

Laboratory Safety Guide

University of Illinois at Urbana - Champaign

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 at Urbana-Champaign are outlined in the [Campus Administrative Manual](#). All groups must understand their responsibilities for providing a healthy and safe 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 Laboratory Safety Plan. 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.

Training

The PI or lab supervisor must ensure that all laboratory personnel receives adequate training for the hazards they will be working with to perform the procedures safely. In addition everyone working in a laboratory must at least have hazard awareness of all materials present even if they are not working with them. Online trainings offered by DRS provide basic information and must be supplemented by lab specific training through the PI or experienced lab members. See the [Safety Training Checklist](#) on the DRS website for specific training and documentation requirements. Online [Laboratory Safety Training](#) is required for all Principal Investigators and researchers with affiliation with a laboratory. This training must be renewed every three years.

Lab Facilities

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

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

Laboratory Safety Audits

Laboratory Safety Audits should be performed and documented annually as a part of [safety management](#) 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 adequate 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 should be requested by contacting DRS.

Food Storage and Consumption

Eating, drinking, and applying cosmetics is prohibited in areas where hazardous materials are in use. Storage and consumption of food is only allowed in well-defined, designated, non-work areas. Food should be stored in designated refrigerators outside of laboratory space and should bear a sticker indicating that no research material storage is allowed. Refrigerators and freezers used to store chemicals, biohazards, or radioactive materials or other potentially hazardous samples should bear a sticker indicating that no food storage is allowed. Contact DRS to request stickers.

Labels

All hazardous material including waste must be properly labeled.

In accordance with the Hazard Communication Standard (29CFR 1910.1200) 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).

Laboratory Safety Guide - University of Illinois at Urbana-Champaign

For more information, refer to the DRS guidance document [Labeling of Chemicals in Laboratories](#).

The **Biohazard symbol** should 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 everywhere where radioactive material is being used, or stored including sinks, fume hoods and benches, and on equipment contaminated with radioactive material. The radiation symbol is also used for x-ray machines.

Electrical Safety

Access to electrical panels should be unobstructed to allow electricians access. Ground Fault Circuit Interrupters (GFCI's) should be used in those locations involving wet processes or outdoor work, including electrical outlets within six feet of a water source. Cords with a three-wire design should have the ground plug intact and be plugged into a three-wire receptacle.

Extension cords should not be used as substitution for fixed receptacle outlets. For more information refer to the guidance document on [Electrical Safety in Laboratories](#).

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 which 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 recapping or any other handling is required, a one-handed technique or a tool should be used.

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

Transportation

If materials are transported by laboratory personnel, they must be contained in such a way as to prevent release to the environment or prevent exposure to people. Shipping hazardous materials requires additional training. For more information, see the DRS guidance document on [Introduction to Shipping](#).

Laboratory Safety Guide - University of Illinois at Urbana-Champaign

Spills

Every laboratory should be equipped with appropriate material to clean-up spills 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](#), [Preparing for Spills](#) 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 with the word “waste” and their content, closed at all times, and segregated by compatibility. Details and procedures for waste collection and disposal can be found on the DRS website at the Waste Management 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](#)

Lab specific policies to be determined by the PI/Lab supervisor

Working Alone: The PI or lab supervisor has to 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).

Prior Approval: The PI/lab supervisor has to decide if the use of a particularly hazardous material or a highly hazardous procedure needs prior approval.

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 (hardcopy or electronic) and clearly addressed in initial training of laboratory personnel.

Exposure Control Measures

Engineering Controls

Engineering controls are designed to remove the hazard out of a person's breathing area, reducing the 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 levels.

Chemical Fume Hoods

All procedures where a chemical exposure to vapor, dust or aerosols is expected under normal conditions or in a foreseeable emergency should be conducted in a chemical fume hood or other adequately vented work area. All users of chemical fume hoods at the University of Illinois at Urbana-Champaign campus should be trained on and comply with the DRS guidance document [Chemical Fume Hoods](#).

A campus-wide Chemical Fume Hood Surveillance Program is conducted by Safety and Compliance at no charge to the users: <http://www.fs.illinois.edu/services/safety-and-compliance/employee-safety-health/chemical-fume-hood>. Hoods are inspected annually and receive a green inspection sticker indicating if the unit is functioning properly.

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 (BSCs) 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 document [Biological Safety Cabinets](#).

BSCs have to 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 has to 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.

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.

The following basic PPE should be worn at all times when entering a laboratory:

Close toed shoes, clothing that covers the legs, a lab coat, and safety glasses.

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

Laboratory Safety Guide - University of Illinois at Urbana-Champaign

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 door knobs. 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. Prescription glasses are not to be substituted 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 as much as possible by using engineering controls. If engineering controls are technically impossible or insufficient, a respirator may be required. Contact Safety and Compliance (S&C) for an assessment of the work and potential exposure. If a respirator is required, compliance with the UIUC Respiratory Program administered by S&C 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 include a face shield, apron, acid smock, or shoe covers.

For more information, refer to the DRS guidance document [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, an exposure evaluation should be performed. Safety and Compliance (S&C) conducts evaluations upon request. Depending on the result of the evaluation, exposure monitoring may be required to assure that OSHA permissible exposure limits (PEL) are not exceeded. Monitoring can also be conducted by S&C.

Medical Consultation and Accident 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 has the capability to mitigate chemical spills that cannot be managed without assistance.

Exposures

Depending on the severity of the exposure and hazard of the material, students and staff can seek medical attention at the emergency room either at Presence Covenant Medical Center or Carle Foundation Hospital. If the exposure involves a chemical, the Safety Data Sheet (SDS) of the chemical should be

Laboratory Safety Guide - University of Illinois at Urbana-Champaign

brought along, if it is readily available (do NOT delay seeking medical attention to find a 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:

Presence Covenant Hospital 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.

Reporting

Supervisors should ensure that an [Employee's Injury Report](#) is completed for all work-related injuries or illnesses, however slight, involving activities for which campus persons are paid.

If a person suffers an injury during activities for which they are not paid, a [Public Injury Report](#) should be completed. These reports should be completed regardless of where the injury occurred or whether the person received medical follow-up. For more information on Worker's Compensation, contact the Claims Management Office.

In addition, exposures to hazardous materials including recombinant or synthetic nucleic acids, ionizing or laser radiation, significant spills, or improper disposal of hazardous material should be reported to DRS immediately.

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 .
- 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 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.

Laboratory Safety Guide - University of Illinois at Urbana-Champaign

Biological Safety

Work 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) prior to 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.

More information about IBC registrations and training requirements can be found at the IBC webpage: <http://www.drs.illinois.edu/Programs/RegistrationInformation>.

Biosafety Levels

Biosafety levels 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 hazard 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 contains 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.

For additional information on biosafety levels and standard microbiological practices, please read "Biosafety in Microbiological and Biomedical Laboratories" published by the Department of Health and Human Services, <http://www.cdc.gov/biosafety/publications/bmbl5/index.htm>.

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 disinfectant and appropriate contact times can be found in "[Biosafety in Microbiological and Biomedical Laboratories](#)".

Chemical Safety

The following is a list of basic policies for certain groups of hazardous chemicals. The provided information is NOT sufficient to safely handle those chemicals. Refer to the Safety Library at the DRS website and

Laboratory Safety Guide - University of Illinois at Urbana-Champaign

Standard Operating Procedures developed by your laboratory group for safe handling procedures for hazardous chemicals.

Acutely Toxic Liquids and Solids¹

Chemicals with a high degree of acute toxicity can cause serious injury or even death upon exposure to small amounts. In particular the handling of 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 being released 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 comparable warning sign.
- The designated working area should be cleaned after each work procedure and thoroughly decontaminated at regular intervals determined by the laboratory supervisor depending upon 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 situation 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.

Compressed Gases

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

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 and 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 document [Compressed Gas Cylinder Safety](#).

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

¹ Acutely toxic category 1 and 2 chemicals have previously been referred to as particularly hazardous substances (PHS)

Laboratory Safety Guide - University of Illinois at Urbana-Champaign

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 and gloves at a minimum. Depending on the amount handled, 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.

Cryogenics

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

For more information, refer to the DRS guidance document [Cryogenics and Dry Ice](#).

Explosive Materials

Compounds that may explode upon heat, friction or shock 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 of the amount of flammable solvent that be stored in a laboratory space.

For more information, refer to the DRS guidance document [Flammable Liquids](#).

Health Hazard Chemicals²

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.

- 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 being released 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 comparable warning sign.

² Reproductive toxins, and "select carcinogens" have previously been referred to as particularly hazardous substances (PHS).

Laboratory Safety Guide - University of Illinois at Urbana-Champaign

- The designated working area should be cleaned after each work procedure and thoroughly decontaminated at regular intervals determined by the laboratory supervisor depending upon 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 situation 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.

Mercaptans

To avoid false reporting of natural gas leaks, mercaptans should not be used in such a manner (e.g. scrubbers for effluent) that persons outside of the laboratory could smell the mercaptan and suspect a natural gas leak in the building. All persons using mercaptans should report these uses to people in the area (including facility managers) that 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 document [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 blood stream 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 document [Nanomaterials](#).

Oxidizers

Strong oxidizers promote 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 the DRS document [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 document [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.

Laboratory Safety Guide - University of Illinois at Urbana-Champaign

Peroxide forming chemicals must be dated upon opening and checked periodically according to the DRS guidance document [Peroxide-Forming Chemicals](#).

Pyrophorics

Pyrophoric materials ignite spontaneously in air and are therefore extremely hazardous. Training for handling pyrophorics must include practical instructions from someone experienced in using such chemicals. Laboratory personnel should only handle pyrophorics once they feel comfortable that they can perform the procedure safely. All handling of pyrophorics requires wearing a flame retardant lab coat. For more information, refer to the DRS guidance document [Handling Pyrophoric and Highly Reactive Materials](#).

Water Reactives

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

For more information, refer to the DRS guidance document [Handling Pyrophoric and Highly Reactive Materials](#).

Storage of Chemicals

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 document [Flammable Liquids](#).

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

For more information, refer to the DRS guidance document [Chemical Storage](#).

Laser Safety

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

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

Laboratory Safety Guide - University of Illinois at Urbana-Champaign

- **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 eyepiece 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 a potential fire hazard. It can also generate airborne contaminants and hazardous plasma radiation.

It is important to understand that also the **low powered lasers can 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 academic, 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. The procurement, possession, or use of radioactive material is permitted only pursuant to a Radiation permit issued by DRS.

The following links provide more information:

- [Authorization to use Radioactive Materials](#)
- [Registering Radiation Producing-Machines](#)

Every person that works with radioactive materials is required to take [Radiation Safety Training](#).

Every person entering a space where radioactive material is present, must take the DRS online training [Radiation Safety Awareness Training](#).