THE A TO Z OF LABORATORY SAFETY

AT TUFTS UNIVERSITY

Tufts Environmental Health and Safety

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The A to Z of Laboratory Safety at Tufts University

In 2017, the research, teaching, clinical and testing laboratory can be a dangerous worksite for scientists, laboratory support staff including maintenance workers and visitors. The laboratory is a highly controlled environment in which carefully planned experiments, exercises and standard operating procedures are conducted using tested and calibrated equipment. In this highly controlled and regulated worksite, the unknown is explored, discoveries are made and new information is created. Injuries and diseases continue to occur among scientists and laboratory staff. This document helps the scientist complete the Tufts Experiment Hazard Control Checklist (EHCC) for each experiment, exercise or SOP.

A

Accident Reporting

All faculty, staff, students, contractors, and visitors must report any accident which resulted in bodily injury/illness, an incident that could have resulted in bodily injury (near miss), or an incident that resulted in property damage that occurred on Tufts property or on a Tufts sponsored/approved activity off campus via the Accident/Incident Report Form. Please go to Accident and Incident Reporting at Tufts University to access the Accident/Incident Report Form and for more information on the topic.

Air Reactive Chemicals

Air reactive chemical agents are extremely hazardous substances. Another name for air reactive chemicals is 'pyrophoric'. These are chemicals which can ignite spontaneously after being exposed to air. These reactive chemicals must be registered using the High Hazard Chemical Registration form. In the laboratory, segregate pyrophoric materials, which will burst into flames when their container is broken from flammables and other heat sensitive chemicals. Keep under considerable secondary containment, preferably under dry inert atmosphere (such as a nitrogen filled desiccator). Please refer to the Chemical Hygiene Plan for more information.

Anesthetic Agents

Anesthetic agents must be used securely and with caution in the laboratory. One common anesthetic agent used is Isoflurane. Anesthetic agents like Isoflurane should be used in a fume hood. If a fume hood is not feasible, an active or passive scavenging system must be used. Prior to using Isoflurane, please read the TEHS Policy on Isoflurane.

Animal Handling Safety

When handling animals, you must use proper technique and caution to avoid being bitten or scratched. Only trained authorized personnel should be handling animals. Follow the OSHA Quick Facts Laboratory Safety: Working with Small Animals.

B

Batteries and Battery Charging

Primary batteries are **non-rechargeable** and include: carbon batteries, zinc chloride "heavy duty" batteries, alkaline batteries, button cell batteries and lithium batteries (these are not the same as lithium ion or lithium polymer (LiPo) batteries!) Secondary batteries are rechargeable. They are available with chargers as free standing units or the charger is a built-in to the electronic device. These include:

NiCad (nickel cadmium), Sealed lead acid (Pb), Nickel metal hydride (NiMHD), Lithium ion, Lithium polymer(LiPo). These batteries and their chargers can be fire and explosion hazards and handled with precautions:

Locate the charger in an area clear of any combustible (paper, plastic, cloth) or flammable materials. Recharge batteries when there is someone nearby to observe or notice overheating and fire. Maintain open air circulation around the charger and battery. Never place primary batteries in a charger. Use only the correct charger specific for the secondary battery. Do not use both primary and secondary batteries together in a single device. Do not mix different types of secondary batteries in the same device. Observe lithium ion batteries for swelling and bulging which can lead to rupture. These batteries must be disconnected and disposed of immediately. Ruptured batteries must be disposed of as hazardous waste through the Satellite Accumulation Area. Intact batteries can be disposed of in small battery recycle bins scattered throughout the buildings. For help, contact EHS.

Biological Safety Cabinet

Biological Safety Cabinets are designed to protect both the researcher and any materials the researcher is working with. As air enters the unit it is immediately drawn down towards the front grille where it goes down and around the back of the unit, towards the top of the unit, and then through a HEPA filter where it is either exhausted out the top or blown back onto the working surface. This design allows clean air to be exhausted back into the room and clean air to pass over the working surface. Once air is blown back onto the working surface it is immediately drawn to either the back or front grille.

Therefore, it is important for researchers to maintain a clean and organized biosafety cabinet with the grilles clear. By blocking the grilles and adding clutter to the biosafety cabinet, you can compromise the materials you're working with by disrupting the airflow. Please refer to the NIH & CDC's document on Biological Safety Cabinets for more detailed information.

Bloodborne Pathogens

Bloodborne pathogens as defined by OSHA are pathogenic microorganisms that are present in human blood and can cause disease in humans. These pathogens include, but are not limited to, hepatitis B virus (HBV) and human immunodeficiency virus (HIV). While handling bloodborne pathogens it is required that Universal Precautions are taken. This means that one must treat and handle all blood and bodily fluids as potentially infectious materials. Bloodborne Pathogen training is required for any researcher who uses primary human materials, components and products made from human blood, human cell lines or culture media, or other solutions containing pathogens that are present in blood and capable of causing disease in humans. BSL2 precautions must be followed. For more information, please visit the Tufts EHS Biosafety Support Page.

C

Carcinogens, Mutagens, Teratogens
These highly toxic chemicals must be used with extreme caution. Illness can occur with chronic small exposures to these chemicals. It is important to use these chemicals in a controlled area and inside a fume hood whenever possible. Prior to using, your laboratory must complete a High Hazard Chemical Registration Form and prepare a safety plan for use and disposal of these materials and obtain the approval of the laboratory supervisor and the Environmental Health and Safety Department. For more detailed information refer to the Chemical Hygiene Plan.

Centrifuges
Centrifuges are a common piece of laboratory equipment here at Tufts University. These are devices which contain motors that spin at extremely high speeds. Some centrifuges spin so fast they can separate fine particles to the nano-scale and molecules of different masses. It is important to follow all safety procedures and follow manufacturer's instructions when using a centrifuge. If not properly used the centrifuge can present many hazards. In addition to the mechanical hazard of the motor, when materials are spun in a centrifuge they can develop aerosols. It is important to open any vials inside a biosafety cabinet following spinning. Please refer to section 2.4.12 of the Chemical Hygiene Plan for more detailed recommendations on how to use centrifuges.

Chemical Hygiene Plan
The Chemical Hygiene Plan (CHP) is an OSHA required document under the standard 29 CFR 1910.1450. This plan is a safety document which covers basic chemical safety i.e. chemical storage, proper use of fume hoods, hazard controls, and personal protective equipment. The CHP outlines essential Tufts chemical safety policies and procedures. The CHP is located on the Tufts EHS website.

Chemical Inventory
Each laboratory is required to maintain a chemical inventory that must be updated at least annually. EHS will ask for the most current chemical inventory during laboratory inspections. At a minimum the chemical inventory must contain the full name of the chemical, the location the chemical is used/stored, and the approximate quantity that is typically on hand. More information on chemical inventories can be found in section 2.1.1 of the Chemical Hygiene Plan.

Chemical Safety Level (CSL)
Laboratory using chemicals are classified as CSL-1 to CSL-5 depending on the potential for high hazard material, equipment or processes to cause minor, major or permanent injury or death. A CSL-5 laboratory is the highest hazard with operations that could seriously affect the health of persons inside and outside the laboratory.

Chemical Security
Chemicals should be stored to prevent access by unauthorized or untrained persons. Stolen laboratory chemicals have been used to make illicit drugs or commit suicide. Avoid leaving hazardous chemicals on the open bench top. Controlled substances must be stored under lock and key. The laboratory should be secure whenever it is unoccupied.

Cryogenic Liquids

Cryogenic liquids present many dangers in the laboratory. Hazards of cryogenic liquids include fire or explosion, pressure build-up, embrittlement of structural materials, cold burn of skin and other tissue, and asphyxiation. The most common cryogenic liquid in the laboratory environment is Liquid Nitrogen (LN2). Store LN2 and cryogenic liquids in well-ventilated area to avoid oxygen displacement and never store inside cold rooms. Always wear appropriate PPE when handling and dispensing cryogenic liquids. This includes a full-face shield with goggles underneath, laboratory coat, and blue cryogenic gloves. Please refer to section 2.4.4 of the Chemical Hygiene Plan for more information.

D

Door Poster

Each laboratory entrance shall have a door poster. The door poster helps visitors and contractors recognize any hazards associated with entering the room. Door posters will display information such as the chemical hazards, biological hazards, emergency contact information, and precautions that untrained visitors and contractors need to follow. If your door sign needs to be updated, please contact EHS.

E

Electrical hazards

Electrical hazards are present anywhere electrical equipment is being used. Electrical hazards can include "daisy chaining" (plugging one power strip into another), using extension cords as permanent wiring, or using damaged cords. Inspect electrical equipment for unsafe conditions frequently, and in some cases, before each use. Look for loose connections or broken parts. Replace power cords and plugs when they show signs of wear or are broken. Protect all wires in or near traffic areas. Ensure that access to all electrical and fire alarm panels are unobstructed at all times. Clearly mark fuse and circuit breaker boxes as to what areas and equipment are covered by each. Check to see that signs are posted in areas where high voltage equipment is in use and posted on the doors leading into rooms with high voltage equipment. Electrical equipment should not be plugged into outlets within 6 feet of sinks which are not GFCI (Ground-fault circuit interrupter). Place a Facilities work order to get a GFCI outlet installed by your laboratory sink. When receiving equipment, it is important to review the owner's manual to ensure equipment can be plugged into power strips. High draw power such as refrigerators and microwaves should be plugged directly into a wall and not a power strip. For more guidelines please read section 2.4.6 of the Chemical Hygiene Plan.

Emergency Evacuation

It is important to familiarize yourself with your surroundings, whether you're in a new location or your normal laboratory/office space. Leave immediately when an alarm sounds. It is important to recognize where exits and stairwells are located. In a high rise building, when a fire alarm sounds, a message will be played over the intercom giving you instructions. If instructed to evacuate, use stairwells, follow illuminated exit signs and any instructions from officials. An announcement will be made when staff is allowed to enter back into the building.

Emergency Gas Shut-Off Valve
This shutoff valve is located just inside or just outside the laboratory exit and is to be used by persons evacuating the laboratory in the event of an unplanned gas release into the laboratory due to valve failure, hose failure or other failure of the gas system. Scientists must be familiar with hazardous gas systems and know the actions to take if they observe a problem.

Emergency Electrical Power Shut-Off Switch
This switch is located just inside or outside the laboratory exit and is used to shut down all electrical power to the laboratory except for the fume hoods, lights and other containment equipment.

Emissions from Fume Hoods and Other Exhaust Systems from Laboratories
The hazardous air pollutant regulations prohibit excessive discharge of chemicals from a fume hood or other exhaust system.

Emergency Response Guide
Tufts University Department of Public and Environmental Safety has created an emergency response guide. This guide is to assist the Tufts Community during any emergency. Each laboratory must have a guide present. Please go to Office of Emergency Management to request a print copy of the guide or read it on line.

Environmental Chambers/Walk-in Refrigerators
Environmental chambers, walk-in refrigerators are a common room in the laboratory setting. These rooms are typically very cold; however, temperature is not the primary hazard associated with these rooms. The air inside these rooms is constantly recirculating, but it is not exhausted out. These means that flammable liquid vapors can build-up over time and present an explosion hazard. Dry Ice if stored in a walk-in refrigerator could displace any oxygen and create a suffocation hazard. Also, lab staff is discouraged from storing any paper, cardboard boxes, or Styrofoam inside these rooms as mold can readilyt grow. Once mold spores are present in the room, they are difficult to eliminate due to the recirculating air. Please refer to section 2.4.11 of the Chemical Hygiene plan for more information.

Equipment Instructions for Use: Please Read Before Operating
Prior to using any piece of laboratory equipment, it is important to have received instruction on the proper use and techniques from a competent person or from carefully reading the instruction manual. Instruction manuals will provide necessary important hazard information. If an electrical piece of equipment, the instructions will inform the user where the equipment can and cannot be plugged in.

Equipment Storage
Equipment can be bulky and heavy. It should be stored in a manner and location to prevent falling. Equipment should be stored away moisture to prevent corrosion. Avoid storing equipment on floors which could present trip hazards and impede exit routes. For questions setting up and storing equipment please reach out to EHS.

Ergonomic Risks in the Laboratory

Hazards in the laboratory can extend beyond chemical, biological, and radiation hazards. One hazard which is frequently forgotten are ergonomic hazards. To minimize ergonomic tasks one should have the task fit the body versus the body fit the task. This means that the tasks should adapt to your comfort to prevent injuries. Please visit the Laboratory Ergonomic webpage for more information on how you can keep yourself injury free

Experiment Hazard Assessment Tool (EHAT)

The EHAT is a tool for researchers to map out each step of their experiment, recognize any hazards, and identify a control for the hazard. This is a tool researchers should be using to prevent any incidents and accidents from occurring. http://publicsafety.tufts.edu/ehs/experiment-hazard-assessment-tool/

Explosion Resistant/Proof Refrigerators

Some flammable chemicals are temperature sensitive and must be stored in a cold environment. These temperature sensitive flammable materials must be stored in an explosion resistant/proof refrigerator. These special refrigerators are engineered with no internal electrical equipment (wires, lightbulbs) and metal latches which removes the risk of a spark from occurring. These refrigerators are engineered to prevent any explosion from occurring inside or outside the unit. If a chemical must be cooled down for a specific experiment procedure, use a bath to chill chemicals rather than store in a refrigerator.

Extreme/Exotic Environments

Extreme Environments involve harsh and challenging conditions. These include deserts, arctic, rainforests and marine environments involving scuba diving. Research in these environments may require special planning, equipment, clothing, and emergency procedures. Exotic environments involve areas that are distant from the United States. Research in these areas may require certain vaccinations and import or export permits to bring research materials to/from a different country.

Eye Protection

Eye protection is an important part of your personal protective equipment (PPE). While conducting experiments without proper eye protection, you are putting your vision at risk. Eye protection must be worn in the laboratory whenever Chemical or Biological hazards exist that may result in a splash or spill accident. Additional eyewear, such as a face shield, should be worn when handling bloodborne pathogens, human vectors, and cryogenic liquids. Whenever a face shield is worn, safety glasses must also be worn underneath. Please read the Tufts University Personal Protective Equipment Plan for more information. All persons using PPE in the laboratory must sign a form indicating they have been trained to use the correct PPE for the hazards present.

F

Fire Safety

Fire safety includes fire prevention, fire detection, and fire suppression associated with laboratory equipment, materials and facilities such as natural gas lines, or other compressed flammable gases. Fire blankets, fire extinguishers, eyewash and showers and sprinkler systems are all used to put out a fire that has started.

First Aid

Each laboratory should have their own basic First-Aid Kit. First-Aid Kits should have common supplies such as gauze and bandages and are designed to treat minor lacerations and burns. Some Kits contain materials which do expire, such as eye saline, so it is important to keep track of these materials. All instances of First-Aid treatment should be reported on the Accident/Incident Report Form.

Flames

When possible, replace open flames with another method of heating. Open flames in the laboratory are a hazard which can be mitigated by using another tool or method of heating, such as a heating block or microwave oven.

Flammable Chemicals

Flammable chemicals are prevalent within the laboratories at Tufts University. The storage, use, and disposal are all important for the safety all both inside and outside of the laboratory. Flammable chemicals should be stored appropriately; this means within a rated flammable storage cabinet. They should be stored away from oxidizers. Keep flammable liquids away from heat, sunlight, and open flames. Use flammable chemicals in fume hoods. Do not pour flammable liquids down the sink. Please refer to the Chemical Hygiene Plan for further instructions.

Food in the Laboratory

Food and drink for human consumption is strictly prohibited in the lab. This includes evidence of food or drink having been present in the lab i.e. food wrappers/empty bottles. Food items which are being used for laboratory purposes must be labeled appropriately i.e. “Not for human consumption” or “For lab purposes only”.

Fume Hood

Fume Hoods are used in the laboratory to protect staff from inhaling any chemical powders, vapors, or gases. All air from the fume hood is exhausted out of the building and does not re-enter. Any procedure that results in the production of air contaminants that are toxic, flammable, corrosive, irritating or have a nauseating odor should be conducted in a fume hood. Please refer to the Tufts Use of Fume Hoods Guide for more information and section 2.3.1 of the Chemical Hygiene Plan.

G

Gas Burners-Bunsen/Fisher Burners

Gas burners add an additional hazard to the laboratory. Having an open flame in the lab is straightforward, you do not want the flame near any flammable, reactive, toxic, combustible materials or compressed gases. Other hazards can exist besides the open flame. Bunsen burners connect to a gas line via tubing. It is important to check the tubing to make sure there are no cracks or penetrations in the tube which would cause a gas leak. Use only natural rubber or Kantleke tubing (do not use Tygon) and ensure gas lines are fully closed when not in use. Whenever possible, replace Bunsen burners with an electric heat block, hot plate, or another tool to eliminate the open flame and use of fuel gases. Please refer to section 2.4.2 of the Chemical Hygiene Plan for more information.

Glassware
Only use glassware which is free of cracks, chips, and irregularities. Inspect all glassware before use. Damaged or defective glassware can break easily and cause harm. Dispose of broken glassware into a box marked Broken Glass CAUTION.

Globally Harmonized System (GHS)
The Globally Harmonized System standardizes the way chemical manufacturers communicate hazards and information to users and general public. This includes what information is displayed on chemical bottle labels and within Safety Data Sheets. The GHS also classifies hazards using a scale from 1-5. GHS Category 1 is the most severe while Category 5 is the least severe hazard. This information is located in section 2 of the chemical's Safety Data Sheet. The GHS hazard scale is important to know since the NFPA diamond uses a reverse scale of 4-0 to classify hazard severity, with 4 being the most severe. Due to Local Fire Department requirements, Tufts uses the NFPA diamond to communicate hazard severity. However, researchers should know the difference between the two scales and know where to find the GHS scale.

Grounding and Bonding Electrical Circuits
All electrical equipment should be on grounded circuits, or itself be grounded. Utilize GFCI outlets when possible. A GFCI will trip in the presence of moisture. If the outlet within reach of a sink is not GFCI, contact Facilities work order to have one installed.

H

Hand Hygiene
Hand hygiene in the laboratory is very important. Inside the laboratory your hands can come in contact with hazardous chemicals, biological hazards, and radioactive materials. It is important to protect yourself by wearing appropriate gloves when handling materials inside the lab. EHS developed a Personal Protection Equipment Selection Guide to assist lab staff when making decisions on what gloves are best for whatever materials you're handling. In addition, the TUEHS Personal Protective Equipment webpage has many links regarding proper glove selection. Prior to leaving the lab or after removing gloves, EHS recommends staff wash their hands as gloves are not impervious to all substances.

Heaters and Hot Plates (electrical)
Electrical heaters and hot plates should be used in place of Bunsen burners or other open-flame devices when applicable. These devices reduce the risk of accidents from occurring by eliminating the flame and gas source and allow even heating. Although electrical heaters and hot plates are safer than open-flame devices, they are not hazard free. Prior to using electrical heaters and hot plates, ensure the unit and cord are in good condition. Confirm that the heater is plugged into a correct outlet and avoid plugging into a power strips. Contact EHS with any questions.

Heavy Material and Equipment Handling
Heavy materials and equipment can cause harm to yourself and others if not handled appropriately. Laboratories should utilize Facilities Services and place a work order if laboratory equipment must be moved or relocated. Laboratory staff should use proper lifting techniques and ergonomics when moving equipment and other heavy materials on their own.

High Hazard Chemicals

Tufts University maintains a list of High Hazard Chemicals which require registration. These are chemicals which the University has identified as needing a specialized safety plan. A High Hazard Chemical is one which poses a potential health risk or is a reactive chemical which poses a physical risk. Laboratories must have a safety plan for each high hazard chemical they have. Please refer to the Tufts EHS High Hazard Chemical Registration page or refer to the Chemical Hygiene Plan for more information.

High Magnetic Fields

High Magnetic Fields can attract tools, particles and dust that are magnetic. Objects such as pacemakers, surgical clips and implants, tools, jewelry, watches, scissors, screws, etc. can present danger in the presence of a high magnetic field. In high magnetic fields, low mass items can become hazardous when moving at high speed. Pulling forces from the magnetic field may not always be felt, so it is important to use caution when in a high magnetic area. Warning signs near high magnetic field areas must be posted. Magnetic Fields do have exposure limits set by the American Conference of Governmental Industrial Hygienists (ACGIH). Pacemaker users or others with magnetic implants should not exceed the 0.5 mT at any time. Routine exposures for whole body should not exceed 2 T during an 8-hour Time Weighted Average.

I

Ionizing Radiation

Ionizing radiation is radiation with enough energy so that during an interaction with an atom, it can remove tightly bound electrons from the orbit of an atom, causing the atom to become charged or ionized. Ionizing radiation is present throughout the environment. Here at Tufts, ionizing radiation sources include radioactive materials and x-ray machines. One must use caution when working around x-ray machines and radioactive materials. Exposure to ionizing radiation can lead to negative health effects. Ionizing radiation is also non-detectable by the human eye so Geiger counters must be used to detect it. Please refer to the Radiation Safety page for more information.

Incompatible Chemicals

Certain hazardous chemicals cannot be safely mixed or stored with other chemicals because a severe reaction can take place or an extremely toxic reactive product can result. Some basic incompatibles are acids & bases, organic solvents and strong oxidizers, and reactive metals and acids or bases. Please refer to the table within the Chemical Hygiene Plan for a list of incompatible chemicals.

Infrared

Infrared Radiation or IR is invisible to the human eye. It is electromagnetic radiation with longer wavelengths than visible light. Skin exposed to IR provides a warning mechanism against thermal effect in the form of pain. Eyes, on the other hand, may not. Since the eye cannot detect IR, blinking or closing the eyes to help prevent or reduce damage may not happen. Special safety glasses must be worn when working in areas of IR. Signage must also be posted warning of IR. Please refer to the TEHS Radiation Safety webpage for more information.

Inspections, Planned
Tufts EHS, Tufts Fire Safety, Tufts Radiation Safety and Tufts Biosafety all conduct routine annual inspections of laboratory and provide reports to the laboratory supervisor. These reports identify and prioritize uncontrolled hazards or noncompliance with regulatory requirements.

Inspections, Self
Scientists should establish a routine schedule in their laboratory to walk through and observe actions and conditions that could or will result in unplanned incidents or accidents or in actions by one or more regulatory authorities.

Inspections, Unannounced
Laboratory safety is primarily about scientists performing every task aware of the hazards and controlling each hazard. Scientists should expect unannounced or surprise inspections of their actions and facility by: Tufts Radiation Safety, MA Radiation Control Program, City and town fire, health and building departments, MA department of environmental protection, US Environmental Protection Agency, US Department of Transportation, Federal Aviation Administration, CDC Select Agents Program and OSHA.

J

Job/task hazard analysis
This is technique to break down any job or task into small steps, identify the actual or potential health hazard at each step and identify the controls necessary to prevent injury or disease at each step. Controls include the use of fume hoods, use of personal protective equipment or reducing the amount of material handled to reduce the hazard.

K

L

Laboratory Coat
Lab workers must wear lab coats while in a lab where Chemical or Biological hazards exist. Lab coats should not be worn outside of the lab. The employer (principal investigator) must provide coats at no cost to all employees who work in the lab. Use an in-house laundering service; do not bring your lab coat home to be cleaned. Please see the Personal Protective Equipment Plan and the Personal Protection Equipment Selection Guide for more information.

Laboratory Operations and Activities
Laboratory spaces, rooms, buildings or facilities are places in which planned experiments, exercises or standard procedures. This includes laboratory support activities such as equipment maintenance and calibration. CSL-5 laboratories should not be used as libraries, food service areas, meeting rooms, conference rooms, resting areas or offices. Persons should only enter such laboratories for the purpose of performing an experiment or an activity in support of performing an experiment.

Laser Safety
A laser is a device, which when energized, can emit a highly collimated beam of extremely intense monochromatic light. The safe use of laser systems depends upon the basic principles of safety, which are recognition, evaluation, and control of potential hazards. Lasers have the capability of causing bodily harm if not used correctly. Please refer to the Laser Safety Program for more information.

Lock Out/Tag Out
Mechanical devices that could cause bodily injury should be deenergized or disconnected form power sources, and prevented from operating by a lock called, lock-out whenever operators are exposed to moving parts, sharp parts or any action of the machine that could cause injury.

M

Mechanical hazards
Mechanical Hazards are different from chemical hazards since they can result in broken bones, lacerations and amputation. These hazards come from machinery in three basic areas:

- Point of Operation – exact area where work is performed on a material such as drilling cutting or stamping
- Power Transmission Apparatus - components which transmit energy to the part of the machine performing the work such as belts, gears, and pulleys
- Other moving parts – anything else that moves while the machine is working such as reciprocating parts, rotating parts, transverse parts, and feed mechanisms

A good rule to remember is: Any machine part, function, or process which many cause injury must be safeguarded. When the operation of a machine or accidental contact with it can injure the operator or others in the vicinity, the hazards must be either controlled or eliminated.

Medical services – screening and surveillance
Medical screening and medical surveillance are two fundamental strategies for optimizing employee health. The fundamental purpose of screening is early diagnosis and treatment of the individual and thus has a clinical focus. The fundamental purpose of surveillance is to detect and eliminate the underlying causes such as hazards or exposures of any discovered trends and thus has a prevention focus. Both contribute significantly to TEHS health and safety programs. Programs that involve Medical Services include:

- Chemical Hygiene Plan Section 3.2 for Medical Screenings/Surveillance for laboratory chemical exposure concerns.
- Respiratory Protection Program which requires medical clearance for respirator use
- Baseline Exams for Work with Class 3B or 4 Lasers are required.
- Exposure Control Plan for work with Bloodborne Pathogens
- Exposure Response Plans for work with pathological viruses and microorganisms.
- List of OSHA Regulated Chemicals who use may require Medical Services.

Mercury and mercury compounds
Mercury is a heavy metal which can be highly toxic in many forms and is a persistent environmental hazard.

Refer to Tufts University's Mercury Management Statement for more information on handling Mercury and its compounds.

Many Mercury compounds, especially organic ones, are highly toxic, and will require a High Hazard Chemical Safety Plan.

Microwave Ovens
Microwave ovens are used to heat substances in the laboratory. Only lab/industrial quality microwaves should be used. Items containing metal, hazardous chemicals, and sealed containers must never be used in a laboratory microwave.

Minors in the laboratory
From page 17 of the Tufts University Employee Handbook:
"The University, as a practice, does not encourage the use of minors in research laboratories. However, if a manager is seriously considering such employment, that person should contact his or her human resource business partner, who can provide a more detailed explanation of the federal and state laws and guidelines, and required training. Additionally, the University's Radiation Hazards Control Group, *(now called Radiation Safety Committee)* has issued a formal policy about minors which states: "Minors are not Effective: July 1, 2015 (rev.02-21-17) 18 allowed to be present in laboratories in which radioactive materials are used unless they are in an organized work or training program which has the prior approval of the University Safety Office *(now called Tufts Environmental Health and Safety)* and Health Physics *(now called Radiation Safety)*."

Mutagens
OSHA defines mutagens as agents that give rise to an increased occurrence of mutations (permanent changes in the amount or structure of genetical material in a cell) in populations of cells, microorganisms, or organisms. With the 2012 Hazard Communication update, OSHA now classifies these the follow way on a Safety Data Sheet:

- Category 1A -Substances known to induce hereditary mutations in the germ cells of humans.
- Category 1B - Substances presumed to induce hereditary mutations in the germ cells of humans.
- Category 2 - Substances of concern because they could induce hereditary mutations in the germ cells of humans.

One of the most common mutagens used in laboratories is Ethidium Bromide. Besides chemicals, Ionizing and certain types of Non-Ionizing Radiation can be mutagenic.

N

Nanotechnology/Nanoparticles/Engineered Nanomaterials
Nanotechnology involves working with matter at the nanoscale (dimensions between 1 and 100 nanometers (billionth of a meter). These materials, often called Nanoparticles or Nanometers, have unique physical, chemical, and biological properties due to their size. Although the potential health effects of such exposure are not fully understood at this time, scientific studies indicate that at least some of these materials are biologically active, may readily penetrate intact human skin, and have produced toxicologic reactions in the lungs of exposed experimental animals.

Links to many guidelines for working with nanotechnology are listed on TEHS's Chemical Safety Page.

Narcotic Effects
Narcotic Effects are those which involve central nervous system depression. These effects include drowsiness, narcosis, reduced alertness, loss of reflexes, lack of coordination, and vertigo. These effects can also be manifested as severe headache or nausea, and can lead to reduced judgment, dizziness, irritability, fatigue, impaired memory function, deficits in perception and coordination, reaction time, or sleepiness. Some SDS sheets may list narcotic effects observed in animal studies may include lethargy, lack of coordination righting reflex, narcosis, and ataxia.

New Employee Orientation
All employees new to the university take New Employee Orientation which includes an overview of Tufts EHS services, along with basic training concerning Emergencies, General Safety, Hazard Communication and Office Ergonomics.

Human Resources has developed a checklist for other unboarding items for a new employee. These items may include EHS trainings when applicable.

Noise Exposure
Equipment or experiments that generate loud noise are covered in TEHS's Hearing Conservation Plan.

National Fire Protection Association (NFPA)
The National Fire Protection Association (NFPA) is a global nonprofit organization, established in 1896, devoted to eliminating death, injury, property and economic loss due to fire, electrical and related hazards. Codes developed by NFPA are adopted by local fire departments and in some cases OSHA. NFPA codes that apply to labs include the following:

- NFPA 1: Fire Code
- NFPA 10: Standard for Portable Fire Extinguishers
- NFPA 30: Flammable and Combustible Liquids Code
- NFPA 45: Standard on Fire Protection for Laboratories Using Chemicals
- NFPA 55: Compressed Gases and Cryogenics Fluids Code
- NFPA 70: National Electrical Code

- NFPA 70E: Standard for Electrical Safety in the Workplace
- NFPA 101: Life Safety Code
- NFPA 704: Standard System for the Identification of the Hazards of Materials for Emergency Response

All of these codes are free for viewing at the NFPA's website.

O

Occupational Health and Safety Administration (OSHA)
With the Occupational Safety and Health Act of 1970, Congress created the Occupational Safety and Health Administration (OSHA) to assure safe and healthful working conditions for working men and women by setting and enforcing standards and by providing training, outreach, education and assistance. OSHA regulations cover employees, contractors, and post-doctoral researchers but do not cover students. However, students must comply with these regulations per Tufts policy.

Occupational exposure to hazardous chemicals in laboratories: 29 CFR 1910.1450
This OSHA regulation is known as the "laboratory standard." it was developed to address workplaces where relatively small quantities of hazardous chemicals are used on a non-production basis. It requires that the employer designate a Chemical Hygiene Officer and have a written Chemical Hygiene Plan and actively verify that it remains effective.

Optical radiation safety
In the electromagnetic spectrum optical radiation are in wavelengths from 100 nm to 1mm. All wavelengths across this range of the spectrum, from UV to IR, can produce thermal injury to the surface layers of the skin, including the eye. Optical radiation includes ultraviolet, visible and infrared radiation.

Organic Peroxides
Organic peroxides are liquid or solid organic chemicals which contains the bivalent -O-O- structure and as such is considered a derivative of hydrogen peroxide, where one or both of the hydrogen atoms have been replaced by organic radicals. Organic peroxides are thermally unstable chemicals, which may undergo exothermic self-accelerating decomposition. In addition, they may have one or more of the following properties:

- Be liable to explosive decomposition
- Burn rapidly
- Be sensitive to impact or friction
- React dangerously with other substances

An organic peroxide is regarded as possessing explosive properties when in laboratory testing the formulation is liable to detonate, to deflagrate rapidly or to show a violent effect when heated under confinement.

Oxidizers

Oxidizers are chemicals, while it themselves not necessarily combustible, may cause or contribute to the combustion of other material typically by yielding oxygen. Proper storage of oxidizers is outlined in section 2.4.13 of the Chemical Hygiene Plan.

P

Pathological waste

Pathological waste consists of recognizable human derived tissues, organs, and body parts as well as vertebrate animal derived tissues, organs, and body parts used in research. Pathological wastes must be disposed by interment or incineration. Waste containers with pathological waste will need the "INCINERATE ONLY" sticker put on them.

More information on pathological wastes can be found at the Tufts University Biological and Regulated Medical Waste Plan

Peroxide-forming chemicals

Peroxide-forming chemicals include many solvents, especially ethers that form unstable peroxides on exposure to air and light. Review TEHS guide on chemical instability before using and ordering these chemicals. Containers must be dated when purchased and dated when opened and then disposed of within a few months.

Personal protective equipment

Personal Protective Equipment (PPE) protects researchers from chemical, biological, radiological and mechanical hazards. Personal Protective Equipment should only be used after guards, engineering controls and good work practices have been implemented. Principal Investigators must follow the Personal Protective Equipment Plan and use the PPE Selection Guide to fill out the Certification of Hazard Assessment and Personal Protective Evaluation (Hazard Assessment Form) in Appendix A of the plan.

Plants

The movement, use, possession, or release of exotic or potentially harmful noxious weeds, and invasive plants are by US Department of Agriculture: APHIS. If genetically modified plants or those harboring organisms pathogenic to humans are used, the research must be approved by the University's Institutional Biosafety Committee before commencing. Normal household plants not involved in research must not be stored in Biosafety Level 2 laboratories and higher.

Poisons (high toxicity chemicals)

A substance is a considered poisonous/highly toxic if it is known to be highly acutely toxic in humans or incomparable animal models as follows:

- Chemicals with an oral median lethal dose (LD50 oral-rat) of 50 mg/kg or less.
- Chemicals with a skin contact median lethal dose (LD50 skin-rabbit) of 200 mg/kg or less.
- Chemicals with inhalation toxicity (LC50-rat) of 200 ppm or 2 mg/L or less in 1 hour.

On a Safety Data Sheet GHS Classification:

- These will be considered Category 1 and 2 for Oral Toxicity
- These will be considered Category 1 and 2 for Skin Contact Toxicity
- These will be considered Category 1 and 2 for Inhalation Toxicty of Gases and Vapors
- For Dusts and Mists this could be any category of inhalation hazard.

Proper storage and use of highly toxic chemicals is outlined in section 2.5.6 of the Chemical Hygiene Plan. Depending on the specific chemical, quantities, or processes, use of these may require a High Hazard Chemical Safety Plan.

Pressure vessels (including autoclaves)
Some equipment is designed to operate above 1 atmosphere. These devices should be equipped with pressure monitors and controllers to prevent excessive pressure that would cause an explosive failure. The device is equipped with one or more pressure relief devices with such devices directed away from occupied spaces. The device should be designed to contain two times the operating pressure as a safety factor.

Pyrophoric Chemicals
Pyrophoric chemicals are liable, even in small quantities to ignite within five minutes after coming into contact with air. Store these chemicals as required per Safety Data Sheet. Proper storage of pyrophorics is outlined in section 2.4.13 of the Chemical Hygiene Plan. Depending on the specific chemical, quantities, or processes use of these may require a High Hazard Chemical Safety Plan.

Q

R

Radiation Safety (Ionizing)
Ionizing radiation sources include radioactive materials and x-ray machines covered by TEHS Radiation Safety site.

Radiofrequency/Microwave and Radiation Safety
Electric and magnetic fields are complex physical agents whose potential health effects are the subject of much research though acute effects such as internal heating of the body is widely known. Particularly controversial are the biophysical mechanisms by which these RF fields may affect biological systems. General health effects reviews explore possible carcinogenic, reproductive and neurological effects. Health effects by exposure source are noted in radar traffic devices, wireless communications with cellular phones, radio transmission, and magnetic resonance imaging (MRI).Tufts University Radiation Safety Officer can provide RF safety training upon request.

Reactive chemicals (high hazard)
A reactive chemical is one that is self-reactive, shock sensitive, pyrophoric or water reactive. Self-reactive chemicals are thermally unstable liquid or solid chemicals liable to undergo a strongly exothermic decomposition even without participation of oxygen (air). Pyrophorics, even in small quantities, are liable to ignite within five minutes after coming into contact with air. Water reactive chemicals are chemicals which, in contact with water, emit flammable gases are solid or liquid chemicals which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities.

Store these chemicals as required per Safety Data Sheet. Use of reactive chemicals is outlined in section 2.5.6 of the Chemical Hygiene Plan. Depending on the specific chemical, quantities, or processes use of these may require a High Hazard Chemical Safety Plan.

Recombinant DNA and Synthetic DNA (rsDNA)
rsDNA is DNA that has been formed artificially by combining constituents from different organisms or created synthetically in the lab without using pre-existing DNA sequences. Certain research involving rsDNA must be approved by the University's Institutional Biosafety Committee before commencing.

Regulated medical and biological waste
Per Massachusetts law, regulated medical and biological wastes include: Human blood and blood products, Animals and animal wastes, Pathological Wastes, Cultures of infectious agents, Sharps, and Biotechnology effluent materials containing Recombinant DNA. Medical and biological wastes regulations are in place to minimize the risk of infection and injury to staff, students, solid waste handlers, and the public. More information on RMW and Biological wastes can be found at the Tufts University Biological and Regulated Medical Waste Plan

Respirators
Use of respirators for personnel protection is highly regulated due to OSHA's respiratory protection standard. One needs to review and follow the clearance procedures of the University's Respiratory Protection Program before a respirator can be used.

Robotics
Robotics is the study of Robots. Robots are programmable multifunctional mechanical devices designed to move material, parts, tools, or specialized devices through variable programmed motions to perform a variety of tasks. Robots are generally used to perform unsafe, hazardous, highly repetitive, and unpleasant tasks. They have many different functions such as material handling, assembly, welding, machine tool load and unload functions, painting, spraying, and so forth. Many robot accidents occur during non-routine operating conditions, such as programming, maintenance, testing, setup, or adjustment. During many of these operations the worker may temporarily be within the robot's working envelope where unintended operations could result in injuries. Though often well designed with more controls than a typical shop machine, Robots have mechanical, electrical and potentially other hazards and are subject to Lockout Tagout and Machine Guarding requirements.

Rule
A rule is a statement that mandates specific actions under specific circumstances without explanation. Note that all rules are based on historical accidents, incidents or `other scientific proof that an actual or potential health hazard exists.

S

Safety Data Sheets
Safety Data Sheets (SDS) are integral parts of both Tufts Hazard Communication Program and Chemical Hygiene/Safety because they provide detailed information on the hazards of a specific chemical and precautions to be taken. These sheets must be kept in the work areas where hazardous chemicals are in use. All employees should know how to access SDS's for the chemicals they use. More information on SDS sheets can be found in the University's Chemical Hygiene Plan and Hazard Communication Program.

Safety Plan for High Hazard Chemicals
Review the High Hazard Chemical List to see if a chemical that is to be used is on it. If a researcher needs to work with a High Hazard Chemical, they will need to fill out a safety plan. For select chemicals such as Hydrofluoric Acid or Ethidium Bromide, there are general Standard Operating Procedures which can work in tandem with the specific plan for the lab.

Satellite accumulation area
A designated area, at or near the point of generation, where hazardous chemicals wastes can be accumulated before consolidation in a Main Accumulation Area. These wastes must be properly tagged with a correctly completed Hazardous Waste label, segregated appropriately from other incompatible wastes, stored in secondary containment, and removed from the lab when full within 3 business days. More information on SAA requirements is on page 9 of the University's Hazardous Chemical Waste Management Plan.

Scientist
Any person that enters a laboratory space for the purpose of following a written experiment protocol, following a written standard operating procedure (SOP) or conducts a learning exercise to acquire skill in laboratory methods or demonstrate a scientific principle.

Select Agents and Toxins
Two federal government agencies (CDC and USDA) run the Federal Select Agent Program to oversee the possession, use and transfer of biological select agents and toxins, which have the potential to pose a severe threat to public, animal or plant health or to animal or plant products. Research using Select Agents and Toxins must be approved by the University's Institutional Biosafety Committee, the Boston Public Health Commission, and either CDC or USDA depending on the agent before commencing. When investigating the use of a new biological agent or toxin, a researcher must review the Select Agents and Toxins list.

Self-Heating Chemicals
A self-heating chemical is a solid or liquid chemical, other than a pyrophoric liquid or solid, which, by reaction with air and without energy supply, is liable to self-heat; this chemical differs from a pyrophoric liquid or solid in that it will ignite only when in large amounts (typically kilogram and higher) and after long periods of time (hours or days)

Self-Reactive Chemicals
Self-reactive chemicals are thermally unstable liquid or solid chemicals liable to undergo a strongly exothermic decomposition even without participation of oxygen (air).

Sensitizers

Sensitizers elicit an immune response to a chemical. These chemicals can affect the respiratory system or skin. Respiratory sensitizer means a chemical that will lead to hypersensitivity of the airways following inhalation of the chemical. Skin sensitizer means a chemical that will lead to an allergic response following skin contact. Sensitization includes two phases: the first phase is induction of specialized immunological memory in an individual by exposure to an allergen. The second phase is elicitation, i.e., production of a cell-mediated or antibody-mediated allergic response by exposure of a sensitized individual to an allergen. An extended definition of sensitizers is included on Page 35 of the Chemical Hygiene Plan

Sharps and hypodermic needles

All objects that could potentially puncture the skin are considered sharps. Commonly used sharps in research laboratories are hypodermic needles, scalpels, and precision cutting tools. For more information on sharps safety read the University's Exposure Control Plan. For Sharps Disposal read the University's Biological and Regulated Medical Waste Plan.

Shop Equipment (Hand and Power Tools)

Many researchers need to use shop equipment such as a power tool to assemble an item to support their research. TEHS can assist labs to have a plan for safe use of these tools. OSHA has an excellent comprehensive Guide on Hand and Power Tools as well.

Shipping hazardous materials

Many materials such as flammable solvents, biohazardous materials, and lithium ion batteries require proper packaging, marking, labeling and documentation in order to meet Federal and International Regulations. TEHS offers training for those wishing to ship Biological and Chemical shipments. Noncompliance can result in severe financial penalties for Tufts University.

Sinks and sanitary waste disposal

Tufts University has permits for wastewater discharges with the MWRA for the Boston and Medford campuses and the town of Grafton for the Veterinary School's campus. These permits have strict limits for pH, Toxic Organic Solvents, and heavy Metals. Sinks are labelled with signage to remind one what can and cannot go down the drain in a laboratory. Biological wastes can be treated with 10% bleach and then disposed after proper contact time as long as the bleach is Mercury Free. More information on wastewater especially Mercury issues can be found on the Wastewater Management page and TEHS Guide on Sink Disposal.

Spills or Releases

In all spills and releases, the primary concern is personnel protection. In the event of a spill emergency, contact University Police at 617-627-6911. More details in the Emergency Response Guide. In the event of any spill, please complete the Accident/Incident Report Form.

Static electricity
Everyone has probably experienced a static electricity spark (and shock) at one time or another. This usually happens in the winter when there is not much moisture in the air (humidity is low), but can occur any time of year. Under certain conditions, liquids, solid objects and people can become charged with static electricity. If these charges cannot move or flow to ground, the static charges continue to accumulate, and will eventually develop enough energy to jump as a spark to another nearby object. If a flammable vapor could is present during pouring operations, this spark can ignite a fire or cause an explosion. To minimize the risks of static electricity, it is critical to ground bulk containers of flammables and bond them to containers flammable and combustible liquids are dispensing into.

T

Target Organ Toxicity
On a Safety Data Sheet, target organ toxicity means specific, non-lethal target organ toxicity arising from exposure to a chemical. It will be noted on the SDS sheet if the toxic effects are from a single or repeated exposure. All significant health effects that can impair function, both reversible and irreversible, immediate and/or delayed are covered under this category that do are not related to other health effects (i.e. acute toxicity, sensitization, eye damage, etc.)

Temperature Extremes
Temperature Extremes can be dangerous due to a person due to surface (i.e touching) or environmental (i.e exposure to hot/cold ambient air) exposures.
Hot surfaces can cause burns at temperatures greater than 110 degrees Fahrenheit depending on the length of exposure but typically temperatures greater than 140 degrees Fahrenheit will cause an instant burn.

A researcher can get chilblains (painful inflammation) or frostbite (i.e cold burn) by having skin come into contact with Liquid Nitrogen or Dry Ice

Exposure to warm environments can be dangerous. Heat cramps and heat exhaustion of two early warning signs for over exposure to heat. Heatstroke is a life-threatening effect of overexposure to heat. This occurs when a core body temperature greater than 104 degrees Fahrenheit, with complications involving the central nervous system that occur after exposure to high temperatures.

Exposure to cold environments can lead to hypothermia when the body temperature dips below 95 degrees Fahrenheit. Frostbite can also occur in temperatures that are less than freezing with improper protection of the skin.

Teratogens
An agent (biological, chemical or radioactive) than can cause birth defects when a pregnant women is exposed to them. For chemicals, OSHA Hazard Communication 2012 refers to these as reproductive toxicity hazards. A SDS will state "May/Suspected of damage to fertility or the unborn child."

Training courses

A researcher rarely needs only one training course since a variety of hazards are present in a laboratory. TEHS has provided a template of what training courses should be taken (when applicable) and how often.

What often is overlooked is the need for Lab-Specific Training. This training must be given by the PI or Lab Coordinator to new **members before starting work. TEHS has made a checklist to help guide this specific training**

Transportation of hazardous materials

Transportation of hazardous materials on a single campus poses risks to people, property, and the environment. For transportation off-campus or between campuses please see Shipping of Hazardous Materials. Chemicals must be transported on a cart with a 2" lip or applicable secondary container. Biohazardous materials must be transported in a secondary container that is leak-proof and shatterproof. Radioactive Materials must have approval from the Radiation Safety Office before transporting since a location may need to be licensed before allowing materials to be brought to it.

U

Ultraviolet Radiation

Ultraviolet light (UV) is non-ionizing radiation that falls within the 180-400-nanometer wavelength region of the electromagnetic spectrum. Exposure to UV radiation can lead to a variety of health effects for the skin and eyes. For more information on UV health effects, Laboratory equipment that uses UV Radiation and UV controls to protect oneself, review the TEHS UV Radiation page.

Universal Waste

Universal waste includes mercury containing items (fluorescent lightbulbs, mercury thermometers), batteries (Ni-Cad, Lithium), and Pesticides. Please alert Tufts EHS if you have any of these for disposal. Section 9 of the Chemical Waste Management plan discusses this waste in greater detail.

Uranium Compounds

Uranium salts such as Uranyl Acetate, Uranium Oxide, Uranyl Nitrate are non-licensed radioactive materials who use still requires following the University's Radiation Safety Manual.

V

Vacuum systems

Some equipment is designed to operate at less than 1 atmosphere pressure. These devices should be deigned to resist implosion by materials of construction and use of tape to reduce the shrapnel produced from an uncontrolled implosion. Equipment includes vacuum pumps, vacuum desiccators, vacuum concentrators, suction jars, vacuum filtration devices.

Ventilation
There are three types of ventilation in the laboratory: Supplied Air, General Exhaust Ventilation and Local Exhaust Ventilation

- **Supplied Air** is the air that comes into the lab and is heated or cooled for personnel comfort. It is often called Make Up Air.
- **General Exhaust Ventilation** is the air being removed from the room from vents.
- **Local Exhaust Ventilation** are the fume hoods, snorkel hoods, slot hoods or other setup engineered to remove fumes and vapors from a point source.

All three of these types of ventilation work in tandem to create air changes in a laboratory in order to dilute a chemical vapor during a spill scenario. The volume of supply air should be less that the volume of the sum of general and local exhaust ventilation so that the lab has negative airflow. In case of a spill, any fumes or vapors will not exit the lab into adjacent rooms when laboratory airflow is properly functioning.

Vibration
Tools may cause vibration that could lead to "white fingers" or hand-arm vibration syndrome (HAVS). This is especially dangerous when proper damping techniques are not applied, if machines are not maintained, if tools are not alternated, or if a worker uses a vibrating tool for consecutive hours during a workday. Workers need to be trained on the hazards of working with vibrating tools, and should always allow the tool or machine to do the work.

Visitors to the laboratory
A laboratory visitor is any person who is not assigned to work in the laboratory space on a regular basis. To protect the visitor and reduce the risk to the University, the following guidelines for visitors to laboratories should be followed:

- Visitors should read the laboratory door poster before entering a laboratory.
- No person under the age of 18 should be allowed to visit a laboratory without the expressed, written permission of TEHS. Contact TEHS or Risk Management for more information.
- All visitors must be escorted and supervised by laboratory personnel at all times while the visitor is in the laboratory.
- Visitors to the laboratory are expected to follow the same requirements as the laboratory workers in regards to such items as personal protective equipment (PPE), proper dress, food and drink, etc.
- A student or other person regularly visiting the lab, even if just as a volunteer, should follow the requirements for a laboratory worker, including the training requirements.

W

Water cooled equipment
Regulations prohibit the use of drinking water for pass through cooling systems in laboratory equipment to reduce water waste and reduce sewage volumes. Water cooled equipment with hoses must secure hoses with clamps to prevent failure and resulting flooding of the laboratory.

Working Alone
Some scientists prefer working at night or weekends when there are fewer persons working in the laboratory. However, this is to be avoided when working with high hazard acutely toxic or reactive chemicals or with high hazard equipment such as high voltage, high pressure or vacuum systems. A written Safety Plan is required for these types of experiments and a" Lab Buddy" is usually part of the Plan. A Lab Buddy is another qualified scientist that understands your experiment and monitors your welfare by being in the lab during the experiment or in the area or connected via computer. Each supervisor, department chair, or Dean can issue a Working Alone or Lab Buddy policy for laboratories they are responsible for.

Working at elevated heights
Working at heights at or above 4 feet requires compliance with the University's Fall Protection Plan. This plan establishes a means to analyze work at heights to protect against falls.

X

X-Rays
X-Rays are a type of ionizing radiation. For information on safe and compliant use of X-Ray Generating Instruments such as Diffractors, Scanning Electron Microscopes and XRF analyzers visit TEHS Radiation Safety site.

Y

Z

Tufts UNIVERSITY
Environmental Health and Safety

Appendix A
Introduction to the Experiment Hazard Assessment Tool

The purpose of the Experiment Hazard Assessment Tool is to assist researchers with incorporating safety fundamentals into an experiment, thus creating an improved, safe and complaint work environment. This is accomplished by identifying hazards and the controls to mitigate or eliminate such hazards. (Common hazards include: Asphyxiation, Cancer, Electrical shock, Eye injury, Hearing loss, Infection, Poisoning, Reproductive organ damage, Repetitive Strain Injury, Respiratory disease, Skin burn, Skin cut and abrasion, Skin disease, Traumatic blood loss and Whole body trauma from explosions, falls, falling objects.) When planning an experiment, while the outcome is often unknown, the equipment, materials, processes and methods are well defined. Using the Experiment Hazard Assessment Tool in conjunction with the A-Z of Laboratory Safety at Tufts Guide, researchers should understand all applicable hazards, whether minor or major and be comfortable with implementing the correct controls to mitigate these prior to beginning work.

The completion of the Tool should be based on an experiment PROTOCOL. You write a protocol to ensure that you have a definite plan for conducting the experiment. This protocol is typically written in your laboratory notebook (paper or electronic). The protocol for your experiment should identify every piece of equipment, all materials, specific processes and step-by-step methods for performing each task. Using your protocol, mark “YES” or “NO” for each hazard. Those that are marked “YES” should be described and have identified control(s) noted. Amongst other resources, utilize reference documents cited within the Tool and/or contact Tufts Environmental Health and Safety for assistance. Once complete, the filing of the Tool is the discretion of the lab, so long as it is easily assessable to researchers performing the experiment.

Name of scientist or person designing the experiment: ____

Title of the experiment protocol: ____

Campus: _______________ **Building**: __________________________ **Room**: ________________ **Date**: _________________

Complete this Checklist before beginning each different laboratory experiment, laboratory exercise or Standard Operating Procedure.

General Equipment Safety			• ***Locate, Read and Understand Operating Instructions and note potential hazards of each piece of equipment as stated by the manufacturer See A to Z guide for Equipment Instructions for Use.*** • ***Be sure to procure all required PPE as stated by the manufacturer for safe use. See A to Z guide for Personal Protective Equipment.*** • ***Label all inoperative or damaged equipment and notify responsible person for repair by a qualified person.***	
Specific Hazard Created	***Yes***	***No***	***Describe***	***Controls in Place***
Electrical: Does equipment in experiment have High Voltage over 600V or potential for exposure to unguarded live parts greater than 50V			*Describe using A to Z guide for* ***Electrical Hazards*** *and* ***Lockout/Tagout*** *as a reference*	
Machinery: Use of Equipment with pinchpoints, nip points, rotating parts (fans etc.) or other point of operation hazards.			*Describe using A to Z guide for* ***Mechanical Hazards*** *and* ***Shop Equipment*** *as a reference*	
Robotics: Use of equipment with Robotics that typically perform more than one task than a machine would.			*Describe using A to Z guide for* ***Robotics*** *as a reference*	
Temperature Extremes: Will equipment involve hazardous temperature extremes: cold or heat			*Describe using A to Z guide for* ***Temperature Extremes*** *as a reference*	
Noise: Will equipment create loud noise over 85 dBA?			*Describe using A to Z guide for* ***Noise Exposure*** *as a reference*	

Specific Hazard Created	***Yes***	***No***	***Describe***	***Controls in Place***
Vibration: Will equipment create loud noise over 85 dBA?			*Describe using A to Z guide for **Vibration** as a reference*	
Reaction/Process Vessels: Will chemical reactions, coatings, depositions be done in a vessel container etc.?			*Describe using A to Z guide for **Pressure Vessels** as a reference*	
Fluids: Does the equipment used have fluids that can leak?			*Describe using A to Z guide for **Personal Protective Equipment** and **Chemical Spills** as a reference*	
Vacuum: Does the equipment use vacuum?			*Describe using A to Z guide for **Vacuum Systems** as a reference*	
High Pressure: Does the equipment create or use high pressure in a vessel such as autoclave?			*Describe using A to Z guide for **Pressure Vessels (including autoclaves)** as a reference*	
High Magnetic Field: Does the equipment create high magnetic fields?			*Describe using A to Z guide for **High Magnetic Fields** as a reference*	
Materials used in Equipment: If not already answered above does the experiment involve the use of materials in equipment? Does it release such materials?			*Describe using A to Z guide for **Electrical Hazards** as a reference*	

Specific Hazard Created	***Yes***	***No***	***Describe***	***Controls in Place***
Material Handling Equipment: Is heavy duty equipment such as cranes or fork trucks used in or to support the experiment?			*Describe using A to Z guide for **Heavy Material and Equipment** as a reference*	

Specific Equipment

Specific Topic	***Yes***	***No***	***Describe***	***Controls in Place***
Sharps - Does experiment use items such as needles, scalpels, and glass which can be broken?			*Describe using A to Z guide for **Sharps and hypodermic needles** as a reference*	
Explosion Proof/Resistant Cold Storage - Does experiment require the need for flammables to be stored or brought to cold temperature?			*Describe using A to Z guide for **Explosion Resistant/Proof Refrigerators** as a reference*	
Cold/Warm Rooms - Will experiment use Environmental Chambers and other types of walk-in storage with temperature control?			*Describe using A to Z guide for **Environmental Chambers/Walk-in Refrigerators** as a reference.*	
Fume Hood- Will experiment require fume hoods to control exposures to chemical agents?			*Describe using A to Z guide for **Fume Hood** as a reference.*	
Biosafety Cabinet-Will experiment require Biosafety cabinets used to control exposures to biological agents?			*Describe using A to Z guide for Biosafety Cabinet as a reference.*	

Specific Topic	*Yes*	*No*	*Describe*	*Controls in Place*
Hot Plates/Water Heaters-Will experiment use hot plates and water heaters?			*Describe using A to Z guide for* ***Hot Plates/Water Heaters*** *as a reference.*	
Centrifuges- Are centrifuges of any size used to separate fluids, settle particles etc.			*Describe using A to Z guide for* ***Centrifuges*** *as a reference.*	

Ionizing and Non-Ionizing Radiation Generating Equipment

Specific Hazard Created	*Yes*	*No*	*Describe*	*Controls in Place*
Lasers: Use of Class 3B or 4 Lasers, describe max power, wavelength, and type of laser (collimated/focus, continuous vs pulse, etc.)			*Describe using A to Z guide for* ***Lasers*** *and* ***Eye Protection*** *and Tufts' Laser Safety Guide:* http://publicsafety.tufts.edu/ehs/radiation-safety/laser-safety/	
Ultraviolet: Will experiment involve equipment that can generate UV Radiation such as UV Transilluminators?			*Describe using A to Z guide for* ***Ultraviolet Radiation*** *as a reference*	
RF/Microwave: Equipment that emits Longwave non-ionizing radiation.			*Describe using A to Z guide for* ***Radiofrequency/Microwave and Radiation Safety*** *as a reference*	
Ionizing Radiation: Will experiment use equipment that can generate X-Rays, Gamma Rays and Neutrons			*Describe using A to Z guide for* ***X-Rays*** *and* ***Ionizing Radiation*** *as a reference. Review Tufts' Radiation Safety Manual for registration of device with Radiation Safety Committee*	

Materials

Materials Used	***Yes***	***No***	***Describe***	***Controls in Place***
Biohazardous and Microbial Agents: Review TU/TMC Biosafety Manual to determine if the agents must be registered with the Institutional Biosafety Committee (IBC); http://viceprovost.tufts.edu/ibc/; Human Source Material: blood or human tissue cells			*Describe using A to Z Guide for Bloodborne Pathogens and A to Z Guide Laboratory Coat, and A to Z Guide Eye Protection as a reference*	
Plant and Plant Material: Will experiment use plants or plant derived materials?			*Describe using A to Z Guide for Plants as a reference*	
Animals and Animal Derived Materials (include invertebrates): Will experiment use animal or invertebrate derived toxins, allergens, sensitizers, infectious agents?			*Describe using A to Z Guide Animal Handling Safety, A to Guide Select Agents & Toxins, and A to Z Guide Sensitizers as a reference*	
Anesthetic Agents: Will any anesthetic agents such as Isoflurane be used be used in the experiment?			*Describe using A to Z Guide Anesthetic Agents*	
Recombinant and Synthetic DNA (rsDNA): Will experiment use artificially formed DNA?			*Describe using A to Z Guide Recombinant DNA and Synthetic DNA (rsDNA) as a reference*	
Nanomaterials: Will the experiment use Nanotechnology?			*Describe using A to Z Guide Nanotechnology as a reference*	

Materials Used	***Yes***	***No***	***Describe***	***Controls in Place***
Controlled Substances: review TU Controlled Substances Policy and ensure that a Permit for possession and use is current. http://publicsafety.tufts.edu/ehs/controlled-substances/			*Describe using A to Z Guide Controlled Substances as a reference*	
Compressed Gas: Will compressed gases be used in the experiment?			*Describe using A to Z Guide Compressed Gas as a reference*	
Cryogenic Liquids: Will cryogenic liquids be used?			*Describe using A to Z Guide Cryogenic Liquids and A to Z Guide Personal Protective Equipment*	
High Hazard Chemicals: review Safety Data Sheet, TU Chemical Hygiene Plan and complete Registration form and written Safety Plan http://publicsafety.tufts.edu/ehs/chemical-hygiene/			*Describe using A to Z Guide High Hazard Chemicals, A to Z Guide Mutagens, Teratogens, A to Z Guide Poisons, A to Z Guide Reactives, A to Z Guide Laboratory Coat, A to Z Guide Eye Protection, A to Z Guide Safety Data Sheets, and A to Z Guide Safety Plan for High Hazard Chemicals*	
Mercury: Will mercury or compounds containing mercury be used?			*Describe using A to Z Guide Mercury as a reference*	
Experiment Waste: Will experiment generate biohazardous, pathological, or chemical waste?			*Describe using A to Z Guide Regulated Medical and Biological Waste, A to Z Guide Pathological Waste, A to Z Guide Chemical Waste, and A to Z Guide Satellite Accumulation Area as a reference.*	
Batteries: Will Batteries or equipment which runs of batteries be used?			*Describe using A to Z Guide Batteries and Battery Charging*	

Logistical Issues

Specific Topic	***Yes***	***No***	***Describe***	***Controls in Place***
Minors- Will minors be performing any of portion of the experiment?			*Describe using A to Z guide for **Minors in the Laboratory** as a reference*	
Transportation - Does experiment involve the need to transport materials intracampus, intercampus or off-campus?			*Describe using A to Z guide for **Shipping Hazardous Material as** a reference*	

Processes

Specific Topic	***Yes***	***No***	***Describe***	***Controls in Place***
Repetitive Motions Will repetitive motions such as hand pipetting be performed in the experiment			*Describe using A to Z guide for **Ergonomics** as a reference*	
Lifting Heavy Material/Equipment Will the need to lift heavy equipment or materials be needed to perform the experiment?			*Describe using A to Z guide for **Heavy Material and Equipment Handling** as a reference*	
Controlling Hazardous Energy: Will the experiment require controlling hazardous energy such as electrical, pneumatic, hydraulic to protect researchers from exposure			*Describe using A to Z guide for **Lockout Tagout** as a reference*	

Specific Topic	***Yes***	***No***	***Describe***	***Controls in Place***
Chemical Waste Disposal - Does experiment involve the need to dispose chemicals			*Describe using A to Z guide for **Chemical Waste, Satellite Accumulation Area, and Sinks and Sanitary Sink Disposal** as a reference*	
Chemicals becoming Airborne - Does experiment involve the chance for airborne emission of chemicals due to volatility, heating or spraying that have a GHS hazard of 1-3?			*Describe using A to Z guide for **Fume Hood, Personal Protective Equipment, and Safety Data Sheets (SDSs)***	
Other processes - Does experiment involve other processes not mentioned above?			*Describe the hazards of these processes using A to Z guide for **Job Hazard Analysis** to assist you.*	