Laboratory Safety Guide

Chemical Hygiene Plan and Safety Policies 2026/2027

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The **Laboratory Safety Guide** is a required element of the Laboratory Safety Plan that introduces basic safety information and best practices for laboratory procedures. It is a reference document for the Division of Research Safety's laboratory programs, campus policies, and common laboratory hazards, including hyperlinks to more detailed information. DRS maintains this guide and updates it annually or as necessary. All researchers must understand the contents of this guide before working in Illinois research laboratories.

Responsibilities and Expectations

The responsibilities for providing a safe work environment at the University of Illinois Urbana-Champaign are outlined in the Campus Administrative Manual. All groups must understand their responsibilities for providing a safe and healthy environment for all faculty, staff, students, and visitors.

Each laboratory group is required to develop a Laboratory Safety Plan (LSP) to address the laboratory's specific hazards and exposure control measures. Development and implementation of a LSP will fulfill each laboratory's requirement for a Chemical Hygiene Plan as specified in the Occupational Safety and Health Administration (OSHA) regulation 29 CFR 1910.1560 (OSHA Lab Standard). The requirements for hazard identification and safety training for other laboratory hazards, such as biological hazards (BMBL), recombinant or synthetic nucleic acids (NIH Guidelines, radioactive materials (IEMA Title 32-Part 340), and lasers (IEMA-Title 32-Part 315) are also satisfied upon implementing a comprehensive LSP. An annual evaluation of the LSP must be completed by the laboratory group to determine necessary revisions or updates.

The Principal Investigator (PI) or Laboratory Supervisor is responsible for implementing the Laboratory Safety Plan and ensuring safety procedures are followed within their laboratories. A Safety Contact may be chosen to assist with the implementation of this plan by developing Standard Operating Procedures, training personnel, and overseeing day-to-day operations while promoting safety in the laboratory. The Safety Contact should be aware of all laboratory activities, be a point of contact with DRS, and play an active role in the annual Laboratory Safety Audits.

Principal Investigators must maintain correct facilities, personnel, and hazard information in the Division of Research Safety Database.

All laboratory personnel are responsible for following safety policies and procedures and for reporting unsafe working conditions to the Principal Investigator or laboratory manager.

The campus Biological Safety Officer (BSO), Chemical Hygiene Officer (CHO), Laser Safety Officer (LSO), and Radiation Safety Officer (RSO) all reside within the Division of Research Safety.

Training

The PI or lab supervisor must ensure that all laboratory personnel receive comprehensive training for the hazards they will encounter in the laboratory and perform all procedures safely. In addition, all laboratory workers must at a minimum receive awareness training regarding the hazards of all materials present, even if they are not working with them. Online training offered by DRS provides basic information and must be supplemented by lab-specific training provided by the PI or experienced lab members. See the training summary page on the DRS website for specific training and documentation requirements. Online Laboratory Safety Training is required for all Principal Investigators and researchers affiliated with a laboratory. This training must be renewed every three years. The training includes an introduction to hazard awareness, engineering controls, work practices, personal protective equipment (PPE) selection, and other common laboratory policies.

Standard Operating Procedures

In addition to relevant DRS online training and Safety Library resources, researchers must train on lab-specific hazards. Standard Operating Procedures (SOPs) must be developed for lab-specific procedures and hazards. A Risk Assessment is performed to determine what needs an SOP and what is to be included within the SOP. This includes, but is not limited to, work with chemicals, biological materials, radiation, lasers, high pressures, electricity, etc. Refer to the DRS Standard Operating Procedures webpage for more information on how to

develop SOPs.

Laboratory Facilities

Work with hazardous materials should only be performed in adequately equipped laboratory spaces:

- Lockable doors to control access.
- Work benches are impervious to water and resistant to heat and chemicals.
- Emergency equipment (safety shower, eyewash, fire extinguisher, emergency spill kit) is necessary for the hazards present. See the Campus Emergency Eyewash and Shower program for details.
- Sink for handwashing.
- No carpet, rugs, cloth chairs, or other porous materials that are difficult to decontaminate.
- Ventilation is adequate for the hazards present.

Laboratory Safety Audits

Laboratory Safety Audits should be performed and documented annually as part of the Laboratory Safety Plan for the laboratory. A Laboratory Safety Audit is an important quality assurance tool to help the PI/laboratory supervisor assess the safety of their laboratory and provide information relevant to a required annual evaluation of the Laboratory Safety Plan. DRS provides this type of audit and typically arranges audits on a per-department basis. However, individual consultations, including auditing of laboratory groups new to campus or new facilities for existing groups, will be arranged upon request.

Laboratory Safety Policies and Work Practices

The following policies and work practices apply to all laboratories on campus. In addition, lab-specific policies and work practices to further mitigate the risk of exposure should be implemented by the PI adequately for the hazards in the laboratory.

Door Signs

All doors leading from a public space to a laboratory must bear a sign that indicates the hazards present and lists the contact information of the occupant(s). Contact information and hazards should be updated as necessary, at least annually, by the laboratory group on the DRS website so that DRS can issue an updated sign. A new door sign can be requested by contacting DRS.

Food Storage and Consumption

Eating, drinking, and applying cosmetics are prohibited in areas where hazardous materials are used or stored. Storage and consumption of food are only allowed in well-defined, designated areas, separated from hazardous materials by floor-to-ceiling walls and a closed door. If the separate area for food consumption can only be accessed through the lab, food and beverages must be transported through the laboratory in closed containers. Food waste, wrappers, and containers must not be placed in laboratory trash cans, as it is considered evidence that food or beverages are consumed in the laboratory. Refrigerators used for the storage of food or beverages intended for human consumption must be outside the laboratory. Refrigerators and freezers used to store chemicals, biohazards, radioactive materials, or other potentially hazardous samples should bear a label prohibiting food storage. Contact DRS to request labels.

Labels

All hazardous materials, including waste, must be properly labeled.

Labels on **chemical** containers should not be removed or defaced. All secondary and temporary containers (including water) must be clearly labeled with at least the name of the chemical (no abbreviations).

For more information, refer to the DRS guidance, Labeling of Chemicals in Laboratories.

The **Biohazard symbol** must be posted on anything where biohazards, including recombinant materials, are used, stored, or discarded; examples include autoclave bags, biohazard containers, incubators, and other equipment.

The **Radiation Hazard symbol** must be posted where radioactive material is being used, stored, or disposed including sinks, fume hoods, lab benches, and on equipment contaminated with radioactive material. The radiation symbol is also used for X-ray machines.

Housekeeping

Exits, aisles, and safety equipment must not be obstructed. Aisles within the laboratory must be at least 28 inches in clear width. Work areas and floors should be kept orderly and cleaned up after completion of work and immediately after any spill. For laboratories with sprinkler systems, an unobstructed vertical clearance of 18" from sprinkler heads or deflector is mandatory. Doors that are not in use, but which are accessible from a corridor or adjacent room, should be appropriately labeled if they are blocked on the interior of the room. For more information, refer to the guidance document on Laboratory Housekeeping.

Hand Washing

Hands should be washed with soap and water frequently throughout the day. Hands should be washed after handling any hazardous materials, after the removal of gloves, and before leaving the laboratory.

Mouth Pipetting

Mouth pipetting is prohibited. Mechanical pipetting devices should be used.

Sharps Precautions

Needles, syringes, and other sharp items should be restricted in the laboratory for use only when there is no alternative. Hypodermic needles should not be bent, sheared, broken, recapped, or removed from disposable syringes. If there is no viable alternative to recapping a needle or removing a needle or scalpel blade, it is required that you develop a plan for a safe procedure and incorporate this method in your lab-specific training. For more information, see the DRS guidance document on Sharps Safety.

Where possible, plasticware should be substituted for glassware, especially when working with infectious agents.

Transportation

If hazardous materials are transported by laboratory personnel, they must be contained in such a way as to prevent release into the environment or exposure to people. Shipping hazardous materials requires additional training. For more information, see the DRS guidance document on Introduction to Shipping. Transfer or transport of laboratory resources, including equipment and materials, is subject to Export Control regulations. Proposed removal of these resources from University property or systems requires (1) review by the Export Controls office, exportcontrols@illinois.edu, and (2) written authorization by the Principal Investigator.

Spills

Every laboratory must be equipped with appropriate materials to clean up a spill of the hazardous material present. Small spills that can be cleaned up by laboratory personnel safely without threatening the health of any person or the environment should be cleaned up immediately. Broken glassware should not be handled directly; instead, it should be removed using a broom and dustpan, tongs, or forceps. DRS can consult in the event of a spill and give advice on proper clean-up procedures. More information on Preventing Spills, Emergency Preparedness, and Spill Response can be found on the DRS web page:

- Biological Material Spill Response
- Chemical Spill Response
- Radiological Material Spill Response

Waste

DRS offers disposal services related to hazardous waste (chemical, biological, and radioactive) for all campus units. Hazardous waste and solid chemicals (including non-hazardous chemicals) must not be disposed of in the regular trash. Liquids containing biological or chemical hazards must not be poured down the sink. Chemical waste must be collected and stored near the point of generation and cannot be shipped off campus. All hazardous waste containers must be properly labeled according to EPA (Environmental Protection Agency) regulations. Labeling requirements are discussed on the DRS Waste Tag Requirement webpage. Details and procedures for waste collection and disposal can be found on the DRS website at the Waste tab on the main menu and under the links below:

- Chemical waste
- Biological waste treated by the user
- Biological waste requiring incineration
- Radioactive waste
- Glass disposal
- Sharps disposal

Prior Approval

The PI/lab supervisor shall decide if the use of a particularly hazardous material or a highly hazardous procedure needs prior approval. The following require prior approval:

Working Alone: Working alone is discouraged. The PI or lab supervisor shall determine under what circumstances working alone is allowed. A system of periodic checks or a buddy system should be implemented. Working alone should be prohibited for highly hazardous materials and procedures (e.g., HF, pyrophorics, or hazardous machinery).

Working with toxic or pyrophoric gases: Before ordering or using toxic gases, the PI must provide approval for work with the gases in their laboratories. Proper training must be handled by the PI. The gas vendor may deny the sale of a toxic gas to research groups that do not demonstrate proper controls are in place to use the gas safely.

Unattended Experiments

If hazardous operations are carried out with no one present, procedures must be developed that prevent the release of hazardous substances in the event of interruptions in utility services such as electricity, cooling water, and inert gas. Lights should be left on, and signs should be posted identifying the nature of the operation and the hazardous substances in use. If appropriate, arrangements should be made for other workers to periodically inspect the operation.

All lab-specific policies should be written down (hard copy or electronic) and clearly addressed in the initial training of laboratory personnel.

Emergency Planning

An emergency can remain within a single laboratory or impact the building or campus. It is important to plan for any type of emergency.

A Building Emergency Action Plan (BEAP) is written for each building on campus, and all occupants of the building must be familiar with the contents of the plan.

The impacts an emergency can have on laboratory equipment and processes are not outlined in the BEAP. This information must be documented in the Laboratory Safety Plan since each laboratory has unique equipment and processes. Building managers or department contacts should provide researchers with building information to help them create an appropriate emergency plan. This information may include the accessibility of backup power, information about safety-critical utilities, location of the BEAP, etc.

Fire extinguishers are often provided in building hallways and many laboratories. If a fire extinguisher is expected to be used in the event of an emergency, the researchers or anyone likely to use the extinguisher must take Fire Extinguisher Training and renew it annually.

Exposure Control Measures

Elimination or Substitution

Eliminating a hazard from a procedure is the best means of protecting the worker. Substitution with a less hazardous material or operation is sometimes more feasible than elimination. Researchers must always consider the elimination of hazards or substitution of hazardous materials during the experimental design phase of research.

Engineering Controls

Engineering controls are designed to remove the hazard from a person's breathing area, reducing the potential exposure. A chemical fume hood, biological safety cabinet, glove box, ventilated gas cabinet, or local exhaust ventilation should be utilized to keep exposures below permissible exposure limits.

Chemical Fume Hoods

All procedures where chemical exposure to vapor, dust, fumes, or aerosols is expected should be conducted in a chemical fume hood or other adequately ventilated work area. All users of chemical fume hoods should be trained on and comply with the DRS guidance on Chemical Fume Hoods.

A campuswide Chemical Fume Hood Surveillance Program is conducted by Safety and Compliance at no charge to the users. Hoods are inspected annually and receive a green inspection tag indicating if the unit is functioning properly at the time it was inspected. Prior to using a chemical fume hood, always check that it is drawing air. A fume hood can malfunction at any time. A green sticker does NOT guarantee proper function.

Biological Safety Cabinets

Any work with biological material at biosafety level 2 that produces aerosols, such as centrifuging, pipetting, vortexing, or sonicating, should be performed inside a Biological Safety Cabinet (BSC) or other physical containment equipment unless precautions are taken to prevent escape of aerosols (e.g., sealed containers).

All users of BSCs at the University of Illinois at Urbana-Champaign campus should be trained on and comply with the DRS guidance for Biological Safety Cabinets.

BSCs shall be certified annually by an accredited certifier. DRS maintains a list of qualified vendors, which is available upon request.

Ventilated Gas Cabinets

Full-sized cylinders of toxic compressed gases (NFPA health hazard ranking of 3 and 4, and a ranking of 2 without physiological warning properties) shall be kept in a continuously ventilated gas cabinet. Small cylinders and lecture bottles of toxic gases may instead be kept inside a chemical fume hood. See the DRS guidance document Compressed Gas Cylinder Safety for more information.

Personal Protective Equipment (PPE)

The PI/laboratory supervisor shall determine which personal protective equipment (PPE) is required to protect laboratory personnel from the hazards they are exposed to and provide such equipment without cost to the personnel. DRS can assist with the selection. PPE selection must be documented in the Laboratory Safety Plan.

All protective clothing should be removed and left in the laboratory before entering non-lab areas (e.g., hallway, cafeteria, library, offices). All protective clothing is either disposed of by the lab or laundered – it should never be taken home by personnel.

Basic PPE is considered to be lab coats, safety glasses, and gloves. These should be worn in the laboratory when there is a potential for exposure to hazards.

Closed-toed shoes and clothing that covers the legs are necessary when in the laboratory.

Long hair must be restrained so that it cannot contact hands, specimens, chemicals, containers, or equipment.

Lab Coats: Lab coats should be chosen based on the hazard present. Protective lab coats should be worn by personnel while in the laboratory. Certain lab coat materials are better suited for fires, aqueous splashes, biological agents, or solvent splashes. Consult the manufacturer or DRS with questions about lab coat materials.

Gloves: Gloves should be worn for performing any procedure that requires the handling of hazardous materials, contaminated surfaces, or equipment. Disposable gloves should not be washed, reused, or sprayed with chemical solvents such as ethanol. Gloves should not be worn when touching clean surfaces like keyboards, cell phones, and doorknobs. Glove materials vary widely in effectiveness in protecting against specific hazards. Consult a chemical resistance chart, a glove manufacturer, or contact DRS for assistance in appropriate selection.

Safety Glasses: Safety glasses must be ANSI Z87.1 certified to offer the desired protection. However, do not rely solely on this certification; safety eyewear must be chosen to specifically address the hazards (e.g., chemical splash, flying projectile, etc.) Prescription glasses are not substitutes for safety glasses unless approved prescription safety glasses are purchased. Goggles should be worn when an elevated splash hazard is present.

Respiratory protection: The use of respirators should be avoided by using engineering controls. If engineering controls are physically impossible or insufficient, a respirator may be required. Contact the Division of Research Safety to discuss your process. The use of other controls will likely eliminate the need for a respirator. If a respirator is required, compliance with the campus Respiratory Program administered by Safety and Compliance is mandatory. The program includes a medical assessment, fit testing, and instructions on proper use.

Additional PPE: Additional PPE that may be required for certain procedures includes a face shield, apron, acid smock, or shoe covers.

For more information, refer to the DRS guidance on Personal Protective Equipment.

Exposure Evaluation and Monitoring

For procedures that cannot be performed inside a fume hood or other well-ventilated enclosure and where an exposure to hazardous chemicals is likely, a chemical exposure assessment should be performed. The Division of Research Safety should be contacted to begin the evaluation process in laboratories. Depending on the result of the evaluation, exposure monitoring may be required to ensure that OSHA permissible exposure limits (PEL) are not exceeded.

Medical Consultation and Incident Response

Emergency Assistance

In case of an emergency, assistance can be reached by dialing 911. The following situations constitute an emergency:

- Life-threatening exposure, injury, or health condition
- Fires
- Explosions
- Hazardous material spills that pose a threat to health or safety

METCAD will dispatch the Fire Department and/or ambulances as appropriate. The fire department can mitigate chemical spills that cannot be managed without assistance.

Exposures

Signs and symptoms of chemical exposures: **Signs** of an exposure are external and can often be seen by you or others in the laboratory. They are objective and can sometimes be measurable. Signs of exposure sometimes include hives, puffiness, sneezing, etc. They are often temporary and can go away when the source of the exposure is removed. **Symptoms** are internal and are not visible to the naked eye. They are only felt by the person feeling them and examples include pain, dizziness, numbness, etc. Sometimes a **sign** can indicate a **symptom**. For example, vomiting is a sign that indicates someone is feeling nauseated (symptom).

Acute and chronic effects: **Acute** health effects can be observed immediately or soon after an exposure, often a

large, brief exposure. Acute health effects include eye, nasal, throat, or mucous membrane irritation, headaches, skin irritation, dizziness, or asphyxia. The occurrence of these effects can be dependent on concentration, personal sensitivity, and the route of exposure (ingestion, inhalation, injection, absorption). **Chronic** health effects can be observed long after initial exposure. Often, they occur after repeated exposures to low levels of chemicals. These include lung disease, cancer, skin damage, or other medical conditions. It is important to protect yourself from all routes of exposure to hazardous materials.

If the exposure and hazard of the materials are severe, students and staff should seek medical attention at the emergency room, either at OSF Heart of Mary Medical Center or Carle Foundation Hospital. If the exposure involves a chemical, the relevant Safety Data Sheet (SDS) should be brought along, if it is readily available. Do NOT delay seeking medical attention to find an SDS. If exposed to a potentially infectious agent or recombinant material, medical follow-up is recommended if: (1) the exposure involves eyes, nose, or mouth, (2) skin is damaged at or near the exposure area, (3) the exposure is through parenteral contact (e.g., needle stick, or cut by sharp object). The emergency rooms are located at:

OSF Heart of Mary Medical Center Emergency Department
1400 W. Park Street, Urbana, IL 61801, (217) 337-2131
Carle Hospital Emergency Department
602 W. University Avenue, Urbana, IL 61801, (217) 383-3313

Students may also seek basic medical care at the McKinley Health Center or with their personal physician.

Employees, including students who are compensated for their work, should seek treatment at the Occupational Medicine Department from 8 A.M. to 5 P.M. unless the exposure is severe and requires treatment at the Emergency Room.

Carle Occupational Medicine
810 W. Anthony Drive, Urbana, IL 61801, (217) 383-3077

Safeworks Illinois
1806 N. Market Street, Champaign, IL 61820, (217) 356-61501

*Urgent or Convenient Care Locations are also options for medical needs, depending on the severity of the incident.

Reporting

Contact DRS immediately to report any incident or near miss (e.g., “close call”) at 217-333-2755 or drs@illinois.edu. DRS will investigate all laboratory incidents and near misses and prepare a follow-up report. The follow-up report seeks to identify and correct the root causes of incidents, not find blame. See the Incident Reporting and Investigation page for more information. For information regarding Workers' Compensation, please see the University Office of Risk Management website, including the First Report of Injury/Illness form and the Public Injury Report.

University policy and state legislation have certain reporting requirements for specific hazards:

- For **biological-related issues**, University policy requires that significant research-related incidents be reported immediately to the Institutional Biosafety Committee (IBC) via the Division of Research Safety. Such incidents include research-related accidents, exposures, and illnesses, as well as inadvertent release or improper disposal of biohazardous materials, including recombinant or synthetic nucleic acids.
- Exposures to **ionizing radiation**, such as accidental exposure to an X-ray beam or ingestion of or skin contact with radioactive materials, must be reported to DRS as soon as possible. Theft or loss of radioactive material must be reported to DRS immediately after the theft or loss is discovered.
- For exposures to **lasers**, the Illinois Emergency Management Agency (IEMA) requires immediate notification for exposures that involve the partial or total loss of sight in either eye or perforation of the skin or other serious injury. IEMA requires notification within 24 hours for exposures that cause second or third-degree burns to the skin.

Medical Surveillance

Safety and Compliance (S&C) coordinates the development and implementation of the campus Medical Surveillance Program. The program includes the routine medical examination of employees over a period of time to evaluate occupational exposure to a potential work-related hazard.

Employees are eligible for inclusion in this program if they perform work-related tasks that might be reasonably anticipated to cause occupational exposure above known exposure limits to a potential hazard. The program does not include pre-employment medical examinations. The medical examinations and tests are provided without cost to the employee and at a reasonable time and place. It is the responsibility of the individual campus unit to bear the full cost associated with the medical examination of its employees.

For more information, contact S&C at (217) 265-9828 or email OSHS@illinois.edu.

Biological Safety

Working with any biological material requires specific safety policies listed in this section. All work with the following materials requires registration with the Institutional Biosafety Committee (IBC) before initiation:

- Recombinant or synthetic nucleic acid molecules.
- Transgenic animals (vertebrate & invertebrate).
- Transgenic plants.
- Pathogens (human, animal, and plant).
- Human and Non-human primate materials (cell lines, blood, blood products, tissues, any bodily fluid).
- Biotoxins.
- Prions.
- Environmental samples that harbor or may harbor pathogens.

More information about IBC registration requirements can be found on the IBC webpage.

Biosafety Levels

Biosafety levels (BL) outline containment criteria based on a combination of practices and techniques, safety equipment, and laboratory facilities necessary to work safely with biological agents. The levels are designated in ascending order, by degree of protection provided to personnel, the environment, and the community.

The University of Illinois at the Champaign-Urbana campus has the capability of housing BL-1 and BL-2 laboratory spaces.

Biosafety Level 1 (BL-1) is the lowest level of containment and is only suitable for work involving well-characterized agents that do not cause disease in healthy adult humans, such as lab strain E coli. These agents present minimal hazards to personnel and the environment.

Biosafety Level 2 (BL-2) builds on BL-1 and is for work with agents that pose moderate hazards to personnel and the environment, BL-2 includes all guidelines of BL-1 with the addition that: 1) personnel have specific training in handling pathogenic agents; 2) access to the laboratory is restricted when work is being conducted; and 3) all procedures that generate aerosols or splashes require physical containment such as a BSC or other physical containment equipment. If working at BL-2, the BL-2 Guide should be a part of your lab safety plan.

Complete information on biosafety levels and standard microbiological practices is found in "*Biosafety in Microbiological and Biomedical Laboratories*," published by the Department of Health and Human Services.

Decontamination

Lab equipment and work surfaces should be decontaminated with an effective disinfectant on a routine basis, after work with infectious materials is finished, and especially after overt spills, splashes, or other contamination by infectious materials. Effective disinfectants and appropriate contact times can be found in Biosafety in Microbiological and Biomedical Laboratories (BMBL).

Biological Storage

It is common practice to store biological materials in liquid nitrogen. For more information about proper practices and safeguards for storing biological materials, see Biological Sample Storage in Liquid Nitrogen.

Training

Anyone working with transgenic or recombinant material at any biosafety level must take the online training: NIH Guidelines Overview.

Chemical Safety

The following is a list of basic policies for certain groups of hazardous chemicals. The information below is not necessarily sufficient to safely handle those chemicals. Refer to the Safety Library at the DRS website and Standard Operating Procedures developed by your laboratory group for additional safe handling procedures for hazardous chemicals.

The OSHA Permissible Exposure Limit (PEL) or Short-Term Exposure Limit (STEL) must not be exceeded. These values can be found in section 8 of the Safety Data Sheet. Proper chemical handling techniques must be used to limit the risk of chemical exposure. Use proper engineering controls and protective measures.

Acutely Toxic Liquids and Solids[1,]

Chemicals with a high degree of acute toxicity can cause serious injury or even death upon exposure to small amounts. Handling highly toxic chemicals (GHS classification of acutely toxic category 1 and 2) requires extra care:

- Quantities of these chemicals used and stored in the laboratory should be minimized, as should their concentrations in solution or mixtures.
- Work should only be performed within a functioning fume hood, ventilated glove box, sealed system, or other system designed to minimize exposure to these substances. (The exhaust air from the ventilation systems may require scrubbing before release into the atmosphere.)
- Where appropriate, an area within the laboratory should be designated for work with highly toxic chemicals. This area should be marked with an appropriate hazard warning such as "DANGER, specific agent, AUTHORIZED PERSONNEL ONLY" or a comparable warning sign.
- The use of acutely toxic materials requires wearing eye protection, a lab coat, and gloves.
- The designated working area should be cleaned after each work procedure and thoroughly decontaminated at regular intervals determined by the laboratory supervisor based on the frequency of usage and level of hazard.
- All laboratory workers with access to a designated area for use with extremely toxic chemicals must be trained about the deleterious effects of these substances, signs, and symptoms regarding exposure, and how to respond in an emergency, like a spill or exposure. This training is required even for those who do not actually work with the substances.
- Highly toxic chemicals should be transported in secondary containment.
- All waste must be disposed of through DRS following the waste procedures described in the above “Waste” section.
- Any spill must be cleaned up immediately, and these materials must be disposed of through DRS.

For additional guidance on chemicals that have health effects, see Health Effects of Chemical Exposure.

Compressed Gases

Gas cylinders should be stored in well-ventilated areas with their protective caps on. They must always be secured in an upright position at or slightly above the midpoint to a secured surface. Gas cylinders must not be stored near heat or high-voltage sources.

[1] Acutely toxic category 1 and 2 chemicals were previously referred to as particularly hazardous substances (PHS)

Compressed gas cylinders containing **flammable, corrosive, oxidizing, or toxic gases** should not be used near egress routes.

Compressed gas cylinders that contain **acutely toxic gases**, such as arsine and nitrogen dioxide, must be stored in a ventilated gas cabinet. Leak detectors should be utilized as a warning system.

Compressed gas cylinders that contain **pyrophoric gases** must be stored in a ventilated gas cabinet with a sprinkler system. Special plumbing and fittings are also required.

Please note that there is a limit on the number of compressed gas cylinders that can be stored in a laboratory space. For moving compressed gas cylinders, appropriate carts should be used. The cylinder must be capped and securely strapped to the cart.

For more information, refer to the DRS guidance on Compressed Gas Cylinder Safety or take the online Compressed Gas Safety training.

Corrosives

Corrosive chemicals can cause severe irritation and permanent destruction of the skin and respiratory tract. They are particularly hazardous to the eye. Besides mineral acids and bases, other chemicals, such as some inorganic salts, phenols, amines, halogens, and some halogenated organic compounds, are also highly corrosive. The use of any liquid corrosives requires wearing eye protection, a lab coat, and gloves at a minimum. When handling large amounts, a face shield, chemically resistant gloves, and an apron/acid smock may be required.

Consult the Safety Library at the DRS website for information on specific materials covered by this category.

Cryogens

Cryogenic material should not be stored in poorly ventilated rooms, such as cold rooms. Cryogens should be stored in well-ventilated places to avoid asphyxiation hazards caused by oxygen depletion. Containers holding cryogens should not be transported in elevators at the same time as people. The handling of liquid cryogens requires wearing cryogenic gloves and eye protection at a minimum.

For more information, refer to the DRS guidance on Cryogens and Dry Ice or take the online Cryogen Safety training.

Explosive Materials

Explosive materials are compounds that may explode upon heat, friction, or shock and pose a serious safety hazard even for laboratory-scale quantities. Heavy metal azides, organic azides, and organic peroxides are often shock-sensitive explosives. Chemicals that become explosive when dry (e.g., picric acid) should be monitored quarterly for their water content and always be kept wet. Potentially explosive chemicals and procedures should only be performed in a chemical fume hood and behind a blast shield.

Consult the Safety Library at the DRS website for information on specific materials covered by this category.

Flammables

Flammable chemicals should be stored in a flammable cabinet whenever possible. They should never be stored or used near ignition sources. Bunsen burners are not permitted to heat flammable solvents. There is a limitation on the amount of flammable solvents that can be stored in a laboratory space.

For more information, refer to the DRS guidance, Flammable Liquids.

Health Hazard Chemicals[2,]

Quantities of these chemicals used and stored in the laboratory should be minimized, as should their concentrations in solution or mixtures.

- Work should only be performed within a functioning fume hood, ventilated glove box, sealed system, or other system designed to minimize exposure to these substances. (The exhaust air from the ventilation systems may require scrubbing before release into the atmosphere.)
- Where appropriate, an area within the laboratory should be designated for work with chemicals dangerous to health. This area should be marked with an appropriate hazard warning such as "DANGER, *specific agent*, AUTHORIZED PERSONNEL ONLY" or a comparable warning sign.
- The use of these materials requires wearing eye protection, a lab coat, and gloves.
- The designated working area should be cleaned after each work procedure and thoroughly decontaminated at regular intervals determined by the laboratory supervisor based on the frequency of usage and level of hazard.
- All laboratory workers with access to a designated area for use with health hazard chemicals must be trained about the deleterious effects of these substances, signs, and symptoms regarding exposure, and how to respond in an emergency, like a spill or exposure. This training is required even for those who do not actually work with the substances.
- Health hazard chemicals should be transported in secondary containment.
- All waste must be disposed of through DRS following the waste procedures described in the above “Waste” section.
- Any spill must be cleaned up immediately, and these materials must be disposed of through DRS.

For additional guidance on chemicals that have health effects, see Health Effects of Chemical Exposure.

Mercaptans

To avoid false reporting of natural gas leaks, mercaptans should not be used in such a manner that persons outside of the laboratory could smell the mercaptan (e.g., scrubbers for effluent). All persons using mercaptans should report these uses to people in the area (including facility managers) who may notice a malodor.

Mercury

Mercury and mercury compounds are extremely toxic and difficult to dispose of. The use of mercury and its compounds should be minimized. Mercury-containing thermometers and other devices should be replaced unless no appropriate substitute is available. Mercury thermometers should not be used in ovens. If metallic mercury is present in a laboratory, a mercury spill kit must be available.

For more information, refer to the DRS guidance, Mercury.

Nanomaterials

The health hazards of nanomaterials are not yet fully understood. There is evidence that they can penetrate intact skin, deposit in the lungs, enter the bloodstream, and travel through the whole body, including the central nervous system. Any handling where an exposure to nanomaterials is likely (handling dry powders, agitating suspension, or mechanically working on materials with embedded nanoparticles) should be performed in a well-ventilated enclosure adequate for nanoparticle use.

For more information, refer to the DRS guidance, Nanomaterials.

[2] Reproductive toxins, and “select carcinogens,” have previously been referred to as particularly hazardous substances (PHS). Chemicals that are classified as carcinogens, mutagens, or reproductive toxins are referred to as health hazard chemicals. Use of these chemicals should be minimized; if possible, they should be substituted with less hazardous chemicals.

Oxidizers

Strong oxidizers promote the combustion of flammable materials and often react vigorously with organic compounds. They should be stored away from reducers, heat sources, organic chemicals, and any other combustible material. Refer to Oxidizers for guidance in identifying such chemicals.

Perchloric Acid

If procedures require the heating of perchloric acid, a perchloric acid fume hood with a water wash-down system or a local scrubbing or trapping system must be used. Evaporation of perchloric acid and condensation of potentially explosive peroxides on ductwork can lead to a severe explosion hazard.

For more information, refer to the DRS guidance, Perchloric Acid.

Peroxide Forming Chemicals

Some chemicals form peroxides over time. The two most serious hazards associated with peroxides are fires and explosions when exposed to heat, shock, or friction. Peroxide decomposition can initiate explosive polymerization reactions. Peroxides can also oxidize human tissue, cotton, and other materials.

Peroxide-forming chemicals must be dated upon opening and checked periodically according to the DRS guidance, Peroxide-Forming Chemicals.

Pyrophorics

Pyrophoric materials ignite spontaneously in the air and are therefore extremely hazardous. Training for handling pyrophorics must include practical instructions from someone experienced in using such chemicals. Laboratory personnel must only handle pyrophorics once they feel confident that they can perform the procedure safely. All handling of pyrophorics requires wearing a flame-retardant lab coat, gloves, and safety glasses.

For more information, refer to the DRS guidance, Handling Pyrophoric and Highly Reactive Materials.

Water Reactives

Water-reactive chemicals react violently with water, often liberating highly flammable or toxic gases. They should be stored safely away from any source of water and must only be used after receiving adequate training.

For more information, refer to the DRS guidance, Handling Pyrophoric and Highly Reactive Materials.

Experimental Chemicals

Some chemicals are synthesized in the laboratory and have unknown hazards associated with them. Some commercial chemicals may also not have enough evidence to be categorized as having a health or physical hazard. These chemicals, which are not well-known, must be treated as potentially hazardous. Precautions must be taken to reduce exposure, including using a chemical fume hood, PPE, and administrative controls until more information is known about the hazards.

Chemical Storage

Chemicals should be stored safely in cabinets and on shelves in an upright position. Toxic or corrosive liquids and any fragile containers (glass) should not be stored above 5 feet.

Chemicals should be segregated based on chemical categories and compatibilities. The specific storage guidelines include:

Acids

Store acids separate from bases and other acid-sensitive chemicals that may liberate toxic or flammable gas upon contact with acid, such as azides, bleach, carbides, cyanides, nitrides, sulfides, and metals. Separate nitric acid from organics such as acetic acid.

Strong Oxidizers

Store away from reducers, heat sources, organics (including organic acids), and other combustible material.

Flammables

Preferably store in a flammable cabinet. Always keep flammables away from any ignition sources.

A special refrigerator or freezer must be used for flammables that must be stored in a cool atmosphere. Refer to the DRS guidance, Flammable Liquids**.**

Pungent-smelling (stench) chemicals and lachrymators should be stored in ventilated storage cabinets.

For more information, refer to the DRS guidance, Chemical Storage.

Electrical Safety

Access to electrical panels must be unobstructed to allow electricians access. Allow 36 inches of clearance around breaker panels and switch boxes. Ground Fault Circuit Interrupters (GFCIs) must be installed/used on any circuit within six feet of a water source. Portable GFCIs are an acceptable substitute if protection has not been installed.

Use flexible cords with a three-wire design wherever possible. The ground prong must be intact, and three-wire cords should be plugged into grounded (three-prong) receptacles. Avoid the use of ungrounded (two-prong) receptacles where possible. Do not use three-to-two-prong adapters.

Extension cords should not be used as substitutes for fixed receptacle outlets. Surge protectors should be used in lieu of extension cords when possible. Do not link multiple surge protectors together in series (daisy chaining). Flexible cords should not be run through doors, windows, walls, or ceilings.

For more information, refer to the guidance document on Electrical Safety in the Research Laboratory.

Laser Safety

All lasers class 3b and 4 must be registered with the Illinois Emergency Management Agency (IEMA) through DRS. More information and access to online laser registration can be found under Laser Registration and Program Information.

Commercially purchased lasers are certified and labeled by the manufacturer as belonging to one of the four hazard classes:

- **Class 1 and 1M**
  Class 1 laser systems do not emit hazardous radiation under normal operating conditions. Most class 1 laser systems incorporate “embedded” higher-power lasers, which can be accessed only if safety interlocks are defeated or bypassed during servicing. In this case, the system temporarily reverts to the original laser classification.
  A class 1M laser system is considered to be incapable of producing hazardous exposure conditions during normal operation unless the beam is viewed with an optical instrument such as an eye-loupe or a telescope.

- **Class 2 and 2M**
  A class 2 laser system emits in the visible portion of the spectrum (400-700 nm), and the natural aversion

reaction to bright visible light (0.25s) is expected to protect the eyes from damage. However, a class 2M laser is potentially hazardous if viewed with magnifying optics.

- **Class 3R (formerly 3a) and 3b**
  A class 3R laser system is potentially hazardous under some direct and specular (mirror-like) reflection viewing conditions if the eye is relaxed (focused at infinity), but the probability of an injury is small.
  A class 3b laser system is more powerful than a 3R and is NOT safe for direct viewing or viewing of specular reflections.

- **Class 4**
  A class 4 laser system is damaging to the eye and skin from the direct beam and diffuse reflections (scattering) and is a potential fire hazard. It can also generate airborne contaminants and hazardous plasma radiation.

It is important to understand that **low-power lasers can also pose a hazard**. Eye injuries can occur when staring directly into the beam or if beams from class 1M or 2M lasers are viewed through optical devices that focus and magnify the beam. In such cases, eye protection may be necessary.

For more information on hazards and control measures of class 3b and 4 lasers, refer to the DRS guidance document, Laser Hazards and Control Measures.

Radiation Safety

DRS administers a radiation safety program that all University personnel on the Urbana campus and all visiting academics, faculty, staff, or students must adhere to when using radioactive material or ionizing radiation sources on or off campus.

All radiation-producing machines must be registered with the Illinois Emergency Management Agency (IEMA) through DRS and operated in accordance with the X-Ray Safety Manual. The procurement, possession, or use of radioactive material is authorized only with a Radioactive materials use permit issued by DRS. Laboratories must develop and train workers on Standard Operating Procedures that are consistent with the guidance provided in the Radiation Safety Manual.

The following links provide more information:

- Authorization to use Radioactive Materials
- Registering Radiation Producing-Machines

Every person who works with radioactive materials is required to take Radioactive Materials Safety Training.

Every person entering a space where radioactive material is present but who does not work with the material must take the DRS online training, Radiation Safety Awareness Training.