ROSEMAN UNIVERSITY
OF HEALTH SCIENCES

Laboratory Safety Manual

General Laboratory Access

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General Laboratory Access Safety Manual

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Personal Protective Equipment

Once a biological hazard has been identified, the supervisor and employee must agree on the appropriate personal protective equipment (PPE) to be worn as the primary barrier of protection. PPE may include, but is not limited to face protection, lab coats and gowns, respirators, and shoe-covers/booties. Supervisory personnel are responsible for the initial demonstration and periodic follow-up of proper use. Appropriate PPE should be donned before handling potentially hazardous biological materials and removed immediately and replaced if contamination of the equipment occurs. PPE is removed before exiting the laboratory.

Face Protection: When splash or splatter of infectious substances or other biological materials is anticipated, appropriate face protection is worn if work is performed outside a biological safety cabinet. Such equipment would include but is not limited to goggles, side-shielded safety glasses and chin length face shields.

Lab Coats and Gowns: Long sleeved lab coats or gowns must be worn to protect skin and street clothes from contamination. In circumstances when splash or splatter is anticipated, the garment must be resistant to liquid penetration. A cuffed lab coat or gown (or lab coat and cuffed disposable sleeve covers) must be worn when working with potentially infectious materials. Standard lab coats should be worn (buttoned) whenever there is a possibility of splashes, spills, or other clothing contamination to lab personnel.

Gloves: Gloves are worn when handling biohazardous materials. Disposable gloves can provide an adequate barrier between the lab employee and most biohazardous materials. Double gloves and/or cut-resistant gloves should be considered when handling sharp items and biohazardous materials. Do not wash or reuse disposable gloves. Dispose of used gloves with other contaminated laboratory waste.

Disposable nitrile gloves (4 to 8 mils thick) should be worn when manipulating chemicals in containers, but they may not be appropriate for direct contact with some laboratory chemicals. In general, nitrile gloves offer better chemical protection than latex gloves, and eliminate the risk of latex sensitivity.

Respirators: When engineering controls (i.e. BSCs) are not available to provide adequate protection against aerosolized agents or when mandated by federal regulations, respirators shall be worn.

Disposable Shoe-covers/Booties: When significant splash and splatter are anticipated, shoe-covers/booties should be considered. Prior to exiting the laboratory, these must be removed and disposed of properly.

Laundering: Reusable lab coats should be laundered on-site or by a laundering service established by the employer, at no cost to the employee. Personnel must never launder lab coats or gowns at home. Soiled clothing being collected for laundering should be placed in leak-proof container (e.g., biohazard bag). If minor contamination is present, laboratory clothing should be decontaminated (i.e. disinfecting, neutralizing, autoclaving) in the laboratory before being sent to the launderer. If grossly contaminated, disposing with laboratory waste may be the best option. Soiled laundry should only be handled by individuals wearing appropriate PPE and should never be taken home.

Additional protective clothing may be indicated in some situations, including:

- Risk of splash with corrosive materials or chemicals that may absorb through the skin - In addition to the standard lab coat, impermeable aprons, sleeves and shoe coverings (or an impermeable coverall), should be worn.

- Risk of splash with cryogens – In addition to the standard lab coat, wear an insulated apron and cryogen gloves.

- Risk of splash with hot liquids – In addition to the standard lab coat, wear a rubberized apron and heat-resistant impermeable gloves. Standard autoclave gloves are not appropriate for handling hot liquids.

- Risk of fire – Instead of the standard lab coat, a fire retardant lab coat should be considered for laboratory work involving pyrophorics or large quantities of flammable materials.

Additional provisions that improve the effectiveness of protective clothing include:

- Hands should be washed as soon as possible when they come in contact with potentially infectious materials. A vigorous handwashing with a mild soap for 20 full seconds is appropriate. Hands should also be washed as soon as feasible after gloves are removed, and before exiting the laboratory.

- Eating, drinking, smoking, applying cosmetics and handling contact lenses are prohibited in work areas in which potentially infectious materials are being manipulated. Food and drink must not be stored in refrigerators in which laboratory materials are kept.

- Good housekeeping in laboratories can reduce the risk of accidents occurring. Work benches should be kept as clutter-free as feasible, and aisles should always be free of trip hazards. Benches should be wiped down with an approved disinfectant at least once a day and immediately after a spill of potentially infectious materials.

- Pipetting infectious agents can lead to personnel exposures by inhalation, contact, or ingestion if not performed properly.

  The following safety precautions should be followed when pipetting in the laboratory:

  1) Never mouth pipette; pipetting aids should always be used

  2) Pipette contents should be allowed to run down the wall of the container, making sure not to release the contents from a height

  3) Place absorbent paper on benchtops to reduce the risk of aerosols being generated by accidental dripping of infectious materials from pipette tips

  4) Place disposable pipettes into pipette disposal boxes which have been lined with an autoclave bag, and then steam sterilize.

Engineering Controls

Chemical Fume Hood: Chemical fume hoods are the primary containment devices used to protect personnel and the laboratory environment from hazardous or irritating chemicals that may become airborne through volatilization or aerosolization.

All hoods must be checked for proper air flow annually. Do not use a hood that is overdue for annual testing. Be sure the hood's construction is compatible with the materials you will be using. (For example, never use perchloric acid in a regular lab hood. A perchloric acid hood is required. Hoods used with hydrogen fluoride must have a special face sash to resist pitting from the acid. Stainless steel lined hoods should not be used with strong acids or other materials corrosive to metal).

Use a chemical fume hood when working with:

- Particularly Hazardous Substances that are volatile or that are in powder form or other volatile compounds.

- Chemicals with a strong odor.

- Other materials as indicated by chemical- or lab-specific procedures.

Follow these steps to ensure safety while working in the chemical hood:

- Make sure your fume hood has been certified within the last year. If not, contact your maintenance provider so that they can arrange for certification (often through a contractor).

- Check to ensure the baffle openings are not blocked and verify that air is flowing properly. For hoods that do not have an airflow monitor, tape a 1" strip of ChemWipe to the lower edge of the sash. (The strip should pull into the hood if air is flowing)

- Conduct work at least six inches from the outer edge of the hood.

- Keep vertical sashes in the lowest practical position while working. For hoods with horizontal sash panels, one panel of the horizontal sash should be positioned between the user's body and the work in the hood. (The user should reach around the sides of this panel to work)

- Check the air flow monitor before each use. It should show that the hood is under negative pressure. (An alarm should sound if flow is too low)

- Keep the fume hood clear of clutter – only those materials necessary to the procedure at hand- should be placed in the hood so as to not interfere the hood's air flow pattern and compromise employee safety.

- Elevate large equipment that must be in the hood at least two inches off the base of the hood interior. This will help air flow as intended inside the hood.

- Route service connections (vacuum, electrical cords, etc.) under the airfoil so that they don't interfere with the operation of the sash.

- Perform work tasks at least 6-8 inches behind the hood opening.

- Close the hood sash when not in use.

- If the fume hood is not functioning properly, stop working in the hood, then close the sash and label the hood to indicate that it is not working.

- If the lights or plumbing (water, sink drain, air, vacuum, or gas) in the hood are not working, remove hazardous materials from the hood & store in a safe place, then call your maintenance depending on the nature of the repair.

  *A special note for working with perchloric acid – Using perchloric acid in a standard fume hood can lead to accumulation of explosive perchlorate salts in the ductwork.

Biological Safety Cabinet (BSC): BSCs provide filtered air inside the cabinet, and filter the air that leaves the cabinet. Though some biological safety cabinets are exhausted, their exhaust ducts may be under positive pressure. These cabinets are primarily intended to protect employees from biological hazards and should not be used for chemical hazards.

BSCs are the most commonly used primary containment devices in microbiological laboratories. There are three classes of BSCs (Class I, II, and III). When combined with appropriate microbiological techniques, each Class provides different levels of protection.

Class I BSC - provide both personnel and environmental protection, however, they do not provide product protection such as that needed for sterile tissue culture work. Class I BSCs are suitable for work with low to moderate risk agents.

Class II BSC - these are the most commonly used BSCs. Class II BSCs provide environmental, personnel and product protection. The main difference between Class I and II cabinets is the HEPA filtration of the air flow down across the work surface of a Class II cabinet.

Things to Remember When Using a Class II BSC:

- Keep front and rear perforated grills free of clutter.
- Cluttered grills can cause a disruption of air flow which can compromise personnel, environmental and product protection.
- Avoid sudden movements in and out of the cabinet.
- Avoid installing BSCs near windows or frequently used doorways.
- Volatile chemicals and volatile radionuclides should not be used in BSC.
- Don't store items on top of the cabinet. The HEPA filter could be damaged and the balance of air flow could be disrupted. Wipe down the cabinet interior with a surface disinfectant before and after all manipulations.

Class III BSC - Gas tight BSCs provide the highest level of environmental, personnel and product protection. A Class III BSC, (also referred to as a glove box), provides a complete physical barrier between the product and personnel. These cabinets are used for high risk biological agents when absolute containment is required.

A high efficiency particulate air (HEPA) filter is the main functional unit of a BSC. The HEPA filter is a device which removes particulates and microorganisms from the air. These filters remove 99.97% of all particulates 0.3 microns in diameter and have a greater efficiency for particles < or > 0.3 microns. HEPA filters are made of boron silicate fiber sheets which are pleated to increase surface area. In order to direct the airflow in the filter, aluminum baffles separate each pleat.
Good microbiological techniques must be used when working in a biological safety cabinet (BSC). In addition, please follow these rules:

1) Certify BSC annually by an outside company.
2) Decontaminate BSC frequently and after work is complete.
3) Prohibit gas lines, open flames, and toxic chemicals in a re-circulating BSC.

Biohazards

Biological research can involve innocuous or hazardous microorganisms. Some typical biohazards include human, plant and animal pathogens, bloodborne pathogens, and Hanta Virus or other biological hazards associated with fieldwork. Work with biological materials can be *in vitro* or *in vivo* (such as using animal models). There are four hazard categories, with biosafety level (BSL) 1 being the least hazardous and BSL 4 representing serious biological hazards. A sign incorporating the universal biohazard symbol must be posted at the entrance to the laboratory when infectious agents are present.

Biosafety Level 1 (BSL-1): BSL-1 is suitable for work involving well-characterized agents not known to consistently cause disease in immunocompetent adult humans, and present minimal potential hazard to laboratory personnel and the environment. All bacterial, parasitic, fungal, viral, rickettsial, and chlamydial agents which have been assessed for risk but do not belong to a higher risk group can be safely handled at BSL-1. Be aware that many agents not ordinarily associated with disease are opportunistic pathogens and may cause infection in the young, the aged and immunocompromised individuals. Examples of agents handled at BSL-1 include: Bacillus subtilis, Eschericia coli -K12, Naegleria gruberi, Baculovirus, etc.

A sign designating a BSL-1 laboratory may include the name of the agent(s) in use, and the name and phone number of the laboratory supervisor or other responsible personnel.

Biosafety Level 2 (BSL-2): BSL-2 builds upon BSL-1. BSL-2 is suitable for work involving agents that pose moderate hazards to personnel and the environment. It differs from BSL-1 in that: 1) laboratory personnel have specific training in handling pathogenic agents and are supervised by scientists competent in handling infectious agents and associated procedures; 2) access to the laboratory is restricted when work is being conducted; and 3) all procedures in which infectious aerosols or splashes may be created are conducted in BSCs or other physical containment equipment.

A sign indicating a BSL-2 laboratory must include the name of the agent(s), laboratory's biosafety level, supervisor's name (or other responsible personnel), telephone number, and required procedures for entering and exiting the laboratory.

Biosafety Level 3 (BSL-3): BSL-3 is applicable to clinical, diagnostic, teaching, research, or production facilities where work is performed with indigenous or exotic agents that may cause serious or potentially lethal disease through the inhalation route of exposure. A BSL-3 laboratory has special engineering and design features.

Currently, research requiring BSL-3 precautions and safety measures to be conducted is not approved at Roseman University of Health Sciences.

Biosafety Level 4 (BSL-4): BSL-4 is the highest level of biosafety precautions, and is appropriate for work with agents that could easily be aerosol-transmitted within the laboratory and cause severe to fatal disease in humans for which there are no available vaccines or treatments.

Currently, research requiring BSL-4 precautions and safety measures to be conducted is not approved at Roseman University of Health Sciences.

Routes of Exposure: There are four main routes of exposure that one must try to avoid when working with biohazardous agents in the laboratory. These would include percutaneous injuries, inhaling infectious aerosols, exposure to mucous membranes, and ingestion.

Percutaneous – Percutaneous injuries can result from needle sticks, cuts or abrasions from contaminated items. These exposures are particularly serious because of the potential for immediate entry of the agent into a normally sterile bloodstream.

Inhalation – Many laboratory procedures can cause the aerosolization of infectious agents. Some of these procedures include the use of vortexes, blenders and sonicators. Appropriate work practices must be implemented such as the wearing of respirators to minimize the inhalation of aerosolized agents, especially those which are known to be transmitted by the aerosol route (e.g., Adenovirus, Vaccinia virus, *Mycobacterium tuberculosis*, etc.).

Mucous membrane – Exposure of mucous membranes to infectious agents can lead to occupationally-acquired infections. Mucocutaneous exposures can result from splashes to the eyes, nose or mouth, or by inadvertent inoculation via contaminated hands. Face protection should always be used if there is a likelihood of splash or splatter.

Ingestion – Accidental ingestion of biohazardous materials can result from improper personal hygiene in the laboratory. Food and drink are prohibited in all areas of the laboratory in which work is conducted with potentially infectious materials. Hands must always be washed before leaving the laboratory, and immediately if visible contamination occurs.

BSL	**Agents**	**Practices**	**Safety Equipment** (Primary Barriers)	**Facilities** (Secondary Barriers)
BSL-1	Not known to consistently cause diseases in immune-competent adult humans	Standard microbiological practices	None required	Open bench top, sink required
BSL-2	Associated with human disease. Hazard: percutaneous injury, mucous membrane exposure, ingestion	BSL-1 practices plus: • limited access • biohazard warning signs • sharps precautions • biosafety manual defining waste decontamination or medical surveillance policies	Primary barriers: Class I or II biosafety cabinets or other physical containment devices used for all manipulations of agents that cause splashes or aerosols of infectious materials; PPE: laboratory coats, gloves, face protection as needed	BSL-1plus: • non-fabric chairs and other furniture easily cleanable • autoclave available • eyewash readily available
BSL-3	BSL-3 studies are not approved to be conducted at Roseman University of Health Sciences			
BSL-4	BSL-4 studies are not approved to be conducted at Roseman University of Health Sciences			

Cryogenic liquids

Cryogenic liquids are extremely cold and rapidly expand from the liquid to gas phase upon release from the Dewar. Working with cryogenic liquids may present a variety of hazards, including, but not limited to frost bite and asphyxiation.

Before using these materials laboratory personnel should don proper personal protective equipment and have adequate ventilation. Cryo-gloves must be worn when retrieving materials from cryogenic freezers.

Hazards: The following are common hazards associated with cryogens.

Oxygen Deficiency - Liquefied gases, when used in large quantities, may dilute or displace the life sustaining atmosphere. For example, ten liters of liquid nitrogen, upon vaporization, will create a life-threatening environment in a 10 ft by 20 ft by 10 ft room.

Air Freezing (potentially leading to over-pressurization) - Liquid helium and hydrogen are cold enough to solidify atmospheric air. Leaks in the storage systems for these gases may become plugged with solidified air. Particularly affected are pressure relief devices which, if plugged, may cause container over-pressurization and failure.

Oxygen Enrichment - Certain liquefied gases, such as helium, hydrogen, and nitrogen, have the ability to condense oxygen out of the air. As the system is replenished to make up evaporation losses, liquid oxygen will build up as a contaminant. If the system or process is not compatible with liquid oxygen, violent reactions may occur.

Tissue Damage- Severe burns or frostbite can occur upon contact with cryogenic materials.

Storage and Handling: Cryogenic fluids should be handled only by persons with adequate understanding of the material, the system in which they are used, and the equipment necessary for safe handling. The following general guidelines shall be adhered to:

- Each part of the cryogenic system must have its own pressure relief system.
- Adequate ventilation must be available in rooms where cryogens are used.
- Only Dewars which were designed for the particular cryogen are to be used. Storage containers must be inspected daily to ensure no air or ice plugs exist in the neck openings.
- Hollow rods or tubes must never be used as dipsticks. When a warm tube is inserted into a cryogen, liquid will spout from the top of the tube.

- Liquid levels should be checked regularly. If higher than normal evaporation rates are observed, the Dewar may be losing its vacuum.
- If cryogenic liquids must be transported by elevator, the transport container shall be equipped with a tight fitting cap to prevent leakage. Only containers certified by the manufacturer to have a leakage rate of less than or equal to 1 liter of liquid or 1 kilogram of solid per day shall be used for elevator transport.
- Cryogenic liquids or dry ice storage in walk-in cold rooms is prohibited.
- Use and store liquid hydrogen, helium, and nitrogen away from flammable materials and ignition sources, as these gases can condense oxygen out of the air.
- For liquid helium and hydrogen storage systems, check the pressure relief and inspect the system for leaks regularly. These gases are cold enough to solidify atmospheric air; leaks in storage systems for these gases may become plugged with solidified air. If the pressure relief device becomes plugged, the container may over-pressurize and fail.
- Open flames and smoking shall not be permitted in areas where liquid oxygen is stored or used. “Liquid Oxygen in Use: No Open Flames” signs shall be posted in these indoor areas. "No Smoking" and "No Open Flames" signs shall be conspicuously posted in these outdoor areas.

Labeling: Storage Dewars, process vessels, piping, etc. shall be labeled with the name of the contents. Labels must be protected so they will remain intact and legible. A label must be replaced whenever any portion becomes damaged or illegible.

Compressed Gas

Hazards: Gas cylinders have several hazards associated with them: impact from falling, dropping, rolling, or pinching; exposure to hazardous cylinder contents; fire resulting from escape of flammable gas/fluids; and unintentional release of energy from over-pressurization or beheading a valve.

Labeling: All compressed gas cylinders shall be legibly marked by stenciling or stamping with at least the chemical name or commonly accepted name of the material contained.

Storage and Handling: Compressed Gas cylinders should be inspected when delivered and prior to use. Cylinders that appear corroded, are not clearly labeled as to contents, or that cannot be

opened with normal force should be returned. Proper storage of compressed gas cylinders includes the following guidelines:

- Select the correct regulator for the gas.
- Cylinders (full or empty) shall be appropriately secured by chains, straps, or other sturdy tie downs to prevent falling and rolling during use, storage and transport. They shall be stored and used in an upright position. They shall be transported using a hand truck specifically designed for this purpose.
- Cylinders designed for protective caps must have the caps in place at all times unless the cylinders are in use.
- Cylinders shall be grouped by type of gas and the groups segregated as to compatibility.
- Full cylinders shall be separated from empty cylinders within the storage area.
- Flammable gases shall be separated from nonflammable gases.
- Cylinders shall not be stored at temperatures above 125 °F, in direct sunlight, or outside of the temperature range specified by the manufacturer.
- Cylinders shall be protected against tampering and damage.
- Cylinders shall not be stored near combustible materials.
- Cylinder valves shall be kept closed when not in use.
- Open flames and smoking shall not be permitted in areas where oxygen is used or stored. “Oxygen in Use: No Open Flames” signs shall be posted in these indoor areas. "No Smoking" and "No Open Flames" signs shall be conspicuously posted in these outdoor areas.
- Toxic or highly toxic gases shall be stored in areas containing adequate exhaust ventilation.
- Cylinders, except for those containing compressed air, shall not be used or stored in cold rooms or other unventilated enclosures.

Lasers

Lasers are categorized by a class system according to type and safety.

Class 1 (1 & 1M), Class 2 (2 & 2M) and some Class 3 (3R) lasers are considered safe under most, if not all conditions and are note regulated. For example, Class 1 lasers are safe under all conditions of normal use. This means the maximum permissible exposure (MPE) cannot be exceeded when viewing a laser with the naked eye or with the aid of typical magnifying optics (e.g. telescope or microscope). Certain lasers classified as Class 1 may still pose a hazard when viewed with a telescope or microscope of sufficiently large aperture. Class 1M lasers are safe for all conditions of use except when passed through magnifying optics such as microscopes and telescopes. The MPE for a Class 1M laser cannot normally be exceeded unless focusing or imaging optics are used to narrow the beam.

Class 2 lasers are considered to be safe because the blink reflex (glare aversion response to bright lights) will limit the exposure to no more than 0.25 seconds. Some laser pointers and measuring instruments are class 2. Class 2M lasers are safe because of the blink reflex if not viewed through optical instruments. As with class 1M, this applies to laser beams with a large diameter or large divergence, for which the amount of light passing through the pupil cannot exceed the limits for class 2. Class 3R lasers are also considered safe if handled carefully, with restricted beam viewing. With a class 3R laser, the MPE can be exceeded, but with a low risk of injury.

Class 3B lasers are hazardous if the eye is exposed directly, but diffuse reflections such as those from paper or other matte surfaces are not harmful. Protective eyewear is required where direct viewing of a class 3B laser beam may occur. Class-3B lasers must be equipped with a key switch and a safety interlock.

Class 4 lasers include all systems with power levels greater than 500 mW CW or greater than 0.03 J for a pulsed system. Class 4 laser systems pose eye hazards, skin hazards, and fire hazards. Viewing the beam or specular reflections or exposure to diffuse reflections can cause eye and skin injuries.

Controls for Class 3B and 4 lasers may be operated only in designated laser control areas, including operative suites, patient treatment rooms and patient examination rooms, or in other laser control areas approved by the LSM. The purpose of laser control areas is to confine laser hazards to well-defined spaces that are under the control of the laser user, thereby preventing injury to those visiting and working near the control area. All personnel authorized to enter a Class 3B or Class 4 laser controlled area shall be appropriately trained, and must follow all applicable administrative and operational controls

Eye Protection: Laser protective eyewear of adequate optical density and threshold limit for the beams under manipulation must be provided and worn at any point where laser exposure could exceed the MPE. This includes provision and use of M-rated eyewear in labs using unenclosed Class 3B or 4 laser systems capable of <1 ns pulses, and R-rated eyewear in labs using unenclosed Class 3B or 4 Q-switched laser systems

In addition, procedures and practices must ensure that optical systems and power levels are not adjusted upstream during critical open beam operations, such as beam alignment. The need for laser eye protection must be balanced by the need for adequate visible light transmission. It is the responsibility of the PI to obtain appropriate laser protective eyewear. Laser eye protection should be inspected periodically to ensure that it is in good condition. Damaged or faded eyewear must be removed from service.

Laser activation warning systems and entryway controls are used to prevent inadvertent entry into a laser control area or inadvertent exposure to the active laser beam. These measures may include:

1. A visible sign or audible warning sign/signal must be at the entrance to the control area to indicate when the laser is energized and operating.

2. A provision for personnel indicating appropriate training and PPE (laser protective eyewear).

3. Doors or blocking curtains/barriers that attenuate the laser beam to below the MPE at the entranceway.

4. Entryway controls (e.g. interlocks, shutters, illuminated “Laser On” warning signs, barrier curtains) shall be checked periodically to verify proper operation

5. If entryway controls must be disabled for any reason, administrative and procedural controls providing the same level of protection must be instituted prior to the operation of the laser or laser system. Any such changes to entryway controls must be communicated to all personnel working in the laser area. All personnel in the laser area must also be notified upon restoration of the entryway controls. Locking entryway doors as a means of access control is not acceptable, because it is contrary to the principle of permitting rapid egress or emergency access.

6. For those laser systems equipped with a key switch to prevent unauthorized use, the key must not be left in the switch when the laser system is unattended.

Laboratory Waste

Sharps: The use of needles, glass pipettes, glass slides and cover slips, scalpels and lancets should be eliminated, when possible. Appropriate precautions should be taken to avoid percutaneous injuries. These items should be disposed of immediately after use by placing them in an appropriate puncture-resistant container. Bending, recapping or clipping of needles is prohibited. If recapping is absolutely necessary, a mechanical device or the one handed scoop method must be used. Plasticware should be used whenever possible, such as plastic graduated cylinders, funnels, aspirators, etc. Safety devices should be used when available (e.g. mylar-coated capillary tubes, Eclipse safety needles, etc.) – See Sharps section for additional details.

Decontamination: The purpose of decontamination is to make a hazardous material safe for further handling. A decontamination procedure can range from sterilization to simple cleaning with soap and water. The following includes a description of the four main categories of physical and chemical means of decontamination.

Heat – Wet heat is the most dependable method of sterilization. Steam autoclaving is the most convenient method available to laboratories for decontaminating biological waste and sterilizing glassware and media. Note: Autoclaves that are used for decontamination of biohazardous wastes should be monitored for the efficacy of treatment. This is accomplished by the use of biological indicators.

Liquid Disinfection – Many types of liquid disinfectants are available under a variety of trade names. The most practical use of liquid disinfectants is for surface decontamination. Agents included in this category include, but are not limited to, quaternary ammonium compounds, phenolic compounds, halogens, aldehydes, alcohols and amines. A tuberculocidal disinfectant or diluted household bleach should always be used for decontamination when human materials are handled.

NOTE: When household bleach is used for the decontamination of spills, a fresh solution (at least 10% household bleach) must be prepared. Bleach solutions used for routine surface decontamination must be made up at least weekly. Each solution container must be labeled with either a made-on or an expiration date.

Vapors and Gases – The use of vapors and gases as decontamination methods usually involve the decontamination of biological safety cabinets, but can also be used for whole building or room decontaminations. Agents used in this category include ethylene oxide, formaldehyde, hydrogen peroxide and peracetic acid.

Radiation – Ultraviolet radiation (UV) is sometimes used in biological safety cabinets for inactivating contaminants, but because of the low penetrating power of UV, dusty or soiled areas may limit its usefulness in the laboratory. Because UV can cause serious burns to eyes and skin, it must not be used when work areas are occupied. Whole room UV is not recommended. Do not rely on just radiation for your disinfection process.

Decontaminants and Their Use in Laboratories

Decontaminant	Active Ingredient / Concentration	Temp (°C)	Contact time (min.)	Vegetative bacteria	Lipo viruses	Tubercle bacilli	Hydrophilic viruses	Bacterial spores
Autoclave	Steam	121	50–90	+	+	+	+	+
Incinerator	Heat	649-929	1 Minute - 1 Hour	+	+	+	+	+
Phenolic compounds	0.2-3%		10 to 30 Mintues	+	+	+	+/-	-
Chlorine compounds	0.01-5%		10 to 30 Mintues	+	+	+	+	+/-
Alcohol (ethyl or isopropyl)	70-85%		10 to 30 Mintues	+	+	+	+	+
*Formaldehyde	4-8%		10 to 30 Mintues	+	+	+	+	+
*Gluteraldeyhyde	2%		10 to 600 Mintues	+	+	+	+	+/-
Hydrogen peroxide	6%		10 to 600 Mintues	+	+	+	+	+/-
	+ very positive response							
	+/- less positive response							
	— negative response							
	*irritating characteristics of agent precludes use for routine spill cleanup							

Flammable Liquids

Hazards: Fire is the main hazard associated with flammable liquids; however, individual chemicals may have associated health hazards.

Storage: Suitable fire control devices, such as portable fire extinguishers, shall be available at locations where flammable liquids are stored. Open flames and smoking shall not be permitted in flammable liquid storage areas. "No Smoking" and "No Open Flames" signs shall be conspicuously posted in these areas. Flammable liquids shall not be stored in a manner that hinders the safe egress of people. Materials which react with water shall not be stored in the same room with flammable liquids. Oxidizers, if in the same room as flammables, shall be stored separately.

Storage in cabinets – The total stored volume of flammable liquids in approved storage cabinets shall not exceed sixty gallons per five thousand square feet. All storage cabinets for flammable liquids shall meet NFPA 30 requirements. Not more than 60 gallons of flammable and combustible liquids may be stored in any single storage cabinet.

Storage outside of cabinets – The total stored volume of flammable liquids outside of approved storage cabinets shall not exceed ten gallons (not in safety cans) plus 25 gallons (in safety cans) per five thousand square feet. Additional quantities of flammable liquids must be stored in a storage cabinet or storage room. In all other areas, the total capacity of flammable liquids outside of approved storage cabinets shall not exceed five gallons per one hundred square feet.

Refrigerator Storage - Class I flammable liquids shall not be stored in flammables unapproved or residential-type refrigerators. Storage of flammable liquids in well-sealed containers is permissible in listed flammable storage refrigerators labeled to indicate that they are approved for storing flammable liquids.

Handling: Use prudent practices to minimize the fire risk and exposures to flammable liquids:

- All sources of ignition (e.g., Bunsen burners, hot plates, open flames, electrical equipment that is not intrinsically safe, etc.) should be eliminated from areas in which flammable materials are used.
- Ensure proper grounding and avoid creating static electricity. Be sure to ground metal containers when transferring flammable liquids.
- Use a chemical fume hood or other local exhaust, where available, to capture vapors when appreciable quantities of flammable substances are being used.
- Keep containers of flammable chemicals closed at all times when not in use.
- Avoid wearing flammable clothing (such as many synthetics).

It should be noted that concentrated aqueous solutions of inorganic acids are not flammable. However, combustion can occur when an acid is mixed with other chemicals or with combustible materials. Acids react with many metals, resulting in a release of flammable hydrogen gas. Some acids, like nitric and percholoric acids, are strong oxidizing agents and can react violently with organic or other oxidizable materials.

Chemical labeling and storage

For all hazardous chemicals, labeling should be done in accordance with OSHA's Hazard Communication standard. Hazardous chemicals must be stored, labeled and inventoried properly to avoid confusion or mistaken identity of a chemical, to provide separation of incompatible materials, and to provide information for emergency response personnel.

Labeling and storage should adhere to the following guidelines:

All Hazardous Chemicals – Hazardous chemicals must be stored and labeled properly. A chemical inventory must be maintained for all chemicals stored in the laboratory. A chemical inventory should be maintained and updated at a minimum of every 12 months. Additional benefits for maintaining an up-to-date inventory include:

- Ability to identify unneeded materials that can be culled from laboratory storage, reducing overall chemical laboratory risks.
- Improved reliance on the inventory to locate needed materials, possibly avoiding unnecessary redundant purchases.
- Reduce compliance risks pertaining to hazardous materials storage and reporting requirements.
- Aid in identification of the relative hazards of the chemicals in the inventory.

Select Agent Toxins – In addition to the requirements detailed above, one additional layer of physical security must be provided for select agent toxins in permissible amounts (e.g., select agent toxin secured within locked freezer, or secured within a permanently fixed lock box). PI and/or Lab Supervisors working with select agent toxins must ensure that recommended permissible amounts are not exceeded.

Controlled Substances – In addition to the requirements detailed above, Controlled Substances must be stored in a securely locked, substantially constructed cabinet, located where access is limited to those individuals with controlled substances authorization. Chemical inventory of controlled substances should adhere and comply with guidelines set forth by the Drug Enforcement Agency (DEA).

Corrosives

A corrosive substance causes irreversible destruction of living tissue by chemical action at the site of contact. Major classes of corrosive substances include strong acids and strong bases. Corrosive substances may be classified as causing *skin corrosion*, *serious eye damage*, or both.

Hazards: Corrosive materials destroy body tissues. The seriousness of the injury depends on such factors as the type and concentration of the chemical, the body parts directly contacted, and the rapidity of first aid measures. In general, potential areas of exposure are:

Skin contact – Most concentrated acids and bases are corrosive and must be immediately flushed with water. Acids, especially when in concentrated form, are likely to cause immediate pain when they contact the skin; however, strong bases may not cause immediate pain. This may result in a longer contact time and a more serious injury if not flushed immediately.

Eye contact – The eyes are especially susceptible to corrosive liquids, vapors, dusts, or mists and may sustain irreversible damage. Appropriate PPE minimizes the risk for hazardous chemical exposure to the eyes.

Inhalation – Corrosive vapors, mists, and dusts act on the body in two ways: irritation of the air passages of the nose, throat, and lungs; and absorption of the substance from the lungs into the bloodstream. The severity of the injury will depend on the concentration in air and the duration of the exposure.

Ingestion – Ingestion causes severe burns to the mucous membranes of the mouth, throat, esophagus, and stomach.

Storage and Handling: The corrosive nature of these materials and their ability to produce fires or explosions make the following considerations mandatory in the selection of a storage site:

- A relatively cool, dry environment free from extremes of temperature should be maintained.

- Acids and bases should be stored in a manner that separates them from other materials and from each other. Secondary containment is useful to ensure that if a leak or spill occurs, the material will stay segregated. Each acid or base should be stored in a manner consistent with its properties.

- Small containers (4 L or less) should be placed on material that is acid resistant. Do not store directly on metal shelves unless they have a corrosion-proof coating.

- Carboys should be stored in the same manner as small containers; preferably covered, not stacked, and on acid resistant material.

- Do not store corrosives under sinks, as this can lead to corrosion of supply and drain pipes.

When handling:

- Never pour water into acid. Slowly add acid to the water while stirring.

- Never empty carboys or drums of chemicals by means of air pressure. Use a tilting rack, a safety siphon, or a liquid pump.

- Never siphon or pipette by mouth.

- Open bottles or carboys slowly and carefully.

- Flush the outside of the container with water after use to clean off any droplets of material.

- When containers are completely empty, flush thoroughly with water before throwing them away.

- Install an eyewash station in all areas where acids and bases are used. A safety shower is necessary where large quantities of corrosive chemicals are used.

- Never mix acid wastes with other materials such as solvents, metal-containing solutions, etc. Explosive mixtures may be formed as a result.

- Work in areas with adequate ventilation to prevent accumulation of vapors and mists.

Procurement Controls: Procurement Controls involve controlling employee exposures by making chemical purchasing decisions that enhance employee safety. For example, labs should order only needed amounts.

- Order an amount that will be used in the foreseeable future; don't order larger quantities for the bulk discount. Having a larger amount on hand increases the risk for a harmful exposure (or, in the case of flammables, a fire), and may lead to additional disposal costs in the future.

- Order a less hazardous form of the same chemical – Use the logic below to help choose the least hazardous physical form that will work for your application.

- Dilute solutions are generally safer than more concentrated solutions.

- Aqueous solutions are generally safer to handle than powders requiring reconstitution.

- Pellets, tablets, granules, or flakes are generally safer to handle than powders.

- When ordering corrosives or highly flammable chemicals, choose containers that are less likely to break, such as metal, plastic, or PVC-coated glass. These options will reduce the risk of exposure or fire if the container is dropped

- When ordering hazardous powders, consider purchasing in a pre-weighed vial with a rubber septum. This eliminates the need to handle the powder, as the diluent can be injected directly into the container.

- Maintain a chemical inventory so that lab members can check the availability of a chemical in the lab before ordering more.

Sharps

Hazards: Sharps can be defined as any item with the potential to puncture, tear, or lacerate human tissue and should be handled according to the guidelines outlined below.

Storage and Handling: Needles, syringes with attached needles, capillary tubes, slides and cover slips, scalpel blades, razor blades, and broken glassware that are contaminated with biological material should be placed in a plastic puncture-resistant container (sharps disposal container or needlebox).

- NEVER dispose of sharps in regular trash containers as this poses a potential health and safety hazard to personnel during trash handling and pickup. All sharps must be disposed of in a labeled, hard-sided, puncture-resistant container with a lid.

- Ensure sharps disposal containers are available in close proximity to where sharps waste is generated.

- Do not overfill sharps containers or broken glass boxes; they must be tightly closed prior to disposal.

- DO NOT clip, bend, shear, or separate needles from syringes, DO NOT recap needles for disposal. These are the times you are most likely to be injured.

Follow the additional requirements below for sharps used with the following materials:

- The use of needles, glass pipettes, glass slides and cover slips, scalpels and lancets should be eliminated, when possible.

- Appropriate precautions should be taken to avoid percutaneous injuries. These items should be disposed of immediately after use by placing them in an appropriate puncture-resistant container.

- Bending, recapping or clipping of needles is prohibited. If recapping is absolutely necessary, a mechanical device or the one handed scoop method must be used.

- Plasticware should be used whenever possible, such as plastic graduated cylinders, funnels, aspirators, etc.

- Safety devices should be used when available (e.g. mylar-coated capillary tubes, Eclipse safety needles).

Additional considerations for safe handling and disposal of sharps are:

- Handle and store laboratory glassware with care to avoid damage; do not use damaged glassware. Dispose of broken glassware using broken glass disposal boxes as outlined above.

- Choose safe cutting devices – use of straight razors should be avoided in favor of safety scalpels or other alternatives. Straight razors should not be used when a safer cutting device (e.g., scissors, box cutter) is more appropriate. Uncontaminated razor blades and needles must be disposed of in puncture-resistant hard-sided sharps disposal boxes.

- If red sharps boxes are used, mark out any biohazard warnings and write “not a biohazard”.

- Cut-or puncture-resistant gloves should be worn when working with sharps. If these gloves reduce dexterity, consider wearing a cut-or puncture-resistant glove only on the non-dominant hand. When working with chemicals or infectious materials and sharps, wear the cut- or puncture-resistant glove under the disposable glove. If the outer glove is damaged, remove both pairs of gloves and wash hands thoroughly before continuing.

Emergency Procedures

Biological Hazards – The following emergency procedures should be followed to ensure proper spill clean-up of blood, body fluids and cultures of biological hazards at Biosafety Level 1 or 2:

1. Alert people in immediate area of spill.
2. At a minimum, wear disposable gloves and face protection.
3. Cover spill with paper towel or other absorbent material.
4. Carefully pour a freshly prepared 1:10 dilution of household bleach (or other effective disinfectant) around the edges of the spill and then into the spill. Avoid splashing.
5. Allow a 20 minute contact period for bleach (or as indicated as effective time for different disinfectant). If broken glass is present, use forceps to remove and place glass in sharps collection container.
6. Use paper towels to wipe up the spill, working from the outer edges into the center.
7. Clean spill area again as indicated in steps 4 and 5.
8. Depending on the size and concentration of the spill, a third disinfection (steps 4 and 5) may be warranted.
9. Discard disinfected disposal materials. Items that do not contain large amounts of bleach may autoclaved according to the Medical Waste Management Policy before disposal.

Hazardous substances – Additional provisions should be considered for working with hazardous substances including carcinogens, reproductive toxins, and substances that have a high degree of acute toxicity.

- Safety Data Sheets (SDS) should be reviewed prior to working with these materials in the lab.
- Hazardous materials should be used in designated and clearly identifiable areas in the lab.
- Do not work with these materials without someone else available to provide assistance in case of an emergency.

The following procedures should be followed in the event of an emergency when using hazardous substances.

- Relevant Safety Data Sheets (SDS) should be reviewed prior to working with hazardous materials in the laboratory in order to become familiar with potential hazards and emergency scenarios.

- If any person experiences symptoms described on the SDS, call 911. Provide the emergency dispatcher with detailed information on type of Emergency (fire, medical event, chemical exposure or spill) and the name of the chemical involved. Have the SDS available for the Emergency Responders.

- To avoid contamination, wear appropriate PPE, including but not limited to lab coat, nitrile or neoprene gloves and eye protection, while assisting any person exposed to the hazardous substance.

- As indicated, follow the specific instructions below for Inhalation, Ingestion or Splash to Mucus Membranes, Eye Splash, or Skin Contact. Do not attempt providing specific medical treatments based on the chemical involved. The goal of onsite assistance is to get the victim immediate care using emergency medical services. Do not transport the victim to the hospital yourself.

Inhalation
- Encourage the victim to remain calm.
- Remove the victim from the contaminated area to fresh air.
- If the victim is not breathing, and you have been trained, perform CPR.
- Remove contaminated clothes from the victim and contain the clothes in a plastic bag for decontamination or disposal. Rather than pull clothing over the victim's head, cut the clothing off their body.

Ingestion or Splash to Mucus Membranes
- Encourage the victim to remain calm.
- Do not give the victim anything by mouth.
- Follow the instructions for inhalation exposure as described above.

Eye Splash
- Remove glasses and any contaminated clothing on victim and contain the clothes in a plastic bag for decontamination or disposal. Glasses can be decontaminated and returned.
- Flush eyes in eyewash for 15 minutes or until medical assistance arrives.
- If necessary, assist the victim by holding their eyes open.

Skin Contact

- Remember, skin absorption can occur from liquids, solids or chemical vapor
- Immediately place the victim under a safety shower while removing any contaminated clothing, including shoes. Collect the clothing in a plastic bag for decontamination or disposal.
- Flush the skin for at least 15 minutes or until medical assistance arrives.

Chemical spills or release of vapor – The following procedures should be followed to ensure proper spill clean-up of chemicals, as indicated below, or the release of vapors in the laboratory area:

- Clean-up of small spills (less than 1 liter) can be performed by lab workers if the material is in a fume hood, the proper spill cleanup equipment is on hand, and they have been trained in the use of the equipment. If not, call 911 for assistance.

- For clean-up of large spills (more than 1 liter), any spills outside fume hood or release of vapors to room, call 911 and follow the procedures indicated below.

- Secure the area by evacuating the laboratory room and post "Do Not Enter" posting.

- Provide emergency dispatcher with the location and size of the spill and the material(s) involved.

- Provide the emergency responders with the SDS.

Personal Injury

In the event of an accident at a university research laboratory in which an injury is sustained, the outlined procedures should be followed.

1. Seek appropriate medical treatment

In the event of a life- or limb-threatening emergency, immediately call 911 Emergency Services and then campus security.

Emergency phone numbers:

- Emergency Services: Call 9-1-1 from any campus phone

- Campus Security:

  Henderson Campus
  11 Sunset Way: 702-208-8841
  4 Sunset Way: 702-208-8062

  South Jordan Campus
  Building 10 Guard: 801-664-2626
  Building 11 Guard: 801-664-1208
  Rover Guard: 801-664-2242

  Summerlin Campus
  Flagship Officer Desk: 702-802-2899
  COM Bldg. Officer Desk: 702-802-2840
  COM Bldg. Supervisor Desk: 702-802-2841

  Swing & Graveyard Phone (site phone remains on campus with security 24/7): 702-305-6396

- Poison Control: (800) 222-1222

For non life- or limb-threatening health emergencies:

During regular hours of operation:

- The accident victim should be directed to immediately visit a qualified local health care provider.

- If the accident victim needs to be escorted and an escort is unavailable, call campus security. Laboratory support staff in research laboratories should not leave the laboratory to act as escorts.

- Detailed information about the incident should be provided to the medical provider(s), including information about laboratory materials, apparatus, and machines involved. If appropriate, obtain and submit Safety Data Sheets (SDS) to the medical provider as soon as possible.

After regular hours of operation:

- The nearest local hospital emergency room should be contacted. Emergency room staff will provide advice over the telephone to determine whether the accident victim needs to come to the emergency room or can wait to see a health care provider the following day.

2. Notify your supervisor

- Employees or students should notify their direct supervisor or supervising research mentor immediately if a laboratory-related injury, exposure, or illness is experienced.

3. Report the incident

- All laboratory-related injuries, no matter how slight, must be reported immediately.

- After being notified of a laboratory-related injury to an employee or student, the supervisor or supervising research mentor should immediately report the incident to the appropriate unit, campus, and university administrators listed below. The *Accident/Injury Report* (see below) should be used to document and report the relevant events.

  - Facilities Management Office at (702) 968-2037

  - Dean of the college in which the laboratory resides

  - Campus Safety Officer

Henderson	**Summerlin**	**South Jordan**
Surajit Dey, Ph.D. Associate Professor, Pharmaceutical Sciences College of Pharmacy 11 Sunset Way, Henderson, NV 89014 Phone: 702-968-2056 sdey@roseman.edu	**Robert Kirsh, B.S.** Manager, Comparative Medicine Unit College of Medicine 10530 Discovery Drive, Las Vegas, NV 89135 Phone: 702-802-2824 rkirsh@roseman.edu	**Tyler Rose, Ph.D.** Associate Professor, Pharmaceutical Sciences College of Pharmacy 10920 South River Front Parkway, South Jordan, UT 84095 Phone: 801-878-1092 trose@roseman.edu

4. File a worker's compensation claim

- If the accident victim is a university employee, a worker's compensation claim should be filed through the Human Resources office.

ROSEMAN UNIVERSITY
OF HEALTH SCIENCES

ACCIDENT/INJURY REPORT

Please Print

Section A: Details of incident

☐ Injury ☐ Work related illness ☐ Non work-related illness ☐ Electrical incident

☐ Environmental incident ☐ Property damage ☐ Dangerous event ☐ Laboratory incident

Name of person completing report: _____

Department: _____ Phone: _____

Date incident occurred: _____ Time incident occurred: _____ am / pm

Name of injured person: _____

Incident occurred while:

☐ At work ☐ Traveling to/from work ☐ On meal break ☐ Other

Date reported: _____ Reported to: _____

Location of Incident: *(external area / building & room etc)*

_____

_____

_____

What happened? *(What were you doing at the time of the incident? Briefly describe how it happened.)*

_____

_____

_____

_____

_____

List any witnesses: *(names, telephone)*

_____

_____

_____

Section B: Details of injured person and injury

Student/Staff ID:_____ M F Date of birth:_____

Telephone:_____ Position title:_____ Department:_____

Employment status:

☐ Faculty ☐ Staff ☐ Graduate student
☐ Undergraduate student ☐ Visitor/member of public ☐ Volunteer
☐ Other: _____

Employment basis: ☐ Full-time ☐ Part-time
Name of injured person's supervisor: _____

Details of treatment required: ☐ None ☐ Self ☐ First aid **
☐ Hospital ☐ Seen by other Medical Doctor

**Describe first aid treatment given:

_____

_____

Nature of injury:

☐ Allergy or sensitivity	☐ Fracture/dislocation	☐ Occupational overuse injury
☐ Respiratory	☐ Burn / scalds	☐ Exposure effects heat/cold
☐ Asphyxiation	☐ Contusion/crush	☐ Communicable disease
☐ Internal injuries	☐ Puncture	☐ Concussion or other neuro injury
☐ Fainting	☐ Bruising	☐ Skin condition eg dermatitis/ eczema
☐ Poisoning/toxic effects	☐ Laceration/deep cut	☐ Hearing loss
☐ Hernia	☐ Sprain/strain	☐ Vision impairment
☐ Foreign body	☐ Nausea/vomiting	☐ Electric shock or effects
☐ Amputation	☐ Multiple injuries	☐ Psychological disorder/stress effects

☐ Other _____

Part of body affected:

☐ Left	☐ Back	☐ Buttock	☐ Forearm	☐ Thigh	☐ Head
☐ Right	☐ Neck	☐ Internal	☐ Wrist	☐ Knee	☐ Face
	☐ Groin /hip	☐ Shoulder	☐ Hand	☐ Shin/calf	☐ Ear
	☐ Chest	☐ Upper arm	☐ Fingers/thumb	☐ Ankle	☐ Eye
	☐ Stomach / trunk	☐ Elbow		☐ Foot/toe	

Further description of injury/illness (if required):

_____

_____

Agency of injury (what?)

- ☐ Vehicle/transport
- ☐ Lifting/ Carrying
- ☐ Repetitive work
- ☐ Needle/sharp
- ☐ Noise
- ☐ Electrical
- ☐ Objects
- ☐ Other (please specify):
- ☐ Radiation
- ☐ Biological agent (eg pathogens)
- ☐ Chemical
- ☐ Explosion/implosion
- ☐ Non-power tool
- ☐ Power tools
- ☐ Surface (slippery/rough)
- ☐ Thermal (heat/cold)
- ☐ Animal/Insect
- ☐ Mobile plant/equipment
- ☐ Machinery/fixed plant
- ☐ Workstation design
- ☐ Situation (violence, assault)
- ☐ Psychological/social

Action/ mechanism which caused injury (*how?*)

- ☐ Fall from height
- ☐ Muscle stress – repetitive
- ☐ Muscle stress- loads
- ☐ Hitting object
- ☐ Noise
- ☐ Slip/trip
- ☐ Other (please specify):
- ☐ Exposure to chemicals
- ☐ Exposure to electricity
- ☐ Exposure to heat/cold
- ☐ Exposure to radiation
- ☐ Insect/animal bite
- ☐ Pressure
- ☐ Exposure to biological material
- ☐ Hit by/trapped in moving object
- ☐ Exposure to vibration
- ☐ Mental stress factors
- ☐ Vehicle accident

Section C: Incident Investigation

This section is to be completed by the local supervisor or department head for any incident involving personal injury, and for a serious incident or near miss where required.

Identify any factors contributing to the incident.

- ☐ Design issues
- ☐ Inadequate supervision
- ☐ Inadequate/ lack of training
- ☐ Failure to follow work procedures
- ☐ Lack of experience
- ☐ Lack of appropriate Personal Protective Equipment
- ☐ Environment (eg floor/ground surface)
- ☐ Inadequate space
- ☐ Unforeseeable event
- ☐ Inadequate safety procedures
- ☐ Improper use/storage of materials
- ☐ Other environmental conditions (eg weather, lighting, ventilation, temperature)
- ☐ Equipment malfunctioning
- ☐ Poor/lack of suitable equipment
- ☐ Personal factors-stress, fatigue
- ☐ Inadequate equipment maintenance
- ☐ Poor housekeeping
- ☐ Other _____

Preventative/Corrective Actions:

Describe the follow up actions planned or taken to prevent a similar incident.

_____

_____

_____

_____

_____ Completion date _____

Supervisor/Department head signature _____