operation with compressed or liquefied gases. Additional protection may be required based on the gases used (e.g., face shield, insulated gloves, chemical resistant gloves and/or an apron).
- After assembly of a gas supply system, test all connections using a soapy water solution or a gas detection device. Retest the system periodically and when leaks are suspected. Refer to the Compressed Gas Leak Procedure if a leak is detected.

Corrosives

Corrosives react at the point of contact to cause eye or tissue damage. Corrosives include acids and bases and other chemicals such as phenol.

- Use splash goggles and heavy weight gloves resistant to the chemical and concentration used.

A face shield, resistant apron and boots may also be appropriate, depending on the work performed.

- Slowly add acids or bases to water. Never add water to concentrated acids or bases.
- Segregate acids from bases.
- Segregate inorganic and organic acids.
- Segregate oxidizing acids (nitric, perchloric and chromic) from all other materials and from each other.
- Store corrosives in secondary containment.
- A plumbed eyewash station must be present in the laboratory. A safety shower must be available within 10 seconds travel time from workspace.
- Appropriate neutralizing agents for spill cleanup should be available in adequate quantities.
- Calcium gluconate gel must be available wherever hydrofluoric acid is used. This gel is used to treat skin exposure. Seek medical treatment for exposure to hydrofluoric acid.
- Polyethylene glycol (PEG 300) must be available wherever phenol is used. PEG 300 is used to treat skin exposure. Seek medical treatment for exposure to phenol.
- Perchloric acid use may result in the formation of explosive perchloric acid salts. Perchloric acid procedures must only be performed in approved laboratory fume hoods.

Explosives

Explosives may be divided into two categories: chemicals designed and produced for use as an explosive, and chemicals that may become explosive due to dehydration, age, or contamination. Follow procedures outlined in Potentially Explosive Chemicals: Guidelines for Safe Storage and Handling.

- Obtain approval from EH&S prior to purchasing, using and synthesizing explosives in the laboratory.
- Store away from other chemicals in a secure cabinet or magazine.
- Keep wetted or otherwise stabilized.
- Use and store away from sources of heat, friction, or static electricity.
- Use barriers such as blast shields, barricades and guards to protect personnel and equipment.
- Use of eye protection and flame-resistant lab coats are required. Never wear synthetic clothing (e.g., polyester or nylon) as it may ignite causing severe burns. Wear heavy leather or Kevlar gloves and a face shield that protects the throat when in a hazardous or exposed position. Refer to information from the chemical manufacturer for additional PPE requirements.

Flammables

Flammable materials burn readily in the presence of an ignition source. Flammable liquids have a flash point of less than or equal to 60ºC (140ºF). Vapor from these liquids can reach remote ignition sources, causing flashback fires.

- Isolate ignition sources including hot surfaces, electrical equipment and static electricity from flammable materials.
- Store flammables away from oxidizers and strong acids.
- Ensure proper bonding and grounding when transferring flammable liquids from a container or drum.
- Implement additional safety precautions when heating flammable liquids, particularly when heating to or above their flash points.
- Store flammable liquids in safety cans where container quantity exceeds four (4) liters (~1 gallon).

- Store flammable liquids in a flammable storage cabinet when total quantity in a laboratory exceeds 40 liters (~10 gallons).
- Store flammable liquids requiring cool/cold storage in refrigerators/freezers manufactured for that purpose. Modification of general-purpose (domestic) refrigerators or freezers for flammable liquid storage is NOT permitted.
- Use flammable liquids in a fume hood when possible to prevent buildup of ignitable vapor/air mixtures.

Additional Resources

Fire Safety

Fire Safety Guidelines

Fire Safety Policy

Lasers

Class 3B and 4 lasers emit amplified visible and non-visible light radiation and may cause immediate harm to eyes and skin. All users of Class 3B and 4 lasers must be pre-approved by the Laser Safety Officer and must adhere to the safety requirements outlined in the *Laser Safety Manual*.

- Ensure that only properly trained personnel operate Class 3B and 4 lasers.
- Complete all required medical surveillance.
- Maintain safety interlocks and laser enclosures.
- Wear appropriately rated protective eye wear and clothing for the specific laser used.

Additional Resources

Laser Safety

Mercury

Small amounts of mercury are toxic and create significant problems if spilled. To minimize the risk of spills, equipment containing mercury must be in secondary containment. The use of mercury substitutes is highly encouraged, such as alcohol or electronic thermometers.

Clean up of small mercury spills (thermometer size) is the responsibility of the user. All spills on porous surfaces such as carpet, and all large spills should be handled by EH&S. Refer to Mercury Spills on the EH&S website for more information.

Nanotechnology

Nanotechnology research involves the creation, manipulation and use of materials with at least one dimension in the 1-100 nanometer (nm) range. Particles of this size may have unique and especially hazardous properties that are not yet fully realized.

Initial animal studies indicate that inhaled nanomaterials can cross the lung/blood barrier and deposit in internal organs. Skin penetration is another exposure route for nanoparticles. Because nanomaterial toxicity is not fully understood, nanomaterials must be treated with a high level of control.

General Safety Requirements

- Treat nanomaterials as toxic substances.
- Mixing, sonication, weighing or agitation of nanomaterials must be done in a glove box, biosafety cabinet or chemical fume hood.
- To ensure containment of nanomaterials, set work 6 inches back from sash, minimize foot traffic, and avoid rapid arm and body movements when working in a hood or cabinet.
- Transport and store nanomaterials in sealed containers.
- Any vacuuming of nanomaterials must be done with a high efficiency particulate air (HEPA)

filtered vacuum that has been certified by EH&S.

- When possible, use amended water to clean nanoparticles from surfaces. Avoid using solvents.
- Review explosion and fire hazards for processes producing airborne dust materials that have high reactivity.
- Ensure equipment is decontaminated before disposal or transfer within the university.
- Many compressed gases used in the production of nanomaterial may require storage in a ventilated cabinet. See gas cylinder guidelines for specific storage requirements.
- Written SOPs must be created for laboratory work involving nanomaterials.

Personal Protective Equipment

- At minimum a lab coat, safety goggles, gloves and fully closed shoes must be worn when using nanomaterials.
- To eliminate nanomaterial skin contact, wear double nitrile gloves, placing the glove over the end of the lab coat sleeve. The use of gauntlet style gloves may allow for better sleeve placement under gloves. Wash hands after using nanomaterials.
- Cleaning surfaces, equipment or spills outside of a fume hood will require the use of a half-face respirator with P100 filters. A medical evaluation, training and respirator fit testing is required for half face respirator use.

Waste Disposal

Waste nanomaterials must be treated as chemical waste. Follow EH&S protocols for waste storage and disposal.

Organic Peroxides

Organic peroxides may react with organic material resulting in fires or explosions. Organic peroxides are highly flammable and extremely sensitive to heat, friction, impact, and light, as well as to strong oxidizing and reducing agents. In addition, organic peroxides may destabilize with age, contamination or improper storage to become self-reactive. Common laboratory organic peroxides include benzoyl peroxide, butyl peroxide, and lauroyl peroxide.

- Mark containers with date received. Dispose of by the expiration date listed on the container label, within one year of purchase or within six months of opening.
- Use in a location removed from chemicals and organic materials, such as paper and wood.
- Strictly adhere to manufacturer's use and storage instructions. Refrigeration and/or hydration may be required.
- Avoid operations that may concentrate organic peroxides (e.g., distillation, extraction or crystallization).

Oxidizers

Oxidizers may react with organic materials resulting in fires or explosions. Common laboratory oxidizers include perchloric and nitric acids, sodium and ammonium nitrates, and hydrogen peroxide.

- Use away from chemicals and organic materials, such as paper and wood.
- Store in secondary containment away from all other chemicals.
- Ensure oxidizers used in organic reactions are completely spent/deactivated prior to placing in sealed containers.
- Deactivate residues according to the laboratory's standard operating procedure before discarding empty container.

Peroxide Forming Chemicals

Some chemicals react with oxygen to form peroxides. Impact, heat or friction can trigger peroxide explosions. Peroxide forming chemicals include ethyl ether, isopropyl ether, potassium metal, and tetrahydrofuran, Refer to the *Potentially Explosive Chemicals: Guidelines for Safe Storage and Handling* document for a representative list of peroxide forming chemicals.

- Affix warning label to containers and record dates received, opened and tested.
- Dispose of peroxide forming chemicals at or before the expiration date marked on the container. To retain chemicals beyond the expiration date, test for peroxide concentration following the procedure in *Peroxide-Forming Chemicals*.
- Never handle deformed containers or those with crystal formation. Contact EH&S to remove the container.

Physical Hazards

Physical hazards include burns, cuts, electrical shock, mechanical, noise, and slips/trips. Laboratory personnel must identify physical hazards present in the laboratory and implement safe work practices to avoid injury. Minimum safety practices include the following:

- Keep exits and aisles unobstructed.
- Ensure laboratory equipment with moving parts are properly guarded (i.e., fan belts, vacuum pump belt drives, etc.).
- Ensure ladders and step stools are in safe working condition.
- Extension cords can only be used for temporary work conditions (<3 days). If longer periods of use are needed, temporary power taps may be used.
- Heavy objects should be stored below 5 feet whenever possible to minimize lifting/falling hazards.
- Ensure adequate illumination for all activities, avoiding reflections and glare that could affect vision.

Additional Resources

Electrical Equipment Lockout/Tagout Noise
Sharps
Fire
Safety

Pyrophoric Chemicals

Pyrophoric chemicals, such as butyllithium, methyllithium, and white phosphorus ignite spontaneously in air. Small amounts of pyrophoric chemicals may initiate fires.

- Use or store in an inert environment.
- Minimize use near flammable solvents.
- Deactivate residues according to the laboratory's standard operating procedure before discarding empty container.
- Ensure appropriate fire extinguishing agent is available.
- Eye protection, flame resistant gloves and a flame-resistant lab coat are required. Never wear synthetic clothing (e.g., polyester or nylon), as it may ignite causing severe burns. Wear a face shield for additional protection.
- An eyewash must be present in the laboratory. A safety shower must be available within 10 seconds travel time from workspace.
- Perform all transfers in a fume hood and prevent body contact by using a splash guard or shield

where possible.

- Review the safe procedures for handling highly reactive reagents. Everyone working with these compounds should be familiar with the Aldrich technical bulletins AL-134 “Handling Air-Sensitive Reagents” and AL-164 “Handling Pyrophoric Reagents.”
- Obtain training from experienced personnel before working with any pyrophoric chemicals.
- Perform initial work with supervision.
- Practice handling and transfer procedures using a solvent before working with pyrophoric materials.
- Use the smallest quantity of pyrophoric material possible.
- Never work alone when handling highly hazardous chemicals, especially organic lithium reagents. Notify others in the laboratory when working with these solutions.

Additional Resources

Working Safety with Organolithium Compounds - Yale University

Working with Pyrophoric Reagents - University of California, San Diego

Radioactive Materials and Radiation Producing Devices

Radioactive materials and radiation producing devices emit ionizing radiation that may cause harm to humans, animals, or plants. All users of radioactive materials and radiation producing devices must be pre-approved by the Radiation Safety Committee and must follow the requirements outlined in the *Radiation Safety Manual*.

- Ensure only properly trained and authorized personnel handle radiological materials.
- Read and understand the Radiation Safety Notice to Workers and Notice to Employee laboratory signs.
- Read and understand the emergency contact information posted at entrances to the laboratory.
- Maintain the security of all radioactive materials including labeled materials, equipment and waste.
- Label locations within the laboratory where radionuclides are used or stored (hoods, refrigerators, microwave ovens, etc.) to indicate the presence of radioactive material.

Additional Resources

Radiation Safety Training Guide for Radionuclide Users

Radiation Safety Guide for Ancillary Personnel

Toxics

Toxics include carcinogens, reproductive toxins, and chemicals with a high degree of acute toxicity. Some examples of chemicals with a high level of acute toxicity include dimethyl mercury, hydrogen cyanide, hydrogen fluoride, and osmium tetroxide. The following special procedures must be developed and specified on the SOP when working with toxics:

- Identify authorized personnel who may work with these materials or equipment. Authorized persons must receive training on the unique hazards of these materials or equipment before use.
- Establish a designated use area (e.g., fume hood, glove box, etc.) and identify the area by signs or postings. Restrict access to this area to authorized personnel. If an entire lab is designated, then access must be restricted to authorized personnel.
- Specify special safety precautions for experiments or laboratory operations where these

materials or equipment are used. Be sure to identify specialized equipment, shielding or security requirements to be used.

Water Reactives

Water reactives combine with water or moisture in the air to spontaneously ignite or produce flammable or toxic gases. Examples include metals such as sodium and potassium, acid anhydrides and acid chlorides, and fine metal powders such as zinc.

- Handle away from water sources.
- Use in well ventilated area or inert atmosphere.
- Store in a dry and/or inert environment.
- Deactivate residues according to the laboratory's standard operating procedure before discarding empty container(s).
- Ensure appropriate fire extinguishing agent is available.

H. Waste and Recycling

Laboratories generate a large variety of waste, including chemicals, biohazardous materials, appliances, and equipment. Generators of waste must manage them as outlined in the *Waste Management Guide*, and the *Biosafety Manual*. Waste MUST NOT be poured into the sanitary sewer system or released to the environment, unless specifically authorized by EH&S, see Drake University Chemicals Generally Acceptable for Sanitary Sewer Disposal guidance. All laboratory personnel must be familiar with appropriate decontamination, disposal and EH&S waste collection procedures.

Biohazardous Waste Materials

Biohazardous waste materials include carcasses, disposable solids, liquids, non-disposable items (reusable), sharps, and tissues or bedding that have been exposed to biohazardous materials. All biohazardous waste must be decontaminated before disposal.

Drake University generates waste that is biologically contaminated with human fluids (blood, vomit, etc) but that is in small quantities and is fully contained in absorbent materials. This waste is not in quantities or of the threat level that it meets the criteria to be managed as Biohazardous waste. This waste will be treated as biologically contaminated waste. Please refer to the Biologically Contaminated Waste procedure.

Common decontamination methods include heat sterilization (e.g., autoclaving), chemical disinfection and incineration. Detailed instructions for decontamination and disposal are included in the *Biosafety Manual*, the Sharps and Biohazardous Waste Procedure and the Sharps and Biohazardous Waste Disposal Flow Chart.

Chemical Waste Materials

Chemical waste includes used and unused reagents, samples, synthesized items, and unknowns. At a minimum, researchers generating waste must ensure

- All personnel have completed the Laboratory Safety online training course
- Waste materials are collected in a designated satellite accumulation area identified with orange EH&S signage.
- Waste satellite accumulation areas are located at or near the point of generation (in the same room or suite of connected rooms where the waste is generated).
- Waste containers are appropriately labeled (no abbreviations, formulas, or shorthand) and dated.
- Triple rinse the containers before using them to accumulate waste.
- Mark out the original container label before use.
- Waste containers are closed except when in use.
- Containers must be picked up by EH&S within 90 days of the date waste accumulation began.

All waste will be collected by EH&S. Request collection by submitting an online request.

Equipment Disposal

Unwanted laboratory equipment includes working and non-working appliances, centrifuges, computers, lasers, ovens, and other items used for research. At a minimum, researchers generating unwanted equipment must ensure that:

- All hazardous substances have been removed and the equipment has been decontaminated.
- A completed Laboratory Equipment Disposal Form has been forwarded to EH&S.

- EH&S has inspected/tested the equipment and authorized transfer and/or disposal

Radiological Waste Materials

All radioactive waste materials, x-ray and radiation producing devices will be collected by EH&S. Researchers generating radioactive waste materials must separate materials by radionuclide half-life into the following categories and sub-categories (i.e., collection containers):

- Solids – into combustible, non-combustible, sharps (needles and razor blades) and source container (lead containers and source vials) groups
- Liquids – into aqueous, organic and flammable groups
- Radioactive tissue (e.g., carcasses, viscera and blood)

Accumulated materials must be properly packaged, labeled, and placed in a designated waste collection area. Container labels are supplied by EH&S. Request collection of radioactive waste materials by submitting an online request. EH&S will assist radioactive materials and device users with development of an appropriate disposal plan on a case-by-case basis. Refer to the *Radiation Safety Manual* for more information.

Additional Resources

Waste and Recycling Guidelines
Biosafety Manual
Radiation Safety Manual
Sharps and Biohazardous Waste Procedure
Sharps and Biohazardous Waste Disposal Flow Chart
Sharps and Glass Disposal Guide

I. Exposure Assessment & Medical Care

Exposure assessment and medical care must be considered when developing laboratory procedures. Certain chemical, biological, radiological, and physical hazards require specific health monitoring. It is the responsibility of the PI, laboratory supervisor and department to ensure personnel are receiving appropriate monitoring and/or medical care based on laboratory hazards.

Medical Emergencies

If injury, illness or exposure is life threatening, dial 911. Be prepared to provide any relevant safety information, such as an SDS. When an employee requires emergency treatment, the incident must be reported to EH&S (515) 271-3804 as soon as possible. Provide assistance to injured or exposed personnel by following the First Aid Procedures.

Occupational Medicine Program

Drake University Occupational Medicine Program is designed to minimize personnel health risks from workplace hazards. Hazards may include chemicals such as formaldehyde or benzene; physical hazards such as excessive noise or lasers; human pathogens, tissues and cell lines; animal handling, pathogens, tissues and cell lines; and radioactive materials or devices. The program includes workplace exposure assessments, exposure monitoring and medical surveillance. All Drake University personnel, including part-time and student workers, are encouraged to participate in the Occupational Medicine Program, which is provided at no charge. Refer to the *Occupational Medicine Guidelines* for more information.

Workplace Exposure Assessment

All personnel who may be exposed to hazards in the workplace must complete a Hazard Inventory form at the beginning of their employment. This form must be reviewed and signed by the supervisor, then submitted to EH&S for review. EH&S will use information on the Hazard Inventory to determine if exposure monitoring or medical surveillance will be required. A new form must be completed whenever job hazards change.

Exposure Monitoring

As part of the workplace exposure assessment, exposure monitoring may be performed by EH&S to quantify the level of exposure experienced by employees at Drake University. Monitoring results are used to determine if medical surveillance of an employee will be required and whether control measures should be implemented to ensure a safe work environment. Each department and laboratory supervisor is responsible for ensuring that any recommended control measures are implemented. EH&S may perform additional monitoring to determine the effectiveness of control measures.

EH&S is available to conduct occupational exposure monitoring whenever a possible exposure or potential health hazard is suspected in the work environment.

Medical Surveillance

Employees enrolled in the Occupational Medicine Program will be required to complete a baseline medical. The Occupational Medicine physician will determine what tests and immunizations will be required to prevent occupational disease relating to an employee's exposure. Ongoing medical surveillance will be offered to personnel exposed to hazards covered under OSHA or other applicable regulations. A separation medical review will be offered to Occupational Medicine Program participants when leaving Drake University.

Work-related Injuries, Illnesses and Exposures

Drake University employees exposed or injured while at work or in the course of employment Who need medical attention should go contact **PMA Care 24 Nurse Triage Service. The Number is 855-574-5580 prior to** seeking nonemergent medical attention.

Reporting

All work related injuries, illnesses, or exposures must be reported to the employee's supervisor, even when medical attention is not required or is refused by the employee:

A First Report of Injury (FROI) must be completed online and submitted within 24 hours of the incident. The employee or supervisor may complete the FROI, but supervisors must review, approve and electronically submit the FROI. Supervisors will be prompted to fill out information relating to the Accident Investigation as part of the FROI process. Questions regarding the form may be forwarded to University Human Resources at (515) 271-3133

Refer to the *Accidents and Injuries web page* for more information.

Student Accidents and Injuries

Students not employed by Drake University who are exposed or injured in the classroom or laboratory should seek medical attention at the Student Health Center, 3116 Carpenter Ave, (515) 271-3731.

All accidents and injuries sustained by Drake University students while in academic classes or events sponsored by the university must be reported to the Office of Risk Management by the student and a university representative using the Student Accident Report Form. Refer to the *Accidents and Injuries web page* for more information.

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