UMDNJ LABORATORY SAFETY PLAN
TABLE OF CONTENTS

(This Laboratory Safety Plan will be updated frequently. Please see http://www2.umdnj.edu/eohssweb/publications/lsp.htm for updated sections)

APPENDICES

TABLES

FIGURES

(This Laboratory Safety Plan will be updated frequently. Three ring binders are not being updated. Please see http://www2.umdnj.edu/eohssweb/publications/lsp.htm for the most current version)

(Page intentionally left blank)

SECTION 1 - INTRODUCTION AND INSTRUCTIONS

1.A INTRODUCTION

1.A.1 Purpose

This Laboratory Safety Plan was developed by the Department of Environmental and Occupational Health and Safety Services (EOHSS), in conjunction with Laboratory Safety Committees from each UMDNJ campus.

The purpose of this Laboratory Safety Plan is to assist UMDNJ laboratories in establishing and implementing a comprehensive health and safety program, as required by the UMDNJ Laboratory Safety Policy, policy number 00-01-45-55:00. This UMDNJ policy describes the minimum UMDNJ safety requirements which must be implemented by all laboratories.

1.A.2 Background

In 1993, The State of New Jersey Public Employees Occupational Safety and Health (PEOSH) Program adopted the federal OSHA standard entitled, "Occupational Exposure to Hazardous Chemicals in Laboratories" (29 CFR 1910.1450).

A main provision of the PEOSH/OSHA Laboratory Standard is that each laboratory or group of laboratories have a written plan which meets the requirement of the regulation. When the information requested in the Laboratory Survey in this Plan is completed and the laboratory safety program implemented, it will ensure each laboratory's compliance with section 29 CFR 1910.1450 (e) of the Laboratory Standard, which requires a written Plan.

However, the laboratory safety program which is described in this Plan goes beyond the scope of the PEOSH/OSHA regulation, which focuses entirely on preventing chemical exposures. For example, this program contains information on reducing the risk from other laboratory-associated hazards such as etiologic agents, flammable materials, and improper use of laboratory equipment.

Any questions about the Laboratory Safety Plan, or any other safety questions should be directed to the Department of Environmental and Occupational Health and Safety Services (EOHSS) on your campus.

1.A.3 Scope/Applicability

At UMDNJ, all research, teaching and clinical laboratories are required to have a written plan which satisfies the requirements of 29 CFR 1910.1450 (e), and includes the minimum safety standards that are outlined in this Plan. The term “laboratories” includes all areas which are carrying out small-scale operations using multiple chemicals and procedures on

a non-production basis.

This Plan is "generic" and the information will apply to many types of laboratories. If this Plan is not used, it is the responsibility of the Responsible Investigator to produce a Laboratory Safety Plan that is both thorough and complete and that will demonstrate compliance with applicable UMDNJ policies and the PEOSH/OSHA Laboratory Standard.

1.A.4 Designation of Responsibility

The appropriate Laboratory Safety Committee for each school or unit is responsible for adapting this Plan to make it specific to the school or unit. The Laboratory Safety Committee is then responsible for the implementation and annual review of the Laboratory Safety Plan.

Each laboratory Department Chair or Division Chief is responsible for designating one or more Laboratory Safety Officers for the department, or for ensuring that individual Laboratory Safety Officers are assigned for each laboratory in the department. The Responsible Investigator (faculty member to whom the lab is assigned), working with the Laboratory Safety Officer, is responsible for the implementation and annual review of each laboratory's Laboratory Safety Plan and for making the Plan available to all laboratory personnel. (See definition of laboratory personnel, Appendix M).

All personnel must be familiar with their laboratory's Laboratory Safety Plan. Therefore, the contents of the Laboratory Safety Plan will be an essential component of orientation and training programs for employees, students, and volunteers who will work in the laboratory. The regulation requires that a copy of the completed Plan must be accessible for each person working in the laboratory.

Detailed descriptions of responsibilities of University personnel with respect to implementing the Laboratory Standard are included in Appendix N.

1.B INSTRUCTIONS ON HOW TO USE THIS PLAN

This Laboratory Safety Plan outlines the minimum health and safety procedures which are expected to be in place in every UMDNJ laboratory. Section 1.C of the Laboratory Safety Plan Survey must be completed by each individual Investigators, to reflect any department- or laboratory-specific hazard which may be present.

Information may be added or deleted from this Plan, as appropriate, so that the text reflects the type of operations which are performed in your laboratory. However, the safety practices that you require in each laboratory must meet the minimum UMDNJ safety standards as outlined in the Laboratory Safety Plan

If a section of the Laboratory Safety Plan Su rvey which follows does not apply to your specific lab, write "Not Applicable" (NA).

The contents of your Laboratory Safety Planshould be used in training sessions to inform employees, students and volunteers who will be working in your lab about the spe cific safety procedures that must be followed.

(Page intentionally left blank)

1.C Laboratory Safety Plan Survey

Instructions:

1. Make a copy of this blank form before you begin.
2. Fill in each of the blanks below with the information requested.
3. Each item indicates a corresponding section of the Laboratory Safety Plan. Refer to the indicated section for additional information.
4. Contact your campus EOHSS office with any additional questions that you may have.

Responsible Investigator(s):	Laboratory Safety Officer:
Building:	Room(s):
Completed By:	Date:

The Laboratory Safety Plan must be reviewed annually. This Laboratory Safety Plan was last reviewed:

Reviewed By:	**Date:**
	, 2010
	, 2011
	, 2012
	, 2013
	, 2014

Part 1. Laboratory Standard Operating Procedures

1. What types of gloves are available in this lab (see Section 7.K)?

□ Nitrile □ Autoclave Gloves □ Other (List)
□ Latex □ Cryogenic Gloves
□ Vinyl

2. Eye Protection, appropriate gloves, and a lab coat are required during the following procedures in this lab (see Section 7.I):

Experiment/Procedure	Type of Eye Protection	Type of Glove
A.		
B.		
C.		
D.		
E.		

3. For Unattended Operations, what safeguards are in place? (see Section 2.E)

Experiment/Procedure	Safeguards in Place
A.	
B.	
C.	
D.	

Note: If any of the unattended operation involves the use of a flammable or high toxic material, prior approval must be obtained from the Department Chair

4. Where are flammable chemicals stored in the lab? (see Section 3.F)

□ In the storage cabinet beneath the chemical hood
□ In a Flammable Cabinet

5. Are there explosion-proof refrigerators available in this laboratory?

□ Yes □ No

Location?

6. What pyrophoric, reactive, or Particularly Hazardous Substances are in use in this lab, and where are the "designated areas" located in this laboratory? (see Section 5.A.2 and Section 4)

Room	Area where Used (e.g. Chemical Hood)	Particularly Hazardous Substance	Experiment/ Procedure

Room	Area where Used (e.g. Chemical Hood)	Pyrophoric or Reactive	Experiment/ Procedure

7. Where is the closest safety shower and eyewash for this laboratory?

Eyewash (Section 6.F):

Safety Shower (Section 6.E):

8. What types of fire extinguishers are available? Where are they located?

Type	Number	Location(s)	Applicable For
Class A			Ordinary Combustibles
Class ABC			Combustibles/Flammable Lquids/Electrical (may break electrical equip)
Class BC			Flammables/Electrical
Class D			Flammable Metals

9. What is the primary route of evacuation in the event of a fire? What is the secondary route?

10. Are emergency evacuation routes free of obstructions? (See Section 2.F.1)
□ Yes □ No

11. In compliance with federal regulations, this laboratory is attempting to reduce its use of particularly hazardous chemicals or environmental toxins by (see Sections 7.B and 9.C):

12. Are there "Clean Benches" in this laboratory?

Clean benches filter the air before it is blown over the work product and in the direction of the person using the clean bench. As they **do not provide any worker protection**, they must never be used with any type of hazardous material.

□ Yes □ No

Location?

Part 2. Biological Safety Procedures

13. Are etiological agents used in this laboratory?

□ No etiological agents are used in this laboratory.

□ Human cell lines □ Human Tissue □ Human Blood or other body fluids

□ Primate cell lines, tissues or body fluids

□ Select Agents - List:

□ Pathogenic Microorganisms - List:

14. Have all of the Biosafety Work Practices listed in Appendix H been addressed?

□ Yes □ No

15. Have the appropriate forms for the etiological agents listed in Question 1 of Part 2 of this form been completed and submitted to EOHSS (See Appendix K)?

□ Yes □ No □ NA

16. Is the lab posted with Biosafety Signs, if needed?

□ Yes □ No □ NA

17. This lab operates at Biosafety Level _____. (See Section 10.C)

18. What class of Biological Safety Cabinets are found in this laboratory? (See Tables 10.2 and 10.3)

□ Class I:

No longer manufactured, these cabinets protect theworker by drawing room air inward over the work, and exhausting the air back into the room after passing through a HEPA filter.

□ Class II Type A:

More commonly found in UMDNJ laboratories, this class of biosafety cabinets is designed to HEPA-filter both the air coming into the cabinet and the exhaust air. This protects both the worker and the work product from contamination. The exhaust is released back into the room air, which makes this cabinet suitable for use with research which does not involve volatile chemicals or radionuclides.

□ Class II Type B:

This is a Class II, Type A biosafety cabinet which has been hard-ducted to the exhaust system. Therefore, small quantities of volatile chemicals or radionuclides can be used with this type of cabinet.

19. Indicate which types of personal protective equipment are required when working in this laboratory (See Section 10.E):

□ Lab coat
□ Gloves - circle type: nitrile, powder-free latex, vinyl
□ Safety glasses with side shields
□ Certified biological safety cabinet (tissue culture hood)
□ Centrifuge with sealed safety cups
□ BSL-3 Containment suite

20. Use of Sharps: The use of sharps (scalpels, syringes, glass) must be minimized in BL2 or higher facilities.

Are sharps used within this laboratory?

□ Yes □ No

Have all research protocols been reviewed to minimize the use of sharps where possible?

□ Yes □ No

21. Which disinfectant will be used routinely and for spills in this laboratory? (See Section 10.F)

□ 1/10 bleach solution
□ 70% ethanol solution
□ povidone-iodine
□ Other_____

22. Describe the Infectious Waste Handlingprocedures to be used: (note: all lab-ware and culture media that contact s BL2 organisms or rDNA are to be inactivated prior to disposal).

Solids:	Liquids:
□ 1/10 bleach solution	□ 1/10 bleach solution
□ 70% ethanol solution	□ 70% ethanol solution
□ povidone-iodine	□ povidone-iodine
□ Autoclave	□ Autoclave
□ Other_____	□ Other_____

23. Check all that are available and are required in your Lab:

□ Handwashing Sink
□ Autoclave
□ Safety Shower
□ Eyewash
□ Authorized Access Warning
□ Biohazard Warning Signs
□ Negative Airflow into Laboratory
□ HEPA-filtered Exhaust

12. What level of medical surveillance is needed for the work conducted in this lab?

□ No medical surveillanc e necessary. This option requires that you be able to provide certification that the hum an cell lines have been found t o be f ree of pathogens.

□ Employees have been provided BloodbornePathogens (BBP) training within the past year. All potentiallyexposed employees have received Hepatitis B vaccine or proven immunity. (OSHA BBP compliance is adequate for BSL-2 work.)

□ Individuals at increased risk of susceptibility to agent (e.g., preexisting diseases, medications, compromised immunity, pr egnancy or breast feeding) have been referred to Employee Health Services for consultation.

□ Additional vaccination/surveillance requir ed for work on this p roject. Must be approved by Employee Health Services/Occupational Medicine Services. Specify agents and special vaccination/surveillance requirements. List below:

Part 3. Responsibilities Chart

Indicate who is responsible for the various tasks listed below

RI	LSO	Other (Name or Title)	Responsibility
			Who will conduct periodic Laboratory Self-Inspections? (See Appendix D and Section 2.H)
			Who will maintain an up-to-date chemical inventory for the laboratory? (Section 3.F)
			Who is responsible to ensure the proper storage and disposal of hazardous waste? (Section 9)
			Who will ensure that all lab personnel have, at a minimum, lab coats, eye protection, and appropriate gloves? (Section 7.H)
			Who will ensure that signs are posted and proper procedures are in place for the use of "Particularly Hazardous Substances?" (Section 4)
			Who will activate the eyewash at least monthly? (Section 6.F)
			Who will ensure that biological safety cabinets are inspected annually? (Section 10.D.2)
			Who is responsible for organizing the safe storage of chemicals, ensuring the amount of flammable liquids is kept below 10 gallons, and disposing of chemicals which have expired? (Section 3.F and Section 9.F)
			Who will ensure that newly-hired employees, volunteers and students attend Laboratory Safety Training and receive lab specific and other appropriate training programs within 30 days of beginning work in the lab? (Section 2.A)
			Who will ensure that all lab staff attend Laboratory Safety Training at least every other year? (Section 2.A)
			If human cell lines or tissues, pathogens or select agents are or will be in use in this laboratory, who will ensure that appropriate forms are completed and submitted to EOHSS? (Appendix K)
			Who will ensure that lab staff is offered appropriate vaccinations for etiologic agents used in the laboratory? (Section 8)
			Who will ensure that lab staff working with etiological agents attend annual Biosafety/Bloodborne Pathogens training? (Section 2.A)

SECTION 2 - STANDARD OPERATING PROCEDURES

2.A TRAINING PROGRAMS AND REQUIREMENTS

2.A.1 Training Overview

The intent of UMDNJ's Laboratory Training program is to ensure that all personnel engaged in research or clinical activities have received appropriate information concerning physical agents and hazardous materials in their work environment; the nature of the risks associated with handling these materials; and the conditions under which these materials may be harmful. Laboratory personnel include all persons working in the laboratory, regardless of formal UMDNJ employment status.

2.A.2 EOHSS Safety Training Programs

The following types of safety training sessions are available for laboratory personnel:

- **Laboratory Safety Training** - All staff, faculty, students, and volunteers who work in a UMDNJ laboratory are required to attend initial Laboratory Safety Training within 30 days of hire, and complete refresher training every other year thereafter.
- **Bloodborne Pathogens/Biosafety Training** - All UMDNJ laboratory personnel must be adequately trained prior to beginning work with etiologic agents, human source materials and non-exempt recombinant DNA organisms that must be worked with at Biosafety Level 2 or greater. Training is required within 30 days of hire, and every year thereafter.
- **IATA Shipping of Hazardous Biological Materials** - UMDNJ personnel who package and/or ship diagnostic specimens or infectious substances via U.S. Postal Service or other delivery services (e.g., Federal Express) must attend initial training, and refresher training every two years thereafter.

The schedule of classes and availability of web-based training programs can be found by following the campus-specific links on the EOHSS website http://www.umdnj.edu/eohssweb/index.htm.

2.A.3 Radiation Safety Training

All UMDNJ personnel who have potential exposure to radionuclides are required to receive training in Radiation Safety that complies with Nuclear Regulatory Commission (NRC) requirements. For more information, contact your campus Radiation Safety Office.

2.A.4 Training Requirements for Visitors to the Laboratory

Visitors and outside contractors who will only be in the laboratory for a short time period shall notify laboratory personnel before they enter the laboratory. The Responsible Investigator shall insure that all visitors have been informed of any necessary precautions before they commence their activities. For example, this would include information about the hazards of activities which are being performed while visitors in the laboratory, as well as the need to wear personal protective equipment such as safety glasses or a laboratory coat. EOHSS is available to provide hazard recognition training to contractors who will be working in laboratories for extended periods. See Section 2.G for more information.

2.A.5 Laboratory Specific Training

Responsible Investigators (RI) must ensure that their laboratory personnel are knowledgeable about the hazards and safe work practices for hazardous materials and equipment they may encounter or be expected to use in the laboratory. Training documentation must include the name and signature of the participants, and the instructor as well as the date. This documentation shall be kept by the Responsible Investigator.

Laboratory Safety Procedures, tailored for the laboratory, from section 1 of this plan shall be reviewed with students and employees before they begin working in the laboratory.

Particularly rigorous training should be presented when it is necessary to use chemicals that require a written Standard Operating Procedure as outlined in section 4 of this Plan.

Each laboratory is expected to conduct specific hands-on training with a new or inexperienced lab-member before allowing him/her to begin work with particularly hazardous or reactive materials. At a minimum, the RI, the Laboratory Safety Officer or other qualified staff member should show the employee the location and safe handling of the potentially hazardous chemicals in the lab as well as the equipment available to contain the hazard and to respond to an emergency. Training should also include a hands–on component or a description of the proper use of the following eqiupment:

- The eye wash, safety shower, fire extinguisher, fire alarm pull station, emergency gas shut-off, chemical spill cleanup kits.
- The location and proper use of equipment used to control chemical/biological exposures (chemical hood, biosafety cabinet, gloves, eye protection, lab coats) .
- Any other unique equipment or procedures that have been implemented to minimize the potential for injury or exposure

2.A.6 Documentation of Training

Documentation of attendance for training sessions is required as listed below.

TYPE OF TRAINING	WHO MAINTAINS DOCUMENTATION
EOHSS Laboratory Safety Training	EOHSS
Laboratory-Specific Training	Responsible Investigator
Radiation Safety Training	Radiation Safety Officer
Biosafety/Bloodborne Pathogens Training	EOHSS
IATA Training	EOHSS

2.B LABORATORY SECURITY

If you see anyone who does not regularly work in the laboratory, do not assume that they have a valid reason for being there. Ask them who they are and what they are doing. If necessary, notify Public Safety of their presence.

2.C LABORATORY DOOR SIGNAGE

Each laboratory shall have a door that has a "Caution" sign posted. “Caution” signs can be obtained from EOHSS. The sign shall include the names of designated occupants, whose phone numbers shall be collected by the school or unit and who may be contacted in the event of an emergency in the room. The "Caution” sign shall also include Public Safety emergency phone numbers, and information on the presence of specific hazardous materials or equipment in the laboratory. In addition, if any personal protective equipment must be worn or special procedures implemented before entering the room, this information shall also be posted.

Compliance with the latest edition of CDC-NIH "Biosafety in Microbiological and Biomedical Laboratories" or NIH "Guidelines for Research Involving Recombinant DNA" require that work performed using Biosafety Level 2 or higher work practices have the appropriate BSL sign affixed to the door. Therefore, Biosafety Level signs will be affixed to each laboratory door where work at BSL 2 or higher is conducted. See Section 10 - Biosafety Plan for more information.

2.D WORKING ALONE

Working with chemicals alone, at night, or otherwise in isolation, places individuals at special risk and should be avoided whenever possible. Personnel should not work alone if acutely toxic or hazardous chemicals will be used.

If it is necessary to work alone, employees are encouraged to contact Public Safety to inform them that they are working in the building during off-hours. You may want to request that patrols in your area specifically check in on you.

Responsible Investigators are responsible for ensuring that employees and students perform only those tasks for which they are qualified by training and experience, especially during off-hours when they may be unsupervised. Undergraduate or other non-degree students who will be conducting research before or after regular business hours must have permission in writing from the Responsible Investigator of the lab where the work will be conducted. Although "blanket" permission can be given, it is preferable for the Responsible Investigator to specifically indicate the type(s) of work which will may be performed during off-hours. An example of an acceptable format for written permission is included in Appendix E. Place completed permission forms for off-hours work in the tabbed section of this Plan marked Laboratory Records.

2.E UNATTENDED OPERATION OF EQUIPMENT

When unattended operation of equipment is necessary, the researcher shall ensure that all hose connections are secure, that electrical and other connections pose minimal risk of accident and that proper and continuing drainage (e.g., in washing and rinsing sinks) is provided.

Post a sign on the exterior laboratory door describing any unattended process which might cause hazardous conditions if there is a mechanical failure. Clearly label the equipment, bench, entry door or other prominent location with a brief description of the unattended operation. The Laboratory Contact persons, listed on the laboratory door, should be familiar with the unattended operations. If the Laboratory Contact persons are not familiar with the unattended operation, then contact information for the person(s) responsible for the work should be posted.

Unattended operations involving flammable or particularly hazardous chemicals are not permitted in UMDNJ laboratories without the permission of the Department Chair.

2.F FIRE SAFETY

2.F.1 Maintenance of Egress Corridors

Both OSHA regulations and the NJ Uniform Fire Code require that corridors remain unobstructed so that it is possible to safely exit the building during a fire or other emergency condition and to facilitate the movement of emergency equipment.

Therefore, corridors leading to **EXITS** or any other similar elements of the means of egress must be maintained in a safe condition and available for immediate utilization and free of all obstructions at all times.

Obstructions such as tables, showcases, holiday decorations, powered equipment, display boards, signs, coat racks and other movable equipment that may interfere with fire-fighting access are prohibited. Storage of combustible or flammable material, and other hazardous materials in any portion of an exit, elevator car or under the stairway is prohibited. Chairs, tables, and other furniture or equipment in each room shall be arranged to provide ready access to each egress door.

2.F.2 Maintenance of Areas Around Emergency Equipment

At no time shall safety showers, eye washes, fire extinguishers or other emergency equipment be obstructed.

2.F.3 Bunsen Burners

Bunsen burner hoses should be made out of thick butyl rubber (wall thickness of 1/8 inch/3.2mm). Other materials are more likely to develop pinholes, which can allow leakage of gas.

The hoses should be replaced periodically before they start to develop cracks. Hose length should be limited to 1.5 feet to minimize the chance of hose contact with the flame. Bunsen burners should not be used in the vicinity of flammable materials. Bunsen burners with pilot lights shall be utilized when feasible.

2.F.4 Combination Hotplate/Stirrers

Combination stirrer/hot plates are no longer allowed in UMDNJ cold or warm rooms and are no longer allowed for stirring solutions containing flammable liquids. If the hotplate is inadvertently used, its maximum temperature of 550° C (for most unit) could easily exceed the melting point of the polycarbonate transfer tank (267° C)

2.G POLICY ON VISITORS

2.G.1 General

The OSHA Laboratory Standard emphasizes the importance of training personnel who may be exposed to hazardous chemicals (see 2.A.4 -Training Requirements for Visitors to the Laboratory for additional information).

Consequently, the concern of UMDNJ for laboratory safety extends not only to employees but also to any persons visiting our laboratories (especially children) who may potentially be exposed to hazardous chemicals. Laboratories must **never** be utilized as a substitute for day care or other child care options. No visitors to the laboratory shall be present during any activity with the potential for exposure to hazardous materials.

2.G.2 Visitors under the age of 18

Persons under the age of 18 may be present in laboratories as **observers** as part of officially sanctioned educational programs for high school or college students or other supervised, educational activities that have been approved in writing in advance by the Department Chair. These activities must be in accordance with the school or unit's Radiation Safety Guidelines. Persons 12 years old or younger are not allowed into any Biosafety Level 2 or higher laboratory as per CDC-NIH guidelines. No minor shall be present during any activity with the potential for exposure to hazardous materials.

2.G.3 Laboratory Workers Who Are Under the Age of 18

UMDNJ has a procedure in place which allows a Responsible Investigator to have high-school students (16 years of age and above) perform work in a laboratory. Procedures and detailed information for obtaining approval for this activity can be found at: http://www.umdnj.edu/eohssweb/publications/highschool.htm

In general, this program requires that:

- The student must be sponsored by a faculty member and be under the supervision of the student's school;
- The proposed activities comply with the federal, state, and local regulations including the Fair Labor Standards Act, Child Labor Laws and to regulations pertaining to health and safety; and
- The student receives health and safety training and supervision appropriate for the anticipated tasks.

2.H LABORATORY SAFETY AUDITS

A Laboratory Safety Audit Checklist has been developed by EOHSS to assist researchers in evaluating the day-to-day operations in his/her laboratory. A sample of the Laboratory Safety Audit Checklist is included in Appendix D. EOHSS and/or the researcher may identify additional lab-specific items to evaluate.

EOHSS will periodically inspect each laboratory area. A written report will be issued to the RI and/or LSO that includes recommended corrective actions. All deficiencies must be corrected.

EOHSS is available at any time to provide technical assistance to laboratories who are having difficulties correcting a safety problem.

2.I LABORATORY VACATING PROCEDURES

Decommissioning a laboratory is a multi-step process which ensures that the laboratory is free of old chemicals, equipment, refuse, and chemical, radiological or biological contamination. This process allows for the orderly scheduling of renovations and turning over lab spaces to new occupants.

Responsible Investigators are responsible for the proper disposition of all biological, chemical, and radioactive materials in the laboratory, as well as for the complete removal of all equipment and supplies. A laboratory will not be decommissioned by EOHSS until all of the items listed in Appendix F have been completed or deemed not applicable.

A minimum of two weeks before the laboratory will be vacated, notify EOHSS, Radiation Safety (even if radiation is not currently in use), and Environmental Services of your intention to vacate a laboratory. The Radiation Safety Office requires four weeks notice if fixed equipment is to be moved or discarded, and in the event the laboratory is being decommissioned for a renovation.

EOHSS will work with the Laboratory Safety Officer (LSO) to identify chemicals for disposal. Laboratory personnel will be expected to label and inventory excess or unwanted chemicals for disposal through the University's Hazardous Waste Vendor. EOHSS and the LSO will make arrangements to transfer the waste chemicals to the Hazardous Waste Storage Area.

Following the decontamination of work surfaces and the removal of chemical, physical, biological, and radiological hazards as well as all equipment and refuse, EOHSS will perform a final inspection to decommission the laboratory.

Outside contractors, Physical Plant, and Environmental Services are not permitted to work in a laboratory which has been vacated until there is a sign on the door from EOHSS stating that the laboratory has been decommissioned.

2.J MATERIAL SAFETY DATA SHEETS

Material safety data sheets (MSDS) are available online at: http://www.umdnj.edu/eohssweb/publications/msds.htm. A copy of a particular MSDS can also be acquired from the manufacturer or product vendor. Contact EOHSS if assistance is needed.

2.K CHEMICAL INVENTORIES

The NJ Worker and Community Right-to-Know Act http://www.nj.gov/health/eoh/

rtkweb/rtkregs.pdf) requires that all laboratories prepare, maintain and update a complete and accurate chemical inventory for all hazardous chemicals present in each separate laboratory area. This inventory is required for all laboratories even if they have a Research and Development exemption. (The exemption only means that the Right-To-Know Survey does not have to be on file with the state). The chemical inventory list will be useful for acquiring MSDSs as needed, for replacing outdated chemicals, for organizing chemicals, and for conducting work safely and in compliance with PEOSH standards.

The inventory for both pure chemicals and chemical product mixtures should include the CAS (chemical abstract service) number(s);percent of each constituent; average quantity of containers; maximum amount in the container(s); unit (e.g., ml, l, gal, oz, lb, mg, etc.); type of container (e.g., glass bottle, plastic jug, can, etc.); and the physical state (solid, liquid or gas).

Instructions for how to view or print your chemical inventory is available at: http://www.umdnj.edu/eohssweb/publications/accessinginventory.htm. The Right-to-Know regulation requires that inventories be updated yearly regardless of whether software or paper inventories are used.

2.L REFRIGERATORS, WARM AND COLD ROOMS

Cold rooms are not ventilated and warm rooms have only limited ventilation. Dry ice, liquid nitrogen and other cryogenic liquids must never be used in these spaces because they expand rapidly in air. **Even if a small volume was released in an unventilated room, sufficient oxygen could be displaced to cause asphyxiation.**

Because of the lack of ventilation, use or a spill of volatile chemicals may result in dangerously high airborne concentrations. For this reason toxic materials must never be used or stored in these locations. Similarly, there is a potential for oxygen displacement if large volumes of compressed gases are used.

Explosion-proof cold rooms are designed with explosion-proof lighting fixtures, thermostats and compressors. These fixtures have vapor-tight seals to ensure that any vapor from a flammable chemical will not have contact with an ignition source. Most cold rooms at UMDNJ are **not** explosion-proof. Additionally, some cold-rooms which were originally designed to be explosion-proof have had standard electrical outlets added to them and are no longer explosion-proof. If any vapors accumulate in the room due to use, leakage, or a spill of a flammable liquid, an explosion can result. For this reason, flammable solvents shall not be used or stored in cold rooms unless EOHSS, in conjunction with Physical Plant, has confirmed in writing that the cold room is explosion-proof.

Standard refrigerators are also inappropriate for storage of flammable materials for the same reason. In standard refrigerators, the light switch, thermostat, or self-defrosting

mechanism can act as an ignition source if there are any flammable vapors. "Laboratory-safe" refrigerators are generally used to store small quantities of flammable liquids in laboratories. Laboratory-Safe refrigerators have all ignition sources located on the outside of the refrigerator. Explosion-proof refrigerators provide additional protection for working in an area where flammable vapors may accumulate on the inside or outside of the refrigerator. In explosion-proof refrigerators the ignition sources are located on the outside and are sealed in vapor-tight enclosures.
If the ability to keep flammable liquids refrigerated is necessary, departmental resources might be pooled to purchase a Laboratory-Safe refrigerator. See Section 3.F of this plan for more information concerning safe storage of flammable materials.

Laboratory-use refrigerators and cold rooms must not be used to store food for consumption.

2.M DISPOSAL OF BROKEN OR OUTDATED EQUIPMENT

In addition to the requirements of UMDNJ's Office of Asset Management (see University Policy Number 00-01-50-65:00 "Surplus Furniture and Equipment" for more information), procedures for discarding of laboratory equipment are as follows:

2.M.1 Refrigerator/Freezer

When discarding a refrigerator or freezer, all materials must be removed from the refrigerator by laboratory personnel. Spills and other visible contamination must be removed by laboratory personnel. If the refrigerator or freezer was used to store biological or biohazardous materials, then all surfaces must be wiped with a 1:10 bleach solution prior to removal by Environmental Services.

In addition, Physical Plant or Shared Equipment Services on the central campus must be contacted to have the freon removed from the compressor. The cost of freon removal is the responsibility of the laboratory.

2.M.2 Laboratory Equipment that contains a Radioactive Source

Contact the Radiation Safety Officer for your campus for assistance.

2.M.3 Computers and other Lead-Containing Equipment

Physical Plant has a recycling program for computer monitors. Contact your campus' Physical Plant for more information.

EOHSS will assist in the disposal of other lead-containing equipment (e.g., shielding from around a radioactive source, rechargeable batteries from uninterruptible power sources).

2.M.4 Other Equipment

All other types of equipment must be free of chemical, biological, and radiation contamination before disposal. Radiation wipe tests should be done first, with decontamination performed as needed.

For chemical residue: Remove visible contamination with a dilute detergent solution.

Biological Decontamination: Disinfect the exposed surfaces of the equipment with a 1:10 bleach solution.

2N BAN ON MERCURY CONTAINING THERMOMETERS AND OTHER DEVICES

In accordance with a 2009 directive (http://www.umdnj.edu/eohssweb/publications/directive.pdf mercury-filled thermometers and other devices will no longer be permitted in UMDNJ facilities after April 30, 2009.

Spills from broken mercury-filled thermometers have been one of the most common type of hazardous spills at UMDNJ. Cleaning up a mercury spill is disruptive to laboratory operations and can cost thousands of dollars since many spills require equipment decontamination and since the spill clean-up materials must be disposed of as hazardous waste.

Elemental mercury, if not collected properly, may become lodged in floor cracks, behind base coving and under benches, slowly evaporating into the room air even at normal room temperatures. Mercury spills in warm rooms, heat blocks, ovens and incubators pose a greater hazard. The increased evaporation rate of mercury vapor from a spill in heated equipment is extremely dangerous..

The use of mercury-containing thermometers and other devices has been discouraged at UMDNJ for many years. The University has been required by the Environmental Protection Agency (EPA) to implement a mercury reduction program. Reducing the number of mercury thermometers and other devices on campus is an essential component towards fulfilling that mandate.

Mercury thermometers must be replaced with a non-toxic, environmentally safe alternative such as spirit-filled, alcohol-based or microprocessor thermometers wherever feasible. Non-mercury thermometers can be used in most applications including, incubators, water baths, or other applications where mercury thermometers have been traditionally used. If use of a mercury thermometer is absolutely essential, an exemption request to allow the use of a Teflon (PTFE) coated model must be requested from EOHSS.

Non-mercury thermometers are available from common laboratory equipment suppliers

(e.g. VWR, Lab Safety Supply, Fisher Safety, etc.) and are relatively inexpensive with prices ranging from $11 and upwards. For more information on mercury-free thermometers, please view the EOHSS Mercury-free Thermometer Fact Sheet located at http://www.umdnj.edu/eohssweb/publications/thermometer.pdf. Examples of typical prices for replacements are included in the following publication: at: http://www.umdnj.edu/eohssweb/publications/merc_therm_alternatives.pdf.

Laboratories that currently have mercury thermometers should purchase non-mercury replacements and contact EOHSS to arrange for proper disposal.

2.O CENTRIFUGE SAFETY

Centrifuges come in three general classes; low speed (i.e., up to about 5000 rpm), high speed machines (i.e., up to about 25,000 rpm), and ultracentrifuges (i.e., up to 100,000 rpm or higher). Rotors on high speed centrifuge and ultracentrifuge units are subjected to powerful mechanical stresses that may cause metal fatigue over time. This can lead to rotor failure-where the rotor breaks apart with great force.

Centrifuges are designed to contain the rotor in the event of a failure. There have been instances, however, where the rotor was propelled through the centrifuge with a force sufficient to penetrate cinder block walls and cause personal injury or death. There have also been rotor failure incidents where the rotor was contained but the entire centrifuge was propelled across the floor.

2.O.1 Responsibility for Centrifuges

Each centrifuge must be under the control of a specific responsible person, which could be a Responsible Investigator or technician. The name of the responsible person must be displayed on a label attached to each centrifuge which is his or her responsibility. Access to the centrifuge will be controlled by the responsible person, who will limit access to authorized users only. Authorized users would be expected, either to be experienced centrifuge users, or to have received appropriate training which provided them with sufficient information to operate the particular machine in a safe manner. Before a new user is allowed to operate a centrifuge on their own, competence to operate the centrifuge must have been assessed by the responsible person or another experienced user.

2.O.2 Training and Supervision of Operators

Responsible Investigators have a duty to provide users of centrifuges with the following:

- information on the hazards and risks to health;
- instruction in safe procedures;
- training, where necessary; and
- effective supervision to ensure, s o f ar as is reasonably practicable, that

centrifuges are operated without risks to the health of employees and other persons, i.e. including students and visiting research workers.

2.O.3 Operating Manuals

The operating manual(s) for all centrifuges in use should be available to all users. They contain important information on how the centrifuge should be operated and maintained. The manual also indicates the maximum safe operating speeds for different rotors and for different loads. Each user should review the operating manual and become familiar with the precautions recommended by the manufacturer.

2.O.4 Know When to Derate and When to Retire Your Rotors

Resources on determining when to derate (permanently lower the speed) and when to retire Beckman and Sorvall rotors are included in Section 2.O.12. The centrifuge operating manual will also include this information.

When spinning loads that are dense or that may result in precipitation, the speed of the centrifuge must be lowered, as required by the instrument's operating manual. The speed on an ultracentrifuge rotor must be derated when it has completed a certain number of runs or accumulated a certain number of hours. Rotors which have sustained damage usually have to be derated or even retired (no longer used).

Because of the high stress that ultraspeed rotors are exposed to, they have a limited useful life span. All ultracentrifuge rotors must eventually be retired. For manufacturer's recommendations or retiring rotors, see the Beckman and Sorvall safety guide.

2.O.5 Have Rotors Inspected Periodically

Lab personnel should inspect the rotor before each use and should not use a rotor which is cracked or corroded. Additionally, an annual inspection is recommended because not all damage is easily visible. The inspection may use fiber-optics boroscopy to find signs of corrosion or other damage. Rotor inspection is **not** performed during centrifuge preventive maintenance unless specified.

RWJMS has instituted a rotor registration and periodic inspection program. The goal of the program is to assist researchers in determining which rotors need to be derated, repaired or no longer used. At RWJMS the program is coordinated by RWJMS Department of Shared Equipment Services (732) 235-4455.

2.O.6 Maintain a Logbook

Maintain a logbook to monitor the number of runs and the number of hours that each rotor has been run. The logbook should include date, user, rotor serial number and any

problems encountered. This information can be recorded in the centrifuge logbook or a separate logbook can be kept for each rotor.

This information will help in determining when rotors must be derated and when they must be retired. A speed derating disk must be installed if and when the warranty conditions require it or when recommended during the annual rotor inspection.

2.O.7 Clean Your Rotor Without Damaging It

Ultracentrifuge rotors are usually made of aluminum or titanium alloys. An aluminum rotor can be easily corroded by chlorine solutions (i.e. Clorox), salts or other chemicals attacking the rotor surface. It appears as rusting, pitting, and cracking usually in the bottom of the tube cavity or on the drive spindle adapter.

Do not scratch or otherwise damage the aluminum oxide layer that protects the underlying metal. Rotor cavities and buckets must never be cleaned with a bottle-brush or other brushes with sharp wire ends. Use special plastic coated brushes. Use a 1% non-alkaline soap rather than alkaline detergents or cleaning solutions that may damage the coating. Finish by rinsing with de-ionized water. To prevent corrosion, let rotors air-dry upside down so liquid will not accumulate.

2.O.8 Do Not Use An Unapproved Rotor

Many incidents where the rotor has failed involved the use of an unapproved rotor. Only use rotors which have been approved for the centrifuge. Check the classification decal on the ultracentrifuge and make sure it matches the classification decal on the rotor. If you are unsure of which rotor or tube to use, ask an experienced colleague or call the manufacturer.

2.O.9 Use The Following Safety Practices for Nitrocellulose Tubes

Nitrocellulose tubes should only be used when they are clear, without discoloration, and flexible. It is advisable to purchase small lots several times a year rather than one large lot. Storage at 4°C will extend their shelf life. They must never be heated because they may explode.

2.O.10 User Error: The Biggest Cause of Rotor Incidents

According to the Howard Hughes Medical Institute video, “Centrifugation Hazards,” approximately 90% of rotor incidents are due to user error. A copy of the HHMI video may be borrowed from EOHSS. The most common user errors are:

- failure to put the lid on the rotor
- failure to secure the lid
- failure to properly secure the rotor to the drive

A rotor that has become detached from the drive shaft can cause serious damage to the centrifuge. There is also a risk that the rotor can be ejected from the unit. Be aware that the head of the rotor may be damaged if the special tool provided to remove it is not used.

Other user errors that can lead to rotor failure include:

- Overloading beyond the rotor's maximum mass without reducing the rated rotor speed
- Running swinging bucket rotors with missing buckets
- Buckets hooked incorrectly or not able to move freely on a horizontal rotor

2.O.11 Safe Work Practices

Check the rotor for evidence of damage before you use it. If you find any of these conditions, do not use the rotor.

- Before placing a rotor in the centrifuge drive, make sure the bowl is dry and that the drive spindle is clean.
- Check "o" rings on containers and rotor for cracks, nicks, chemical degradation, pitting or corrosion.
- Avoid overfilling tubes or bottles, Remember that centrifugal forces drive the fluid up the outside tube wall for tubes used in fixed angle rotors.
- If you have derated the rotor, ensure that you are using the correct overspeed disk.
- Check that the rotor is seated on the drive hub correctly.
- Use only the correct tubes for the rotor. Do not modify them to make them fit.
- Ensure that the load is balanced. Remember that a .5 gram difference at 500,000 Gs is equivalent to a 250 kg difference
- Stay at the centrifuge until it is running smoothly. Shut the machine down immediately if there is any unusual noise or vibration.
- Record details about the run in the rotor log and/or centrifuge log.
- Do not open the door until the rotor stops spinning.
- Always check for spills. If you find one, clean the centrifuge and rotor thoroughly. Clean the equipment after it is used with salts or corrosives.
- Precautions when centrifuging infectious materials:
    - Always use aerosol containment tubes and safety cups or a sealed rotor.
    - Load and unload tubes and rotors in a biological safety cabinet.
    - Wait ten minutes before opening the centrifuge door in order to avoid hazardous aerosols.
    - If there is evidence of leakage or damage of any kind, close the lid immediately and carefully plan the cleanup. Request assistance from EOHSS as necessary.

2.O.12 Online Resources for Centrifuge Safety

- Beckman/Coulter Rotor Safety Guide: http://www.beckmancoulter.com/resourcecenter/labresources/centrifuges/pdf/rotor.pdf

- Sorvall Rotor Care Guide: http://www.chem.purdue.edu/safety/SOPs/RotorCareGuide.pdf

- The Howard Hughes Medical Institute has a 9 minute video on Centrifugation Hazards which may be borrowed from EOHSS.

- Laboratory Accidents Involving Centrifuges, posted by the AIHA Laboratory Health and Safety Committee: http://www.aiha.org/insideaiha/volunteergroups/labHandScommittee/Pages/CentrifugeExplosion.aspx

- Additional Centrifuge Safety Links, posted by the AIHA Laboratory Health and Safety Committee: http://www.aiha.org/insideaiha/volunteergroups/labHandScommittee/LabHSTechnicalTopics/Pages/LaboratoryEquipment.aspx#6

SECTION 3 - STORAGE AND HANDLING OF CHEMICALS

3.A INTRODUCTION

Hazardous chemical substances are frequently used to perform the complex research carried out at UMDNJ. The chemicals can be flammable, corrosive, toxic, carcinogeogenic, reproductive hazards, or have unknown health effects. Proper handling and storage of these materials requires that research staff plan and implement safety procedures, including safe storage procedures, before ordering the materials.

EOHSS is available to evaluate Material Safety Data Sheets, assist in preparing a safety plan, and/or conduct project specific training when hazardous chemical substances are to be used.

In addition to compatibility concerns, safe chemical handling requires regular inspections of chemical storage areas and maintenance of stringent inventory control.

3.B IDENTIFICATION OF CHEMICAL SUBSTANCES

Safe storage of chemicals begins with well-identified containers. Original containers will very likely list all of the information needed to fully identify the chemical contents. However, when chemicals or mixtures are stored in secondary containers, identifying information must be listed on that container, including the chemical name and Chemical Abstract Service number (CAS number) of all ingredients.

In addition, laboratories are required to maintain an up-to-date inventory of hazardous chemicals by types and quantity, as per the New Jersey Uniform Fire Code and the University policy, NJ Worker and Community Right To Know (00-01-45-25:00). Contact your campus EOHSS office if you require assistance.

3.C STORAGE OF HAZARDOUS CHEMICAL SUBSTANCES

Hazardous materials and chemicals shall be stored, handled and used in accordance with the requirements of the New Jersey Uniform Fire Code (NJUFC) and other applicable National Fire Protection Association (NFPA) Standards. The types of hazardous materials include: flammable and combustible liquids, oxidizing materials, radioactive materials, unstable (reactive) chemicals, highly toxic materials and poisonous gases.

Each chemical must be stored in a manner which minimizes the risks associated with the hazards. In general:

- Chemicals must be segregated according to the hazards that they present.
- Chemicals should be stored on sturdy shelving or in flammable storage

cabinets, with containers located no higher than eye level. Shelving units should be attached to the wall.
- Heavier materials/larger containers should be stored closer to the floor.
- Caps must be intact and tightly fastened.
- Highly toxic, narcotic or other controlled substances, and other sensitive materials should be stored in a locked cabinet.
- All chemical containers that are not in active use should be tightly capped.
- No chemical containers shall be stored on a laboratory floor without proper containment.
- Limit the quantities of flammable liquids to *ten* gallons per laboratory, and combustible liquids to *thirty* gallons per laboratory. (*Note*: Consult EOHSS for a safety review and recommendations in situations where quantities are expected to exceed the above limits.)
- Laboratories are expected to purchase any containers needed for the handling, storage, and disposal of hazardous materials.

3.D STEPS TO ORGANIZE HAZARDOUS SUBSTANCES ACCORDING TO HAZARD CLASS

Generally, a good chemical segregation system has the following elements: color-coding of chemicals by hazard or class; separation of organic and inorganic substances; a storage pattern which prevents the side-by-side or vapor interaction of incompatible chemicals; and ensuring at incompatible chemicals are separated from each other.

If a laboratory buys most of its chemicals from a single supplier, then that supplier's chemical organization system can be used. However, the chemical containers from other suppliers should then be labeled with symbols, colors, or text to match the overall chemical segregation scheme.

Overall, a lab should divide the materials into a minimum of the following chemical categories:

- Flammable
- Corrosive - Acidic
- Corrosive - Alkali
- Corrosive/Flammable
- Radioactive
- Biohazardous
- Reactive
- Oxidizer
- Compressed Gas
- Poisonous/Acutely Toxic
- Explosive
- General Storage

3.E SEGREGATION OF CHEMICALS

Chemicals must be stored according to chemical compatibility. For example, acids, bases, and flammable liquids must be stored separately from each other. Cyanide-based products must be segregated from acids.

Examples of chemical incompatibilities are listed in Table 3.1, below. The material on the left should be stored and handled so that it does not contact the incompatible chemical(s) on the right, in order to prevent the possibility of a potential violent reaction or generation of toxic reaction products.

3.F STORAGE OF FLAMMABLE AND COMBUSTIBLE CHEMICALS

Flammable and combustible liquids shall be stored, handled and used in accordance with the requirements of the New Jersey Uniform Fire Code (NJUFC) and other applicable National Fire Protection Association (NFPA) Standards. Extensive use of flammable solvents in laboratories presents a potentially serious fire and explosion hazard. Even a very small quantity involved in a fire can significantly increase the potential of fire spreading. To ensure compliance with the UMDNJ Fire and Life Safety Policy # 00-01-45-60:00, ***each laboratory*** shall:

a. Maintain an up-to-date inventory of all hazardous chemicals, including flammable and combustible liquids, as required by the NJUFC and the University policy, NJ Worker and Community Right To Know (number 00-01-45-25:00).

b. Restrict the container size to *one gallon* for all flammable liquids, i.e., liquids with flash point less than one hundred degrees Fahrenheit. Flammable liquids received in original approved containers, which are of a five-gallon or less capacity, are exempt from this requirement.

(Section continues on Page 3-7)

Table 3.1 Partial Listing of Incompatible Chemicals

Chemical	Is Incompatible With and Should Not Be Mixed or Stored With:
Acetic acid -	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetylene -	Chlorine, bromine, copper, fluorine, silver, mercury
Acetone -	Concentrated nitric and sulfuric acid mixtures
Alkali and alkaline earth metals* -	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens
Ammonia (anhydrous) -	Mercury, chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid (anhydrous)
Ammonium nitrate -	Acids, powdered metals, flammable liquids, chlorates, nitrates, sulfur, finely divided organic or combustible materials
Aniline -	Nitric acid, hydrogen peroxide
Arsenical materials -	Any reducing agent
Azides -	Acids
Bromine -	See Chlorine
Calcium oxide -	Water
Carbon (activated) -	Calcium hypochlorite, all oxidizing agents
Carbon tetrachloride -	Sodium
Chlorates -	Ammonium salts, acids, powdered metals, sulfur, finely divided organic or combustible materials
Chromic acid and chromium trioxide -	Acetic acid, naphthalene, camphor, glycerol, alcohol, flammable liquids in general
Chlorine -	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, benzene, finely divided metals, turpentine
Chlorine dioxide -	Ammonia, methane, phosphine, hydrogen sulfide
Copper -	Acetylene, hydrogen peroxide
Cumene hydroperoxide -	Acids (organic or inorganic)
Cyanides -	Acids
Flammable liquids -	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Fluorine -	Everything

Table 3.1 Partial Listing of Incompatible Chemicals, Cont.

Chemical	Is Incompatible With and Should Not Be Mixed or Stored With:
Hydrocarbons@ -	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
Hydrocyanic acid -	Nitric acid, alkali
Hydrofluoric acid (anhydrous) -	Ammonia (aqueous or anhydrous)
Hydrogen peroxide -	Copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, combustible materials
Hydrogen sulfide -	Fuming nitric acid, oxidizing gases
Hypochlorites -	Acids, activated carbon
Iodine -	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Mercury -	Acetylene, fulminic acid, ammonia
Nitrates -	Sulfuric acid
Nitric acid (concentrated) -	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, copper, brass, any heavy metals
Nitrites -	Acids
Nitroparaffins -	Inorganic bases, amines
Oxalic acid -	Silver, mercury
Oxygen -	Oils, grease, hydrogen, flammable liquids, solids, or gases
Perchloric acid -	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease, oils, combustibles
Peroxide, organic -	Acids (organic or mineral), avoid friction, store cold
Phosphorus (white) -	Air, oxygen, alkalis, reducing agents
Potassium -	Carbon tetrachloride, carbon dioxide, water
Potassium chlorate -	Sulfuric and other acids
Potassium perchlorate (see also chlorates) -	Sulfuric and other acids
Potassium permanganate -	Glycerol, ethylene glycol, benzaldehyde, sulfuric acid
Selenides -	Reducing agents
Silver -	Acetylene, oxalic acid, tartartic acid, ammonium compounds, fulminic acid

Table 3.1 Partial Listing of Incompatible Chemicals, Cont.

Chemical	Is Incompatible With and Should Not Be Mixed or Stored With:
Sodium	Carbon tetrachloride, carbon dioxide, water
Sodium nitrate	Ammonium nitrate and other ammonium salts
Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydrite, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulfides	Acids
Sulfuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate (similar compounds of light metals, such as sodium, lithium)
Tellurides	Reducing agents

* - such as powdered aluminum or magnesium, calcium, lithium, sodium, potassium

@ - such as butane, propane, benzene

Source: *Introduction to Safety in the Chemical Laboratory, Academic Press.*

c. All flammable and combustible liquids containers shall:
   - Be properly capped when not in active use
   - Be stored in a cool area, away from sunlight or any sources of ignition or heat.
   - Not be stored on a laboratory floor without proper containment.
   - Not be stored near any corrosives or oxidizers.

d. Flammable liquids not in active use shall be stored in an approved flammable storage cabinet. Storage of flammable liquids is not permitted outside of an approved flammable storage cabinet in laboratories constructed or renovated after December 2001.

e. Flammable liquids in quantities of one gallon or more shall not be dispensed by gravity. Approved pumps taking suction from the top of the container shall be utilized, except when the viscosity of the liquid makes such a restriction impractical. To prevent the hazards of static electricity, any transfer of flammable liquid, utilizing electrically conductive containers, shall be bonded and grounded. Transferring more than five gallons of flammable liquid is not allowed inside a building, except in a specifically designed storage area.

f. Collect flammable and combustible liquid waste in appropriate containers as specified in the University's Hazardous Waste Management Program. Once a container is full, it shall be transferred to the designated Hazardous Waste Store Room within three working days.

g. Limit the quantities of flammable liquids to ten gallons per laboratory, and combustible liquids to thirty gallons per laboratory. In open-type laboratories, where several labs operate in one common fire area, more stringent quantity restrictions may apply to ensure regulatory compliance.

***Note*: Consult EOHSS for a safety review and recommendations in situations where quantities are expected to exceed the regulatory or above specified limits.**

3.G STORAGE OF CORROSIVES

- Separate acids (ie. hydrochloric acid) from alkalies (ie. sodium hydroxide).
- Keep in a well ventilated, cool area, away from other materials, especially organic solvents.
- Store in a wooden, corrosion-proof cabinet or use secondary containment, like a Nalgene® tub.
- Organic Acids, like acetic acid and propionic acid, must be separated from inorganic acids and alkalies.
- Use a bottle carrier when moving these materials around the lab.

3.H TOXIC OR POISONOUS MATERIALS

Chemicals which are toxic may also have other undesirable hazardous physical or chemical properties.

Highly acutely toxic materials should be ordered in small quantities, and stored in a locked cabinet. Less toxic materials should be stored with compatible materials (i.e. if the toxic material is flammable, it should be stored with flammable materials).

3.I OXIDIZERS

Oxidizers act as an oxygen source, especially during a fire. They may also present a fire and explosion hazard when they come into contact with organic or combustible materials.

Examples of oxidizers include, but are not limited to: nitric acid, hydrogen peroxide, sulfuric acid, nitrates, nitrites, perchlorates, peroxides, chromates, dichromates, permangantes, hypochlorites, bromates, iodates, chlorites, and chlorates.

The following precautions should be taken when storing oxidizing agents:

- Isolate oxidizers from all flammable or combustible material.
- Store in a cool, dry place.
- Do not store on wooden shelves.
- Do not store near organic substances or reducing agents.
- Strong oxidizing agents, such as chromic acid, should be stored and used in glass or other inert containers.

3.J COMPRESSED GASES, CRYOGENIC LIQUIDS AND DRY ICE

All compressed gases, dry ice, and cryogenic liquids shall be stored, handled and used in accordance with the requirements of the applicable New Jersey Uniform Fire Code (NJUFC) and the University's Laboratory Safety Plan to minimize the hazards of fire, explosion and personal injury.

3.J.1 Compressed Gases

Each department or laboratory storing or using compressed gases shall, at a minimum, ensure that:

- Quantities of compressed gas supplies in laboratories do not exceed a two month supply and/or the maximum quantities specified by the NJUFC or other applicable Fire Code. Consult EOHSS for assistance in determining compliance.
- Flammable compressed gas cylinders in laboratories are limited to only those in current use.

- Excess cylinders are stored in a separate ventilated room approved for that use.
- Valve covers are removed only when a cylinder is in use.
- All cylinders (in service or storage, full or empty) are:
  (i) adequat ely secured with chains or by proper nesting to prevent falling or being knocked over,
  (ii) never allowed to be dropped or banged together violently,
  (iii) kept away from fire- and spark-producing operations,
  (iv) grouped according to their properties,
  (v) stored such that fl ammable gases are separate from oxidizing gases, and empty cylinders are separate from the full cylinders, and
  (vi) properly marked with the name of the contained gas.
- Compressed gases are never transferred from one container to another.
- Any damaged cylinder or valve is immediately reported to the supplier and to the Public Safety emergency number.

3.J.2 Cryogenic Liquids

- Cryogenic liquid tanks are checked periodically to ensure that they:
  (i) have not lost vacuum orinsulation (a cold outside jacket of the tank indicates the need for tank service),
  (ii) are checked at the neck of the tankopening for any ice accumulation to prevent any blockage and subsequent pressure buildup within the container,
  (iii) are checked for sabotage of the pressure relief devices on the tank.
- **Always use and store cryogenic liquids in a well-ventilated area.** If allowed to vent into a closed space, a cryogenic liquid will vaporize, displacin g oxygen and possibly causing asphyxiation. For example, liquid nitrogen expands in air to 700 times its volume. Therefore, never stor e a container of cryogenic liquid in a cold room or unventilated area.
- **Wear protective equipment, including face shield, cryogenic gloves, and an laboratory apron.** Cryogenic liquid and vapors can rapidly freeze human tissue. Delicate eye tissues can be damaged (by fros tbite) even when the contact is too brief to affect the skin of the hands or face.
- **Place cryotubes in a desiccator, a heavy-walled container, or behind a safety shield while thawing.**
- **Exercise care that cryogenic liquids are never contained in a closed system**. Liquefied gases boil, with a resultant rapid increase in pressure.
- Boiling and splashing usually occurs whenilfing a warm container, or when inserting warm objects into a liquid. **Stand clear and perform these operations slowly** to minimize the possibility of contact with the cryogenic liquids.
- **Do not dispose of cry ogenic liquids dow n the drain!** Ordinary materials, like plumbing, for use under ambient conditionsmay not be able to withstand cryogenic temperatures without failure.

3.J.3 Special Precautions for the Use of Dry Ice

- Do not handle dry ice with an unprotected hand.
- Avoid putting dry ice into a sink (can embrittle the sink material, causing it to crack)
- Use in a well ventilated area (i.e. not the cold room)
- Many departments have a recycling program, or a designated place to store dry ice. Ask the laboratory safety officer, responsible investigator, or the department administrator to find out if this is available.

3.K LOW-HAZARD MATERIALS

These are the chemicals which present little or no danger in the laboratory, like buffers, salts, and media. They may be stored on sturdy shelving or in cabinets, below eye level.

3.L NARCOTICS

The purchase of narcotics and controlled substances is strictly regulated by the Drug Enforcement Agency (DEA). Therefore, UMDNJ has set in place procedures for the purchase of narcotics and other controlled substances. (See University Policy 00-01-55-15:00, Requisition Processing, for more information.)

Narcotics and other controlled substances should be stored in a secure, locked location such as a drawer or safe. Access to narcotics and controlled substances must be restricted to specific personnel who will be using these materials. Narcotics and controlled substances should not be stored in a cabinet with other, general use chemicals, even if it locks. Laboratories should maintain an accurate, signed, up-to-date inventory of the all narcotics and controlled substances.

Individuals with a DEA license are also required to maintain a log book for drug dispensing, which includes the date, amount dispensed, and amount remaining. Each entry must be dated and signed. All DEA registered substances must be disposed of in accordance with DEA regulations, through a licensed vendor. Contact EOHSS to arrange for disposal.

3.M PEROXIDE-FORMING AND SHOCK SENSITIVE COMPOUNDS

Most chemicals that are used in research laboratories are stable and non-explosive at the time of purchase. But, over time, certain chemicals can oxidize, become contaminated, dry out, or otherwise destabilize to become a potentially explosive chemical. The chemical can then literally detonate when exposed to heat, light, friction, or mechanical shock.

3.M.1 Examples of Peroxide-Forming and Shock Sensitive Compounds

- Organic chemicals (e.g. cyclohexene, most ethers, dioxane, and tetrahydrofuran) that form peroxides through exposure to air or light. These

peroxides are not always in crystalline form; some are soluble and essentially invisible.

- Hydrated picric acid that becomes dry or becomes contaminated with metals that form metal picrate salts
- Sodium amide that reacts with air or moisture to form superoxides, as evidenced by yellow or brown discoloration
- Some normally stable perchlorates (e.g., pyridium perchlorate or tetraethylammonium perchlorate) may become unstable at elevated temperatures.

Table 3.2 Common Laboratory Chemicals That Form Peroxides During Storage

Acetal	Diisopropyl ether	Sodium amide
Butadiene	Dioxane	Styrene
Cumene	Dimethyl ether	Tetrahydrofuran
Cyclohexene	Divinyl acetylene	Tetrahydronaphthalene
Cyclooctene	Ethyl ether	Tetralin
Decahydronaphthalene	Ethylene glycol dimethyl ether (glyme)	Vinyl acetate
Decalin	Isopropyl ether	Vinyl actylene
Diacetylene	Methyl acetylene	Vinyl choride
Dicyclopentadiene	Methylcyclopentane	Vinyl ethers
Diethylene glycol	Potassium metal	Vinylidene chloride

3.M.2 General Precautions for Peroxide-Forming and Shock Sensitive Compounds

- Purchase these chemicals in limited quantity - buy only what is needed for short-term use.
- Record the date the container is received and the date which it is opened. If there is an expiration date, keep in mind that the material must be given to EOHSS as a hazardous waste at least three (3) months before that date.
- Keep explosive chemicals away from all ignition sources such as open flames, hot surfaces, spark sources, and direct sunlight.
- Store in a cool area, but not in standard refrigerators.
- Keep the materials dry. Do not store near sources of water (sink, waterbath).
- Store containers in low traffic areas to reduce the possibility of shock or vibration.
- Compounds which have reached their expiration date should be handled with the utmost care. It is extremely important that such containers not be opened or moved until they have been evaluated by an EOHSS staff member. Also, do not open any container if the compound is overly viscous, has formed crystals, or looks “aged.”

3.N SODIUM AZIDE

Frequently used in UMDNJ laboratories, sodium azide can violently decompose if heated near its decomposition temperature (275°C).

Violent reactions can also occur if sodium azide comes into contact with copper, lead, carbon disulfide, nitric acid, dimethyl sulfate. Contact with water and acids forms hydrazoic acid, which is both toxic and explosive.

Sodium azide should never be allowed to come into contact with heavy metals and/or their salts, which could result in the formation of shock-sensitive, explosive heavy metal azides.

DO NOT store sodium azide on metal shelves or use metal lab utensils when working with it.

3.O PERCHLORIC ACID

A highly corrosive, non-combustible material, perchloric acid is used to denature proteins and stain gels. Laboratories will usually purchase gallon or smaller containers of 70-72% perchloric acid

Perchloric acid presents an additional hazard in that perchloric acid mist and vapor can condense in ventilation systems to form metallic perchlorates, which can be explosive.

3.O.1 Special Precautions for Using Perchloric Acid

- Whenever possible, substitute a less hazardous chemical for perchloric acid.
- If possible, perchloric acid should not be purchased in concentrations greater than 60% by weight.
- Work must be performed under a chemical hood. No benchtop digestions are permitted.
- There must be no other chemicals in the chemical hood when using perchloric acid. Contact with organic substances may result in a violent reaction.
- Perchloric acid must never be heated in the types of hoods available at UMDNJ. Special hoods with a wash-down feature are required when it is heated.
- To prevent injury, goggles or face shield, gloves, and apron should be worn when handling perchloric acid.
- When diluting perchloric acid (or any other acid) always add **ACID TO WATER**, not the reverse.
- Perchloric acid must be segregated from all other chemicals and inside a glass or porcelain secondary containment.
- Store perchloric acid away from organic acids such as acetic acid. Do not store it

near bases, or near other organic or flammable or combustible material.
- Perchloric acid waste must not be mixed with any other waste. Place it in a chemically compatible container (e.g. the original container), then label and dispose of it as detailed in Section 9 - Hazardous Waste Management.
- Make sure that you have an appropriate acid-neutralizing agent (for example, J.T. Baker Liquid 'Low Na+' Neutralizers) and clean up spills immediately. **DO NOT** use paper towels, spill pillows, or any other organic absorbent to clean up spills of perchloric acid. Contact between 70% perchloric acid and wood, paper, or cotton can produce fires and explosions.
- Anhydrous perchloric acid is exceptionally dangerous; do not order it.
- See the EOHSS website for more information about use of perchloric acid.

3.P PYROPHORIC AND REACTIVE CHEMICALS

Pyrophoric chemicals are liquids or solids that will ignite spontaneously in air. Many of them are also water reactive and will ignite upon contact with water (or even moist air). Most typically, pyrophoric materials are manipulated in an inert (non reactive) atmosphere of nitrogen or argon using specialized glassware. Standard Operating Procedures must be tailored and implemented for use of prophoric reagents, as described in Section 4B of this Plan.

3.Q RADIOACTIVE MATERIALS

Ensure that radioactive materials are stored, handled and used only by the trained authorized users to keep exposure As Low As Reasonably Achievable (ALARA) and to minimize the property damage by radioactive materials resulting from fires and explosions. The users of such materials shall also comply with the requirements of the University's Radiation Safety Policies and Procedures.

The NRC requires that radioactive materials be used or stored only in restricted areas which are secured and regularly wiped and where no food or drinks are consumed.

Contact your campus Radiation Safety Office for information about storage and use of Radioactive Materials.

3.R BIOHAZARDOUS MATERIALS

See Section 10 of this plan for a detailed description of how to use and store biohazardous materials.

3.S SELECT AGENTS

In order to comply with the new regulations from the Public Health Service, all possession and transfers of infectious agents and potentially hazardous materials

included on the CDC's List of Select Agents (Table 10.8) must be registered with EOHSS. Shipment or receipt of Select Agents must also be registered with the US Centers for Disease Control and Prevention. See Section 10.L of this plan for more information.

3T. PACKING AND MOVING CHEMICALS DURING LABORATORY MOVES OR OTHER OCCASIONS

DOT requirements for packing and moving chemicals must be adhered to as described in Appendix F, UMDNJ Protocol for Vacating a Laboratory.

SECTION 4 - ADDITIONAL PRECAUTIONS FOR PARTICULARLY HAZARDOUS AND PYROPHORIC/REACTIVE SUBSTANCES

4.A INTRODUCTION: Particulaly Hazardous Substance

"Particularly Hazardous Substance" is a term used in the OSHA Laboratory Safety Standard, and includes:

- **Acutely toxic materials** - Substances that meet the ANSI Z129.1 standard definition for high toxicity; due to the paucity of data for inhalation and dermal toxicity. In practice this means having a rat oral LD_{50} of 50 mg/kg or less. In addition, microbial toxins with an LD_{50} less than 50 mg/kg are considered an acutely toxic substance. See Table 4.1 for examples.
- **Select carcinogens** - Substances which meet one of the following criteria are considered select carcinogens:
  - (i) It is regulated by OSHA as a carcinogen; or
  - (ii) It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition) (see complete listing in Table 4.2); or
  - (iii) It is listed under Group I ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest edition); or
  - (iv) It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals.
- **Reproductive toxins** - Agents which affect reproductive capabilities including causing chromosomal damage and/or teratogenic effects on fetuses.

Table 4.1 - Examples of Acutely Toxic Compounds

Acrolein	Nitrogen dioxide
Hydrogen cyanide	Osmium tetroxide
Hydrofluoric Acid	Phosgene
Hydrogen Sulfide	Sodium azide
Methyl mercury, and its other organic forms	Sodium cyanide

4.B STANDARD OPERATING PROCEDURES (SOP)

It is crucial to carefully plan experiments and procedure involving particularly hazardous substances. Therefore, a written Standard Operating Procedure (SOP) is **recommended** for work involving particularly hazardous substances, which includes select carcinogens, reproductive toxins and acutely toxic chemicals. Written SOPs are **required** for chemicals with very low oral, inhalation or skin LD_{50} as defined in section 4.B.2 of this chapter, and must be reviewed by EOHSS.

EOHSS should be informed when a lab will use a chemical for which a written SOP is required. EOHSS will provide assistance in the development of the written SOP, if requested, even if the chemical does not meet the specific criteria listed in section 4.B.2. EOHSS will also post "Safe Work Practices" for various chemicals on the EOHSS website at http://www.umdnj.edu/eohssweb/publications/index.htm#Toxin. The written SOP and material safety data sheet for each particularly hazardous substance must be reviewed by personnel who will work with the substance.

4.B.1 Topics To Be Included In A Written SOP

A written SOP should include the following:

1. Name of Chemical(s) to be used;
2. A Material Safety Data Sheet for each chemical (available from http://www.umdnj.edu/eohssweb/publications/msds.htm)
3. Details as to the type of required personal protective equipment (e.g., safety glasses or goggles; glove type - nitrile, neoprene, vinyl; laboratory coat with sleeves rolled down, closed toed shoes);
4. Personal Hygiene Procedures, including, but not limited to:
   - All personnel must wash their hands immediately after the completion of any procedure in which a particularly hazardous substance has been used.
   - Immediately after any known exposure, employees must wash or shower and notify his/her supervisor.
   - No food or drink of any kind may be consumed in areas where particularly hazardous substances are in use.
5. Emergency Procedures. In addition to the procedures listed in the flipchart entitled, "EOHSS Emergency Response Guide," the SOP should detail additional chemical-specific emergency procedures including any special first aid treatment or antidote required by the type of particularly hazardous substance(s) handled in the laboratory.

   The Emergency Medical Procedures should be reviewed by Employee Health Services and any antidote required shall be provided to Employee Health Services before any work using the hazardous material shall take place.

Information on Emergency Medical Procedures shall be posted in the work area.

6. Other procedures for safe handling of the material, including but not limited to:
   - Limiting its use to the chemical hood.
   - Requiring that acutely toxic chemicals be manipulated over plastic-backed disposable paper work surfaces, or in secondary containers or trays, where feasible.
   - Waste disposal procedures.
   - Cleaning procedures for contaminated areas.
   - Procedure for decontaminating equipment and glassware before removing them from the designated area.
   - Procedure for safely weighing out powders.
   - All containers of a particularly hazardous material shall be labeled with hazard warnings, and stored in non-permeable, unbreakable secondary containers, which are also labeled with hazard warnings.
   - Only the smallest amount of these materials necessary for use should be present in the work area.
   - A knowledgeable colleague who can provide assistance should be available at all times when a highly toxic material is being used.
7. The location of the areas within the laboratory designated for the use of the material. In addition, the locations within the laboratory where particularly hazardous substances are handled should be demarcated with designated area signs. See Section 4.D for more information.
8. The sop should describe medical evaluation and/or surveillance, which may be indicated for work with specific substances.

4.B.2 Requirement for EOHSS Evaluation of Written SOP

Laboratories must submit SOPs to EOHSS for review before conducting procedures involving uncommon, unusually hazardous materials with LD_{50} values below the levels specified in the chart below, which can cause life threatening health conditions with only small exposures or which need antidotes to be kept on hand. (EOHSS will develop or assist in the development of SOPs if requested.)

The chart below can be used for guidance as to which standard operating procedures must be submitted to EOHSS for review.

Types of Study	Chemical considered "Toxic"	Chemical considered "Highly Toxic"	EOHSS Review Required
Oral LD_{50} [1] (albino rats)	50 - 500 mg/kg	< 50 mg/kg	**< 30 mg/kg**
Skin Contact LD_{50} (albino rabbits)	200 - 1000 mg/kg	< 200 mg/kg	**<100 mg/kg**
Inhalation LC_{50} [2] (albino rats)	200 - 2000 ppm in air	< 200 ppm in air	**< 100 ppm in air**
Inhalation LD_{LO} [3] (Human)	NA	NA	**< 100 ppm**

1. An LD_{50} value is the amount of a solid or liquid material that it takes to kill 50% of test animals in one dose.
2. LC_{50} (50% lethal concentration) is a related term used for gases, dusts, vapors, mists, etc. It is the concentration of a material in air that will kill 50% of the test subjects when administered as a single exposure (typically 1 or 4 hours).
3. LD_{LO} - This is the lowest known lethal dose.

These values gives you an idea of the relative toxicity of the material. Both LC_{50} and LD_{50} values state the animal used in the test. However, chemicals have varying amount of toxicity for different animals species and do not necessarily extrapolate (extend) to humans. Contact EOHSS if there are any doubts about the need to submit a SOP for EOHSS review. For more information on toxicity measures see: http://www2.umdnj.edu/eohssweb/aiha/technical/msds.htm#Toxic.

Examples of chemicals that would need to have an SOP reviewed by EOHSS include, but are not limited to:

Chloromethyl methyl ether	55 ppm LD_{50} rat inhalation
Cyanogen Bromide	92 ppm LC_{LO} human inhalation
Dimethyl mercury	1 to several drops LD_{LO} human skin
Hydrogen Cyanide	10 mg/kg LD_{50} rat oral
Hydrofluoric acid	50 ppm LC_{LO} human inhalation
Methyl Mercury Salts	varies
Osmium Tetroxide	14 mg/kg LD_{50} rat oral
Mechloroethamine HCL	10 mg/kg LD_{50} rat oral
>5% Sodium Azide	27 mg/kg rat oral LD_{50}

4.C DESIGNATED AREAS FOR USE OF PARTICULARLY HAZARDOUS SUBSTANCES

Reducing the potential for exposure to particularly hazardous chemicals is achieved by restricting the use of these materials to **designated areas** which are equipped with proper control devices. Examples of designated areas include a control device such as a glove box or chemical hood, or using materials only on a specific bench within the laboratory. An entire room may be a designated area only when the nature of ongoing operations requires that any person who enters the room wear special protective equipment.

The PEOSH Laboratory Standard requires that particularly hazardous substances are stored, used, and prepared for disposal only in designated areas. The designated area must be identified by signs so those entering the area are aware that a particularly hazardous material may be in use. For example:

> "Acutely Toxic Chemical (Hydrofluoric Acid)" over the chemical hood where it is used.
>
> "Reproductive Toxin (Ethidium Bromide)" over balance area where it is weighed.

The Laboratory Standard also requires that consideration be given to the appropriateness of establishing specific procedures for the safe removal of containers with particularly hazardous substances and decontamination procedures for designated areas.

4.D TRAINING

There is an added risk for persons using particularly hazardous substances. Therefore, each person must be up-to-date on their Laboratory Safety Training and must be knowledgeable of the specific hazards of the material in order to use or to give prior approval for the use of Particularly Hazardous Substances. This requirement applies to all laboratory personnel.

4.E CONTAINMENT EQUIPMENT

Personnel should always verify that containment equipment such as chemical hoods, biological safety cabinets, and local exhaust ventilation is working appropriately before beginning work involving particularly hazardous materials.

In certain facilities, operation of the ventilation system may be affected by a number of conditions. For example, air supply and exhaust rates may be reduced during off-hours or when the lights are turned off in the room. This information can be obtained by contacting Physical Plant.

4.F REPRODUCTIVE HAZARD EVALUATION PROGRAM

Reproductive toxins are often mistakenly considered an issue only for pregnant women. Broadly defined, however, reproductive toxins are materials that can interfere with reproductive functions or can cause damage to an exposed adult's ova, sperm, embryo, fetus or child. Examples of reproductive effects include the following:

- effects on the reproductive organs (e.g. enlarged breasts, atrophied testicles, damaged ova)
- effects on adult sexual functions (e.g. ovulation, libido, fertility, menstruation)
- effects on the offspring of males or females who were exposed, by causing structural abnormalities, functional deficiencies, diseases or altered growth or death of the conceptus
- effects on the health of the neonate by concentrating in breast milk
- increased risk of cancer early in life or in adulthood from transplacental carcinogens crossing the placenta

Mutagens effect offspring through changes in the DNA of paternal spermatogonia or material oocytes prior to conception. *Teratogens* effect the developing embryo or fetus via exposures in the uterus.

There are few proven human teratogens. However, the vast majority of chemicals have not been conclusively studied for teratogenicity. The embryo/fetus is most susceptible to potential harmful effects of teratogens in the early part of the first trimester of gestation while the organs are forming.

Pregnancy is often not confirmed until well into the first trimester. For this reason employees should not wait to assess any potential risk related to their jobs until pregnancy is confirmed. Employees should be knowledgeable about the toxicological properties of materials that are being used in the laboratory. Materials safety data sheets are available for this purpose. EOHSS will also perform a search of the literature for health effects of various chemicals, upon request. In addition, exposure to potentially hazardous materials should be minimized at all times by the use of good laboratory practices, a properly functioning chemical hood and other control measures described in Section 7 of this Laboratory Safety Plan.

Exposure to certain chemicals may affect male reproductive organs and may be manifested as reduced fertility. Spermatogonia are continuously developed during the course of the lives of adult males. Spermatogonia continuously develop and mature over a 73-86 day period in adult males and are susceptible to mutations or other damage during this time. Birth defects or death of the conceptus and heritable changes in chromosomes are possible if conception occurs from a sperm which has been damaged or mutated.

Breast-feeding employees may also need to take special precautions to prevent exposures to chemicals which could concentrate in breast milk resulting in exposure to their babies.

Any employee who is concerned about potential exposures to reproductive toxins on the job should request a Health Hazard Evaluation of their work area from EOHSS. The purpose of a Health Hazard Evaluation is to ascertain employees' potential for exposure to chemicals or other hazardous materials. It is strongly recommended that a copy of the report which summarizes the Health Hazard Evaluation findings be provided to a physician and/or Employee Heath Services, so that recommendations for additional safety measures can be implemented.

4.G SUBSTANCES WITH UNKNOWN TOXICITY

Insufficient data exist to characterize the toxicity of certain substances that may be used at UMDNJ. We are obliged to assume that they are toxic, and handle them accordingly. Special consideration should be given to the possibility of dermal contact and inhalation exposure. Always handle these materials with gloves. Use the chemicals in the chemical hood if there is any possibility of aerosol generation, or if the chemicals are of low molecular weight. Special attention should also be given to decontamination of work surfaces and materials by thorough cleaning with a detergent following the use of these substances.

4.H WEIGHING TECHNIQUES FOR HAZARDOUS SUBSTANCES

Dilutions of particularly hazardous substances should take place in a chemical hood. To minimize exposure to the PHS during weighing, a closed vessel can be tared on the open bench, with the drug added to it in the chemical hood, followed by reweighing outside of the hood. Adding of the solvent, and any additional dilutions of the material should take place in the chemical hood.

While preparing dilutions, ensure that the sash of the chemical hood is lowered to operating height. Wear eye protection, gloves, and a lab coat and/or a gown with low permeability (please see Sections 7.H to 7.L for more details).

Surfaces should be covered with disposable bench paper. Contaminated bench paper and any remaining solutions should be disposed of as hazardous chemical waste. The bench paper should be changed after work is done for the day, at the end of the work shift, and after a spill.

Table 4.2 - Known or Suspected Carcinogens as listed in the 10th Report on Carcinogens - National Toxicology Program

Acetaldehyde
2-Acetylaminofluorene
Acrylamide
Acrylonitrile
Adriamycin®® (Doxorubicin Hydrochloride)
Aflatoxins
Alcoholic Beverage Consumption
2-Aminoanthraquinone
o-Aminoazotoluene
4-Aminobiphenyl
1-Amino-2-methylanthraquinone
2-Amino-3-methylimidazo[4,5-f]quinoline
Amitrole
o-Anisidine Hydrochloride
Arsenic Compounds, Inorganic
Asbestos
Azacitidine
Azathioprine
Benzene
Benzidine and Dyes Metabolized to Benzidine
Benzotrichloride
Beryllium and Beryllium Compounds
Bromodichloromethane
2,2-bis(Bromoethyl)-1,3-propanediol (Technical Grade)
1,3-Butadiene
1,4-Butanediol Dimethylsulfonate (Myleran®®)
Butylated Hydroxyanisole (BHA)
Cadmium and Cadmium Compounds
Carbon Tetrachloride
Ceramic Fibers (Respirable Size)
Chlorambucil
Chloramphenicol
Chlorendic Acid
Chlorinated Paraffins (C_{12}, 60% Chlorine)
1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea
1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea (MeCCNU)
bis(Chloroethyl) nitrosourea
Chloroform
bis(Chloromethyl) Ether and Technical-Grade Chloromethyl Methyl Ether
3-Chloro-2-methylpropene
4-Chloro-o-phenylenediamine
Chloroprene
p-Chloro-o-toluidine and p-Chloro-o-toluidine Hydrochloride
Chlorozotocin
Chromium Hexavalent Compounds
C.I. Basic Red 9 Monohydrochloride
Cisplatin
Coal Tars and Coal Tar Pitches
Coke Oven Emissions
p-Cresidine
Cupferron
Cyclophosphamide
Cyclosporin A
Dacarbazine
Danthron (1,8-Dihydroxyanthraquinone)
2,4-Diaminoanisole Sulfate
2,4-Diaminotoluene
1,2-Dibromo-3-chloropropane
1,2-Dibromoethane (Ethylene Dibromide)
2,3-Dibromo-1-propanol tris(2,3-Dibromopropyl) Phosphate
1,4-Dichlorobenzene
3,3 ´-Dichlorobenzidine and 3,3 ´-Dichlorobenzidine Dihydrochloride
Dichlorodiphenyltrichloroethane; (DDT)
1,2-Dichloroethane (Ethylene Dichloride)
Dichloromethane (Methylene Chloride)
1,3-Dichloropropene (Technical Grade)
Diepoxybutane
Diesel Exhaust Particulates
Diethyl Sulfate
Diethylstilbestrol
Diglycidyl Resorcinol Ether
3,3 ´-Dimethoxybenzidine and Dyes Metabolized to 3,3 ´-Dimethoxybenzidine
    3,3 ´-Dimethoxybenzidine Dyes Metabolized to 3,3 ´-Dimethoxybenzidine
4-Dimethylaminoazobenzene
3,3 ´-Dimethylbenzidine and Dyes Metabolized to 3,3 ´-Dimethylbenzidine
3,3 ´-Dimethylbenzidine Dyes Metabolized to 3,3 ´-Dimethylbenzidine
Dimethylcarbamoyl Chloride
1,1-Dimethylhydrazine
Dimethyl Sulfate
Dimethylvinyl Chloride
1,4-Dioxane
Disperse Blue 1
Epichlorohydrin
Erionite
Estrogens, Steroidal
Ethylene Oxide
Ethylene Thiourea
di(2-Ethylhexyl) Phthalate
Ethyl Methanesulfonate
Formaldehyde (Gas)
Furan
Glasswool (Respirable Size)
Glycidol
Hexachlorobenzene
Hexachloroethane
Hexamethylphosphoramide
Hydrazine and Hydrazine Sulfate
Hydrazobenzene
Iron Dextran Complex
Isoprene
Kepone®® (Chlordecone)
Lead Acetate and Lead Phosphate
Lindane and Other Hexachlorocyclohexane Isomers
Melphalan
Methoxsalen with Ultraviolet A Therapy (PUVA)
2-Methylaziridine (Propylenimine)
4,4 ´-Methylenebis(2-chloroaniline)
4,4 ´-Methylenebis(N,N-dimethyl)benzenamine
4,4 ´-Methylenedianiline and its Dihydrochloride Salt
Methyleugenol
Methyl Methanesulfonate
N-Methyl-N ´-nitro-N-nitrosoguanidine
Metronidazole
Michler's Ketone (4,4'-(Dimethylamino)benzophenone)
Mineral Oils (Untreated and Mildly Treated)
Mirex
Mustard Gas
2-Naphthylamine
Nickel Compounds and Metallic Nickel
Nickel Compounds
Metallic Nickel
Nitrilotriacetic Acid
o-Nitroanisole
Nitroarenes (selected)
1,6-Dinitropyrene
1,8-Dinitropyrene
6-Nitrochrysene
1-Nitropyrene
4-Nitropyrene
Nitrofen (2,4-Dichlorophenyl-p-nitrophenyl ether)
Nitrogen Mustard Hydrochloride
2-Nitropropane
N-Nitrosodi-n-butylamine
N-Nitrosodiethanolamine
N-Nitrosodiethylamine
N-Nitrosodimethylamine
N-Nitrosodi-n-propylamine
N-Nitroso-N-ethylurea
4-(N-Nitrosomethylamino)-1-(3-pyridyl)-1-butanone
N-Nitroso-N-methylurea
N-Nitrosomethylvinylamine
N-Nitrosomorpholine
N-Nitrosonornicotine
N-Nitrosopiperidine
N-Nitrosopyrrolidine
N-Nitrososarcosine
Norethisterone
Ochratoxin A
4,4 ´-Oxydianiline
Oxymetholone
Phenacetin and Analgesic Mixtures Containing Phenacetin

Table 4.2 - Known or Suspected Carcinogens as listed in the 10th Report on Carcinogens - National Toxicology Program (cont.)

Phenacetin Analgesic Mixtures Containing Phenacetin
Phenazopyridine Hydrochloride
Phenolphthalein
Phenoxybenzamine Hydrochloride
Phenytoin
Polybrominated Biphenyls (PBBs)
Polychlorinated Biphenyls (PCBs)
Polycyclic Aromatic Hydrocarbons
15 Listings
- Benz[a]anthracene
- Benzo[b]fluoranthene
- Benzo[j]fluoranthene
- Benzo[k]fluoranthene
- Benzo[a]pyrene
- Dibenz[a,h]acridine
- Dibenz[a,j]acridine
- Dibenz[a,h]anthracene
- 7H-Dibenzo[c,g]carbazole
- Dibenzo[a,e]pyrene
- Dibenzo[a,h]pyrene
- Dibenzo[a,i]pyrene
- Dibenzo[a,l]pyrene
- Indeno[1,2,3-cd]pyrene
- 5-Methylchrysene

Procarbazine Hydrochloride
Progesterone
1,3-Propane Sultone
ßß-Propiolactone
Propylene Oxide
Propylthiouracil
Radon
Reserpine
Safrole
Selenium Sulfide
Silica, Crystalline (Respirable Size)
Soots
Streptozotocin
Strong Inorganic Acid Mists Containing Sulfuric Acid
Styrene-7,8-oxide
Sulfallate
Tamoxifen
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD); "Dioxin"
Tetrachloroethylene (Perchloroethylene)
Tetrafluoroethylene
Tetranitromethane
Thioacetamide
Thiotepa
Thiourea
Thorium Dioxide
Tobacco Related Exposures
Toluene Diisocyanate
o-Toluidine and o-Toluidine Hydrochloride
Toxaphene
Trichloroethylene
2,4,6-Trichlorophenol
1,2,3-Trichloropropane
Ultraviolet Radiation Related Exposures
Broad-Spectrum Ultraviolet (UV) Radiation
Solar Radiation
Sunlamps or Sunbeds, Exposure to
- Ultraviolet A Radiation
- Ultraviolet B Radiation
- Ultraviolet C Radiation

Urethane
Vinyl Bromide
Vinyl Chloride
4-Vinyl-1-cyclohexene Diepoxide
Vinyl Fluoride
Wood Dust

4I- ADDITIONAL PRECAUTIONS FOR PYROPHORIC AND REACTIVE CHEMICALS

4.I.1 Pyrophoric chemicals are liquids or solids that will ignite spontaneously in air. Many of them are also water reactive and will ignite upon contact with water (or even moist air). Most typically, pyrophoric materials are manipulated in an inert (nonreactive) atmosphere of nitrogen or argon using specialized glasswar e. Most of these reagents are supplied diluted in a flammable organic solvent such as hexane.

Some of the most common pyrophoric lab reagents include chemicals that contain functional groups such as: organolithium (l ithium aluminum hydrides), organozinc, organomagnesium (Grignard reagents), aluminum alkyls, and boranes.

Pyrophoric reagents can be identified in a num ber of ways. The warning label on each container will include a symbol indicating water cont act should be av oided. The NFPA reactivity classification will also be ranked as 3 or 4. The Material Safety Data Sheet will describe the material as “highly flammable” and/or “pyrophoric” and include a list of some incompatible chemicals.

4.I.2 Laboratories using pyrophoric or highly reactive reagents are required to do the following:

1. Adapt, for the lab, and implement the UMDNJ Standard Operating Procedure (SOP) for pyrophoric chemicals, which is available at:

http://www.umdnj.edu/eohssweb/publications/pyrophoric.pdf

2. Provide hands-on training on laboratory procedures for personnel who will work directly with the reactive reagents, and document this training in the appropriate section of the SOP; and,

3. Document training of all laboratory staff regarding the SOP and hands-on emergency actions.

4.I.3 When tailoring the SOP for the laboratory, the points listed below should be addressed:

- Each highly reactive chemical should be identified along with the incompatible chemicals stored/used in the lab that can lead to a reaction;
- A signature page should be completed documenting that personnel have reviewed and understand the specific handling procedures in the SOP and that they have attended additional training as determined by the PI and EOHSS;
- Detailed procedures should be written for handling the reagents, including the methods of isolation and storage:
    - location where the material should be used (usually in a chemical hood with the sash lowered, or a glove box or disposable glove bag filled with an inert gas);
    - procedures for transferring and manipulating the reagents while preventing contact with air;
    - equirements for safety shielding;
    - vacuum system protection; and,
    - storage of pyrophoric reagents away from flammables and ignition sources.

- A requirement that lab coats and gloves made of flame resistant materials such as Kevlar or Dupont Nomex be worn to completely cover personal clothing when handling these reagents (a key word search on the term “flame resistant lab coats and gloves” will provide information on safety suppliers);
- A requirement that eye and face protection such as goggles and face shields be worn;
- A requirement prohibiting working alone that includes identifying specific individuals who must be available in the lab to help in the event of an emergency;
- A method for storing of any unused or incompletely reacted reagent as hazardous waste. (Note: highly reactive waste streams should not be comingled with other

waste streams. They should not be stored near any waste streams that contain incompatible chemicals and removal from the lab should be scheduled as soon as possible);

- Emergency procedures, which address:
  - response actions to fires, explosions, spills, and injury to staff, and who to contact in an emergency
  - the location and types of safety equipment to use in an emergency (showers, spill equipment, eye wash, class D fire extinguishers, sand, etc.)
- The method used to alert personnel in neaby areas of potential emergencies; and,
- Identification of signs and symptoms of overexposure and any specific first aid treatment that would be required by the type of reactive material handled in the laboratory.

The MSDS, open literature, and links to the websites provided in the SOP should be reviewed to assist in addressing the details described above. EOHSS will assist the lab with developing the written SOP upon request. Review and discussion of the final SOP details within the laboratory group can serve as appropriate training with EOHSS approval. Training on the basic principles of handling reactive materials can also be accomplished by accessing the website links provided in the SOP or contacting EOHSS for assistance.

4.I.4 In addition to the SOP, details of the 2009 death of a UCLA laboratory technician should be covered during training. An official report on the incident (http://www.cdph.ca.gov/programs/ohb-face/Documents/09CA001.pdf) is available through the California Department of Public Health's Fatality Assessment and Control Evaluation (FACE) Program.

SECTION 5 - PRIOR APPROVAL

5.A SYSTEM FOR SITUATIONS REQUIRING PRIOR APPROVAL

The PEOSH Laboratory Standard requires that the written Laboratory Safety Plan include a description of circumstances when prior approval must be obtained for activities associated with laboratories. At UMDNJ, prior approval must be obtained before certain procedures or activities are carried out. These procedures, as well as who the approval must be from, are summarized below. All persons who are granting or obtaining approval must be up to date on their Seminar and Workshop Laboratory Health and Safety training.

PROCEDURE	APPROVAL REQUIRED BY:
5.A.1 Visitors who are under the age of 18 in the laboratory (See Section 2.G "Policy on Visitors")	Departmental Chair - written approval required
5.A.2 Initial purchase and use of substances which are acutely toxic, carcinogenic, reproductive toxins or pyrophoric/reactive. (See Section 4 “Additional Precautions for Particularly Hazardous and Pyrophoric/Reactive Substances”)	Responsible Investigator or Designee A written SOP may be required. See Section 4.B and 4.I. for details.
5.A.3 Live-animal use of hazardous substances	Institutional Animal Care and Use Committee (IACUC)
5.A.4 Use of chemicals in a ductless chemical hood (See Section 7.C Use of Ductless Hoods")	EOHSS
5.A.5 Use of Respiratory Protection (See Section 7.L "Respiratory Protection")	EOHSS
5.A.6 Operations that will result in the generation of mixed radioactive/ hazardous chemical waste (See Section 9 “Hazardous Waste Management”)	EOHSS and the Radiation Safety Officer must be consulted to ensure that disposal options exist
5.A.7 Purchase of radionuclide-labeled hazardous chemical (See Section 9 “Hazardous Waste Management)	EOHSS, Radiation Safety Officer

PROCEDURE	APPROVAL REQUIRED BY:
5.A.8 Research classified as "non-exempt" as per NIH Guidelines on Recombinant DNA (See "non-exempt" in the Definition section as well as the Biosafety Plan - Section 10 and Appendix J for more information)	School/Campus Institutional Biosafety Committee
5.A.9 Use of a etiologic agent which requires a higher Biosafety Level that agents currently in use. UMDNJ research laboratories must complete and submit a registration form within one week of initiating work with each new pathogen. Use of a pathogens which requires a higher biosafety level (BL) than pathogens currently in use requires prior approval before use of the pathogen is initiated. (See the Section 10 “Biosafety Plan” and Appendix K for more information)	School/Campus Institutional Biosafety Committee
5.A.10 Non-laboratory storage areas for flammable materials (See Section 3 “Storage and Handling of Chemicals”)	EOHSS
5.A.11 Moving into a vacated laboratory (See Section 2.I “Laboratory Vacating Procedures” and Appendix F "UMDNJ Protocol for Vacating a Laboratory")	EOHSS/Radiation Safety Officer must have decommissioned the laboratory
5.A.12 Disposal of hazardous chemical waste by any means other than the procedure discussed in the UMDNJ Hazardous Waste Management Plan (See Section 9, "Hazardous Waste Management")	EOHSS
5.A.13 Outside contractors working in a laboratory (See Section 2.A.4 Training Requirements for Visitors to the Laboratory and 2.G “Policy on Visitors”)	Responsible Investigator or designee

PROCEDURE	APPROVAL REQUIRED BY:
5.A.14 Storage of more than 10 gallons of flammable liquids in a laboratory (See Section 3.F Storage of Flammable and Combustible Chemicals)	EOHSS and Department Manager
5.A.15 Permission for undergraduate students to work during off-hours (See Section 2.D “Working Alone” and Appendix E “Sample Permission Slip for Off-Hours Work”)	Responsible Investigator - Written approval required
5.A.16 Renovations to an existing laboratory	EOHSS, Operations and Facilities Planning & Design must review and approve plans. In addition, EOHSS has Minimum Laboratory Design Guidelines for renovations to existing labs. Contact EOHSS for more information.
5.A.17 Use of CDC-listed Select Agents (See Section 10.L “Pathogen and Toxin Registry” for more information)	School Responsible Official and the Institutional Biosafety Committee
5.A.18 High School Students Working in Laboratory (See Section 2.G.3 for additional information)	Human Resources, EOHSS, School/Campus Laboratory Safety Committee, Institutional Biosafety Committee, Radiation Safety Officer, and or IACUC.

(Page intentionally left blank)

SECTION 6 - EMERGENCY PROCEDURES AND EQUIPMENT

6.A POSTING OF THE EMERGENCY FLIPCHART

Every laboratory shall have a copy of the UMDNJ flipchart entitled "Emergency Response Guide" posted in a prominent location. This flipchart, available from EOHSS, and posted at: http://www.umdnj.edu/eohssweb/publications/emergency_response_guide.pdf contains campus-specific instructions on how to respond to fires, chemical spills, radioactive spills, biological spills and medical emergencies. Each laboratory should also list any additional emergency procedures, such as specific antidotes or instructions that are applicable to the laboratory, on the flipchart.

6.B EMERGENCY EQUIPMENT

At a minimum, each laboratory area should have the following emergency and containment equipment available:

- A 10-lb ABC type multipurpose fire extinguishers mounted conspicuously near the laboratory door. Equivalent clean agent fire extinguisher (e.g., CO_2, water mist, or other clean agent) may be substituted for an ABC dry powder fire extinguisher in consultation with EOHSS to accommodate any special needs of each lab. Use of flammable metals requires that a D type extinguisher be available.
- Appropriate eye protective devices for staff, students, and visitors, and a means to maintain them in a sanitary condition.
- Laboratory coats or rubber aprons.
- An emergency eye wash device capable of a 15 minute flow of water.
- An emergency shower capable of a 15 minute flow of water.
- A chemical hood capable of exhausting toxic and offensive vapors to the exterior.
- Gloves which are resistant to the chemicals in use. Autoclave or cryogenic gloves should also be available.
- Spill clean-up kits for acids, bases, and organic solvents. Additional chemical resistant bags should be available to contain solid chemical spills.

6.C IN THE EVENT OF A FIRE

6.C.1 Notes and Precautions

- When you hear a fire alarm, never assume that it is a false alarm.
- Follow the specific emergency procedures for your area.
- To prevent fires, report all unsafe conditions.
- Smoking is prohibited in all University buildings.

- If your clothing is on fire, **STOP, DROP, and ROLL**!
- Stay low - crawl under smoke.
- Fire extinguisher use is discouraged at UMDNJ for all but the smallest fires. After activating the fire alarm pull station, a person might consider the use of a fire extinguisher providing the fire does not block a safe exit route and he/she takes no chances of personal injury.
- Use fire extinguishers for small fire-defense and only if you are trained. Remember the "PASS" procedure: ***Pull*** the pin, ***Aim*** the nozzle at the base of the fire, ***Squeeze*** the lever continuously, and ***Sweep*** slowly from side to side. Make sure that your exit is clear and you can extinguish the fire with your back to the exit. More detailed information concerning the use of fire extinguishers can be obtained by contacting EOHSS, or by attending a Fire Safety Training Course offered by EOHSS.

6.C.2 If You Discover Fire or Smoke:

- **ALERT** the people in your area.
- **PULL** the fire alarm.
- **CLOSE** doors to isolate the fire. Turn off electric and gas equipment, if possible.
- **USE FIRE EXTINGUISHER** only for small fire-defense.
- **EVACUATE.** Follow EXIT signs.
- **CALL** Public Safety at 5-4000 to report the incident.

6.C.3 If You Hear or See a Fire Alarm:

- **EVACUATE the building OR**
- **EVACUATE AS INSTRUCTED**

If you know specific details concerning the fire, contact Public Safety personnel or emergency responders.

6.C.4 Clothing Fires

Stop, Drop, and Roll

In the event of a clothing fire, use the safety shower if it is nearby. Otherwise, the "Stop, Drop, and Roll" method should be used. A person should immediately drop to the floor, and roll on the floor to smother the flames, while calling for help. **Never** run, as this will intensify the clothing fire. If another person's clothing is on fire, the observer should force that person to the floor while being careful to avoid the flames, and should help the victim roll around to smother the flames.

6.C.5 Use of Fire Blankets

Fire blankets provide a very effective means of extinguishing a clothing fire, provided that they are immediately at hand. They are secondary in importance to following the "Stop, Drop and Roll" procedure and are not required. However, where blankets are installed, laboratory personnel should know the appropriate procedure for their use. Improper use can make the injury worse. Move the blanket over the head and proceed towards the feet. Do not simply drop the blanket on the victim since this may trap heat from the smoldering clothing. The blanket should immediately be removed once a clothing fire is extinguished. Blankets may also be used as protective covering by those seeking egress from a fire area.

6.D CHEMICAL SPILL

6.D.1 Notes and Precautions

- Because of the types and characteristics of hazardous materials used in laboratories, preplanning is required for safe and effective response in the event of a spill.
- Chemical spills should only be cleaned up by knowledgeable and experienced personnel who have received the appropriate training and information.
- Clean-up response equipment, including chemical spill kits and personal protective equipment, must always be available.
- Laboratory staff are responsible for cleaning up minor chemical spills. A minor spill means < l liter of any chemical that is NOT a carcinogen, acutely toxic, or a reproductive hazard. EOHSS and other emergency response personnel will handle all other chemical spills.

6.D.2 Minor Chemical Spills

- Assess whether you are able to clean up the spill, based on your experience and training, as well as the availability of hazard information and clean-up response equipment. If you feel that you are unable to do the clean-up yourself, treat it as a "small or large" spill (see instructions below).
- Alert people in the immediate area and post a hand-written warning sign.
- Evacuate from the area all personnel not involved in the clean-up and isolate the area.
- Turn off all ignition and heat sources if the spill material is flammable.
- Notify the Public Safety Emergency Number before proceeding with the spill clean-up.
- Review the MSDS for the spilled material. If you do not have this information, or need other technical assistance, ask Public Safety to contact EOHSS.

- Wear appropriate personal protective equipment to prevent exposure to skin, eyes, and respiratory system.
- Use the appropriate spill clean-up kit.
- Form a dike with the absorbent and mix with spilled material. Collect the residue, place it in a bag and label it as hazardous waste. Dispose of the clean-up material with other chemical waste through EOHSS
- Call Environmental Services to wet-mop the cleaned spill area.

6.D.3 Small or Large Chemical Spill

- NOTIFY the Public Safety Emergency Number immediately.
- ISOLATE the area to prevent the spread of contamination (i.e., close doors to affected area and post a warning sign).
- ALERT personnel in the immediate area to EVACUATE.

6.E SAFETY SHOWERS

A safety shower is an essential component of any laboratory where chemicals are used. It must be accessible to all personnel who work in the laboratory. All laboratory personnel should be familiar with the location of safety showers in or near laboratory.

6.E.1 Directions for Use of a Safety Shower

- Position the injured person under the safety shower, and activate it by pulling down on the bar or chain. (Note: Some safety showers require repeated pulling of the chain to maintain the flow of water.)
- Assist the victim by helping to remove contaminated clothing.
- Continue rinsing for a minimum of 15 minutes.
- Contact the Public Safety emergency number to advise them of the medical emergency.
- A disposable laboratory coat should be readily available to cover the victim after using a safety shower.

6.E.2 Inspections of Safety Showers

Physical Plant is responsible for periodically inspecting safety showers to ensure the flow of water is sufficient to rapidly drench a person following a chemical exposure. The inspections will be documented by either a tag or sticker located on or near the safety shower.

6.F EYEWASH FOUNTAINS AND HOSES

Eyewash stations provide protection against injuries to the eyes - one of the most common types of injuries in laboratories using chemicals. All employees are required to be familiar with the location of the eyewash in the lab. The station must be in a prominent and easily accessible location.

6.F.1 Directions for Use of an Eyewash

In the event of a splash, it is essential to rinse for 15 minutes. For this reason, plumbed units are required rather than bottled units. While rinsing, the victim or someone in attendance must keep the eyes of the injured person open. It is essential to call the Public Safety Emegency number so that the afflicted individual may be brought to the Emergency Room immediately after rinsing the eye.

6.F.2 Inspection of Eyewash Fountains and Hoses

Eyewash units located in the corridorsshall be tested and tagged by Physical Plant periodically. Some laboratories have aneyewash mounted at the sink. Laboratory staff are responsible for testing these units on a monthly basis to ensure adequate clean water flow, and that access is unobstructed.

6.G MEDICAL EMERGENCIES

Instructions for responding to medical emergencies are included in the UMDNJ "Emergency Response Guide" flipchart, which must be posted in each laboratory. The flipchart is available from EOHSS.

6.G.1 Planning for Medical Emergencies

If unusual treatments or vaccines are needed in case of an accident, emergency care providers should be notified before work begins so that the appropriate materials are available for emergency treatment. For example, calcium gluconate should be available for hydrofluoric acid users and atropine should be available for organophosphate users.

6.G.2 Reporting of Incidents

Any incident that results in injury, symptoms that may be related to exposure to a hazardous material, or a significant exposure to a hazardous material must be reported to the Department of Risk and Claims using the UMDNJ "Incident Report" form. A copy of the form may be obtained from the Departmental Administrator's office. Completion of this form facilitates proper follow-up medical care and compliance with state law. The Responsible Investigator is responsible for

determining the cause of accidents that occur in the laboratory. EOHSS may be called upon to provide assistance, as necessary. These investigations will focus on methods which can be implemented to prevent the recurrence of similar accidents.

6.H FLOODING SITUATIONS

A flood from a burst pipe, hole in the roof, or excessive rain can create a dangerous condition in a laboratory.

6.H.1 Electrical Hazards

Do not walk through a flooded area to unplug electrical equipment. The flood waters may be in contact with live electricity. Evacuate the area, and let Physical Plant and EOHSS evaluate the situation.

Call the Public Safety emergency number for your campus and explain what is happening. Ask them to dispatch an electrician immediately to turn off the power. (Physical Plant has the ability to turn off all of the electricity from a remote location.)

While the power is off, the appliance can be unplugged, and the water can be safely cleaned up. Physical Plant can then restore power to the lab, and the appliance or instrument turned back on, if it is safe to do so.

6.H.2 Chemical, Biological, or Radiation Contamination

Flood waters may have come into contact with chemical, biological, or radiation storage or use areas and become contaminated. In some cases, the flood water may have to be collected as a hazardous waste. EOHSS or the radiation safety office will be able to assist in this determination.

6.I LOSS OF UTILITIES

Laboratory work may have to be curtailed or even stopped when an essential utility is lost. In addition, the labs will have to take steps to ensure the continued safety in the lab, and to preserve valuable work. For example:

6.I.1 Loss of electricity

Lab staff should turn off items such as hot plates, centrifuges, and any other equipment which has the potential to create a dangerous situation if the electricity came back on while the equipment was unattended.

Laboratories will lose the use of chemical hoods, incubators, and refrigerator and

freezers, unless this equipment is connected to emergency power. Some lab spaces are equipped with electrical outlets which are connected to emergency generator power. If you are unsure, check with Physical Plant to find out if a piece of equipment is connected to emergency power.

6.I.2 Loss of water

Of greatest concern is the inability of an injured staff member to rinse a chemical out of the eyes or off the body because of the lack of water.

Therefore, while some lab operations may be permitted, procedures which involve the use of injurious materials could be restricted until water service was restored.

6.I.3 Telecommunications

The threat to lab staff is the inability to summon help in the event of an emergency. In fact, if the phone lines are down, then the fire alarm system may also not work.

(Page intentionally left blank)

SECTION 7 - METHODS TO CONTROL EXPOSURE TO HAZARDOUS SUBSTANCES

7.A GENERAL WORK PRACTICE

The following work practices are in effect inall laboratory areas, regardless of the type of research being conducted:

- Wear eye protection and a lab coat when anyone in the lab is working with hazardous chemicals, radioactive materials, and biological agents at BL2 or higher. Wear appropriate protective gloves when working with hazardous chemicals, radioactive materials, and biological agents at BL2 or higher.
- Do not eat, drink, smoke, chew gum, store food, or apply cosmetics in work or storage areas.
- If you are working with a Particularly Hazardous Substance (see Section 4 "Additional Precautions for Particularly Hazardous Substances" for more information):
  - Use secondary containment while working (bench paper, nalgene tub).
  - Post Designated Areas signs
  - Weigh and use all the materials in the chemical hood.
- Label all containers solutions with the chemical names fully spelled out - not just the chemical symbols.
- Wash hands and decontaminate surfaces after work.
- Be prepared with appropriate spill containment items.
- Plan ahead. Know what you are going to do with any waste generated.

7.B ELIMINATION OR SUBSTITUTION OF TOXIC MATERIALS

The first step in evaluating anew experiment, process or operaton is to investigate the possibility of eliminating the use of hazardous materialsor substituting a less hazardous material. For example:

- many gross anatomy labs have eliminated the use of formaldehyde-based formulations;
- Instead of using an organic solvent or chromic acid based material for washing glassware, a laboratory can substitute an aqueous based detergent;
- Aromatic compounds (i. e., benzene) and chlorinated hydrocarbons (i.e., methylene chloride) used in experiments may sometimes be replaced with aliphatic compounds or non-chlorinated hydrocarbons;
- Mercury based temperature/pressure sensing devices can be replaced with non-mercury devices;
- Isoflurane is a less toxic anesthetic compared to halothane;

- Commercially-prepared chromatography columns for DNA and plasmid preparations are available to replace phenol/chloroform extractions.

The particular process, experiment or operation may also be modified to reduce the quantity of the hazardous material(s) used or to limit the potential emission release rate or exposure time. For example, the use of microscale techniques may be applicable in measuring boiling points of a material.

Upon request, EOHSS will assist laboratory personnel in performing the necessary research to identify alternatives to particularly hazardous chemicals or environmental toxins which can be employed in specific procedures.

Lastly, purchase any chemical substance in the smallest practical quantity.

7.C USE OF CHEMICAL HOODS

Chemical hoods are intended to provide protection from toxic, offensive and flammable vapors by maintaining a steady flow of air away from the user and out of the building. When the sash is down it also offers protection from splashing or minor explosions that may result from vigorous chemical reactions.

However, no chemical hood offers 100% containment of materials that are used within it. Effectiveness depends on the hood's design, location within the room, fan speed, as well as how it is used and maintained.

EOHSS performs an annual inspection of chemical hoods to ensure that the hoods are effectively able to contain contaminants generated inside. Staff shall not work with hazardous materials in a chemical hood unless it has an inspection sticker indicating it passed inspection by EOHSS in the past year. Hoods that fail inspection will have a notice (black lettering on orange background) indicating that the hood must not be used for work with hazardous materials until it has been repaired.

For extremely hazardous materials, EOHSS may conduct additional testing to ensure that the hood is effectively containing contaminants which are generated within. This evaluation is designed to determine if small amounts of leakage occur at various locations at the face of the hood. Even extremely small leakages may be unacceptable for highly toxic materials.

In general, the following safe work practices shall be used when working in a chemical hood:

1. Work well inside the hood, at least 6 inches from the face of the hood.

2. Maintain sash height as low as feasible for the manipulations performed.

3. Do not block the air exit slots at the lower rear of the hood. Large equipment in the hood creates potentially dangerous zones of turbulence. If this use is necessary, the hood should be dedicated and not used for other purposes.

4. Chemical storage should be minimized in the hood. If chemical storage is necessary, an acceptable "shelf" which can be used to prevent blockage of the rear slot. Contact EOHSS for more information.

1. Do not store loose kimwipes and other light papers in the hood. These can get sucked up into the exhaust duct and reduce the performance of the hood.

6. If your hood is not equipped with a pressure-gauge, keep a "kimwipe" or other light paper "flag" taped to the sash to verify continued operation. If particularly hazardous materials are often used in the hood, a pressure-gauge that can be easily mounted on the hood or a low air-flow alarm is highly recommended. If you believe that your hood is not operating properly, contact EOHSS to have it checked.

7. Do not use a hood which has not been inspected within the past year or which has a sign which indicates that the hood failed inspection. Contact EOHSS to have the hood reinspected or call Physical Plant to have the hood repaired.

8. If particularly hazardous materials are to be used in the hood, a more stringent hood inspection test is recommended. This testing will be performed by EOHSS upon request. The more stringent inspection test involves the use of a smoke generator the hood. The smoke allows the air patterns and any leakages from the hood to be visualized.

7.D USE OF DUCTLESS HOODS

Ductless hoods are extremely limited in terms of the range and quantity of toxic materials that they can handle. They should be used only as an auxiliary device in a lab which has a functioning ducted chemical hood. They would only be permitted for use with nuisance vapors and dusts that do not present a fire and toxicity hazard. In addition, they should not be used in rooms where the air which is leaving the laboratory is recirculated into another room. Written procedures must be in place and implemented to ensure that appropriate filters are utilized and that filters are replaced before they become saturated. Responsible Investigators shall contact EOHSS for approval before ductless hoods are purchased.

7.E USE OF GLOVE BOXES

Glove boxes are to be used when the extreme toxicity of a material warrants virtually 100% protection from exposure to the material. Labs who are planning to use materials with such extreme toxicity must first obtain the approval of EOHSS and the appropriate laboratory safety committee.

7.F USE OF CLEAN BENCHES

Clean benches, also known as "blow-out hoods" are present in a number of UMDNJ laboratories. Air is passed through a HEPA filter in the back of the unit and flows in the direction of the person working at the hood. These "clean benches" provide a particle-free environment within the work chamber but provide no protection for the person working at the hood. Since the operator sits in the immediate downstream exhaust from the "clean bench" this equipment must never be used for toxic, infectious or sensitizing materials. See Section 10.D “Engineering Controls” for more information on the use of biosafety cabinets for infectious agents.

7.G SECONDARY CONTAINERS

The use of a secondary containment device such as a Nalgene® pan, bench paper, and absorbent lab mats or underpads can be helpful in preventing or minimizing the effects of chemical spills. Use of secondary containment is recommended when using particularly hazardous substances.

7.H PERSONAL PROTECTIVE EQUIPMENT

Laboratory staff is expected to wear personal protective equipment that is appropriate to the work being performed.

Laboratory coats, gloves, goggles, and other safety equipment provide protection when working inside of the laboratory; and there are few instances where their use outside of the laboratory should be necessary to provide protection from laboratory-associated hazards.

Table 7.1 - Examples of Appropriate Personal Protective Equipment

Source	Assessment of Hazard	Protection
Corrosive Chemicals Examples: hydrochloric acid, ammonium hydroxide, phenol	Splash	Indirectly vented goggles For severe exposure, use a faceshield.
	Skin Contact	Chemical Resistant Gloves
Impact Examples: Breaking an ampule or glass tubing	Flying Fragments	Goggles. For severe exposure, use a face shield.
Organic Solvents	Skin Contact	Labcoat, Chemical Resistant Gloves
	Eye Contact	Safety Glasses or Goggles
Toxic Substances - Dry Powders	Skin absorption	Any “chemically resistant” glove.
Heat Example: Handling materials after autoclaving	Burn	Use heavy, heat-resistant gloves. Wear safety glasses.
Pyrophoric/Reactive	Fire/Explosion	Fire-resistant labcoat and gloves
Handling Cryogenic Liquids	Skin Contact	Use cryogenic gloves.
	Eye Contact	Use goggles and a face shield.

7.I EYE PROTECTION

The chemical hood provides both eye and inhalation pr otection against volatile chemicals. In addition, working in the c hemical hood with the sash lowered to 12 - 14 inches provides important protection agains t chemical splashes or small explosions which could injure the eyes.

Choosing and wearing the correct eyewear is also an important protection against splashes or small explosions. For prescription eyeglass wearers, eye protection must either fit over prescription glasses or incorporate the wearer's prescription. Each individual who works in the laboratory must be issued his/her own pair of safety glasses.

When materials which require eye protection are used on a frequent basis throughout the day, it can be difficult for laboratory personnel to remember to put on their eye protection for each operation. In this circumstance, eye protection should be worn at all times while in the laboratory.

7.1.1 Safety Glasses

Because they do not fit tightly against the face and do not completely surround the eye area, safety glasses with side shields offer only minimal protection from chemical splashes. Safety glasses are only appropriate when using small quantities of hazardous chemicals in procedures with a low potential for producing splashes, spills, or other means of ocular exposure.

Safety glasses with solid side shields are the minimum eye protection for laboratory personnel when they are present in a laboratory work area where hazardous chemicals are being used. RI's must provide a pair of safety glasses for each individual working in the laboratory for his/her own exclusive use. Also, it is prudent to have several spare pairs of safety glasses available for the use of visitors to the laboratory.

7.I.2 Safety Goggles

Safety goggles are designed to provide protection from splashes and flying glass and other objects that may result from an explosion. Vented models are recommended to prevent fogging. Fog-preventing solutions are also available.

There have been serious eye injuries from activities as innocuous as opening a microfuge tube which could have been prevented with goggles. Goggles must be worn for activities where a moderate risk for splashes with corrosives or other hazardous liquids exists, including:

- pouring corrosive or hazardous liquids.
- working with microorganisms that pose a risk of infection to mucous membranes as the result of a splash. This includes the opening of microcentrifuge tubes.

7.I.3 Face Shields

Face shields are necessary for high risk activities where there is a need to protect the face in addition to the eye. Faceshields are designed to be worn with goggles. Examples of when goggles and face shields must be worn include:

- pouring large amounts of corrosive or toxic liquids.
- removing a closed container from liquid nitrogen.
- washing glassware with acid.
- handling glassware under reduced or elevated pressure.
- handling glass apparatus in combus tion or other high temperature operations.
- the use of undiluted cleaning agents and disinfectants.
- when highly reactive chemicals are used.

7.I.4 Determining what Type of Eyewear to Use in Special Procedures

1994 revisions to OSHA's Personal Protective Equipm ent standard (29 CFR 1910.132) require that employers assess the hazards of each employee's job t o determine the need for glov es, eye protection and other equipment. The Responsible Investigator is most familiar with the type of operations being performed in each laboratory and should determine which type of eye protection is necessary. EOHSS should be contacted for techni cal gui dance i n the sel ection of the appropriate eye protection.

Specific goggles and masks for protection against laser hazards and ultraviolet or other intense light sources, as well as glassblowing goggles, and welding masks and goggles are required if these activities are conducted in the laboratory.

7.J PROTECTIVE CLOTHING

7.J.1 Laboratory Coats/Rubber Aprons

A fully fastened laboratory coat, with the sleeves rolled down, must be worn in laboratories under the following circumstances:

- When working with microorganisms requiring work at Biosafety Level 2 or higher as defined in the CDC/NIH guidelines[1]

- When working with recombinant DNA microorganisms classified as non-exempt from NIH recombinant DNA guidelines[2]. (See Appendix J) This would be analogous to working at BSL-2, where agents capable of casing disease in immune-normal adults are in use.

- Where required by the school/unit Radiation Safety Guidelines.

- When hazardous chemicals are being used. (If chemicals are being used periodically throughout the day then laboratory coats should be worn at all times while in the laboratory.)

[1]CDC-NIH "Biosafety in Microbiological and Biomedical Laboratories, most recent edition

[2]NIH "Guidelines for Research In volving Recombinant DNA," latest edition

Laboratory coats which have beenworn as personal protective equipment shall not be worn in offices or outside of laboratory areas. Contaminants which are on the laboratory coats can be transf erred to clean surfaces which can lead to an inadvertent exposures at a later time.

When handling corrosives or large quantities of hazardous chemicals, a rubberized apron should be worn f or a dded protection. Laboratory coats that are grossly contaminated with hazardous chemicals sha ll be dis posed of as chemical waste unless they can be safely decontami nated by laboratory personnel who are knowledgeable of the hazard involved. Contact EOHSS t o determine if an item which is grossly contaminated by a chem ical should be disposed of as chemical waste.

Laboratory coats that ar e grossly cont aminated with infectious microorganisms, blood or other potentially infectious body fluids shall be aut oclaved or otherwise decontaminated by laboratory personnel knowledgeable of the hazard before being laundered. Otherwise, they shall be handl ed by the laundry as infectious or disposed of as regulated medical waste.

Laundering for laboratory coats must be provided as necessary, at the expense of the department or laboratory. Laboratory coats shall not be laundered at home.

7.J.2 Other Clothing Considerations

In addition to equipment designed specifically for protection, the way in which people dress for work (i.e., their "street clothes") may also affect their on-the-job safety.

Long pants, rather than shorts, are recommended for wear in laboratories. Pants provide some protection from skin exposure which may result from a spill. This protection may mean the difference between just a ruined article of clothing and a serious injury. Laboratory personnel who wear shorts should consider keeping a change of clothing at work. The spare set of clothing should be appropriate for working with chemicals in case the need unexpectedly arises.

Sandals are not allowed in laboratories due to the potential risks posed by dropped objects and skin exposure to spilled liquids.

Loose or overly large laboratory coats should also be avoided because of the relative ease with which they may dip into chemicals or become ensnared in apparatus or moving machinery. The same adverse consequences may result from unrestrained long hair.

7.K HAND PROTECTION

Proper selection and use of gloves is essential for most procedures involving the use of chemicals. They should also be used when working with radionuclides and infectious materials.

In general, gloves provide only short-term protection. When contaminated they should be immediately removed and decontaminated or discarded into a regulated medical waste container. Afterwards you should immediately wash your hands. Frequent changing of gloves is a more effective technique for preventing penetration of materials through the glove than is double gloving.

Remember that "like dissolves like." The composition of gloves must be different than any chemicals they are to protect against.

The chart below can help you select the appropriate gloves for a variety of chemicals. If you need glove compatibility information for a chemical which is not listed, contact EOHSS.

Gloves are to be removed when leaving the laboratory. The use of secondary containers (e.g. a clean beaker) for transporting materials outside of the laboratory will eliminate the need to use gloves in these situations.

Latex 'surgical gloves' provide very little protection against chemicals. In addition, use of latex gloves can trigger both allergic contact dermatitis and latex allergies.

- Allergic contact dermatitis is the result of exposure to chemicals added to latex during harvesting, processing, or manufacturing. These chemicals can cause skin reactions 24 to 48 hours after exposure and may progress to oozing skin blisters or spread away from the area of skin touched by the latex.
- Latex Allergy (immediate hypersensitivity) is a more serious reaction to latex. Certain proteins in latex may cause sensitization (positive blood or skin test, with or without symptoms). Although the amount of exposure needed to cause sensitization or symptoms is not known, exposures at even very low levels can trigger allergic reactions in some sensitized individuals. Reactions usually begin within minutes of exposure to latex, but they can occur hours later. Mild reactions to latex involve skin redness, hives, or itching. More severe reactions may involve respiratory symptoms such as runny nose, sneezing, itchy eyes, scratchy throat, and asthma (difficult breathing, coughing spells, and wheezing). Rarely, shock may occur; but a life-threatening reaction is seldom the first sign of latex allergy.

Table 7.2 - Glove Compatibility

This chart provides general guidelines and is based on information available at the time of preparation of this document. Compatibility information should be verified (e.g., review the MSDS) prior to using a particular type of gloves. Compatibility charts with specific chemical information are available from manufacturers and lab supply catalogs. You should always contact the manufacturer when you have questions about chemical/glove compatibility.

Glove Type	Advantages	Disadvantages	Gloves Used For
Natural Rubber (Latex)	Low cost, good physical properties, dexterity	Poor vs. oils, greases, organics. Frequently imported; may be poor quality; use increases the risk of developing latex allergy, powdered latex gloves should not be used.	Bases, alcohols, dilute water solutions; fair vs. aldehydes, ketones, good against biological agents
Natural rubber blends	Low cost, dexterity, better chemical resistance than natural rubber vs. some chemicals	Physical properties frequently inferior to natural rubber	Same as natural rubber
Polyvinyl chloride (PVC)	Low cost, very good physical properties, medium chemical resistance	Plasticizers can be stripped; frequently imported, may be poor quality	Strong acids & bases, salts, other water solutions, alcohols
Neoprene	Medium cost, medium chemical resistance, medium physical properties	NA	Oxidizing acids, anilines, phenol, glycol ethers
Nitrile	Low cost, excellent physical properties, dexterity Good for general lab use.	Poor vs. benzene, methylene chloride, trichloroethylene, many ketones	Oils, greases, aliphatic chemicals, xylene, perchloroethylene, trichloroethane; fair vs. toluene, good against biological agents
Butyl	Specialty glove, polar organics	Expensive, poor vs. hydrocarbons, chlorinated solvents	Glycol ethers, ketones, esters
Polyvinyl alcohol (PVA)	Specialty glove, resists a very broad range of organics, good physical properties	Very expensive, water sensitive, poor vs. light alcohols	Aliphatics, aromatics, chlorinated solvents, ketones (except acetone), esters, ethers

Glove Type	Advantages	Disadvantages	Gloves Used For
Fluoro-elastomer (Viton)	Specialty glove, organic solvents	Extremely expensive, poor physical properties, poor vs. some ketones, esters, amines	Aromatics, chlorinated solvents, also aliphatics and alcohols
Norfoil (Silver Shield)	Excellent chemical resistance	Poor fit, easily punctures, poor grip, stiff	Use for Hazmat work

7.L RESPIRATORY PROTECTION

OSHA/PEOSH has very stringent requirements concerning the wearing of respirators in the workplace. Wearers have to receive a medical evaluation to ensure that they are physically capable of wearing the respirator and must receive fit-testing to ensure that there is no leakage around the facepiece. In addition a written program is required, as well as detailed training.

Another issue with the use of respirators in the laboratory is that, while the wearer may be protected from exposure, co-workers and support personnel who enter the room may not be adequately protected.

Respiratory protection should not be necessary in UMDNJ laboratories. A chemical hood should be adequate protection against the vast majority of chemicals being used in the laboratory as long as it is operating properly.

If you have reason to suspect that you are breathing in chemicals or that your may be absorbing chemicals through your skin, notify your LSO, RI, or EOHSS. EOHSS can perform monitoring to determine if the control measures currently in place need to be augmented with respiratory protection. If any type of respiratory protection is to be used by a laboratory personnel, EOHSS must be contacted to ensure compliance with PEOSH's stringent legal requirements. These requirements are designed to ensure that a comprehensive program is implemented including testing, cleaning, medical fit-testing and medical surveillance.

7.M BAN ON FOOD AND DRINK IN THE LABORATORY

Laboratory personnel may become exposed to chemicals or other contaminants without the occurrence of an obvious incident. Contamination of food is possible if it is eaten with unclean hands or if it has contact with chemicals or other contaminants which are stored or used in the laboratory. For this reason, eating, drinking, and storage of food in UMDNJ laboratories is prohibited.

7.N PREVENTING CONTAMINATION OF SURFACES

A regular schedule of cleaning and decontamination of surfaces must be an integral part of any laboratory housekeeping program. Skin contact with contaminated surfaces may lead to absorption of hazardous materials into the body or ingestion of materials due to unclean hands.

Upon request, the EOHSS can perform surface wipe tests of laboratory surfaces which can be analyzed in a laboratory. Unlike radiation wipe tests however, there are no legal standards for chemical surface wipe tests which specify acceptable surface contamination levels. The purpose of the wipe test is to provide a measure of the effectiveness of cleaning and to determine whether decontamination of surfaces is being performed frequently enough.

(Page intentionally left blank)

SECTION 8 - MEDICAL CONSULTATION, MEDICAL SURVEILLANCE AND EXPOSURE MONITORING

8.A MEDICAL CONSULTATIONS

Personnel who work with chemicals must be provided with an opportunity to receive a medical consultation under the circumstances listed below:

- Whenever an employee develops signs or symptoms due to exposures to hazardous chemicals in the laboratory

- Where exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements

- Whenever an event takes place in the work area such as a spill, leak, explosion, or other occurrence resulting in the likelihood of a hazardous exposure

Medical examinations and consultations must be performed by or under the direct supervision of a licensed physician, and must be provided without cost to the employee, without loss of pay and at a reasonable time and place.

The following information must be provided to the physician:

- The identity of and a material safety data sheet for the hazardous chemical(s) to which the employee may have been exposed

- A description of the conditions under which the exposure occurred including quantitative data, if available

- A description of the signs and symptoms of exposure that the employee is experiencing, if any

The examining physician must provide the employer with a written opinion which includes the following:

- any recommendations for further medical follow-up.

- any medical restrictions which may be found to be necessary in the course of the examination as a result of medical conditions which may place the employee at increased risk as a result of exposure to a hazardous chemical found in the workplace.

Any incident that results in injury, symptoms that may be related to exposure to a hazardous material, or a significant exposure to a hazardous material must be reported to the Department of Risk and Claims using the UMDNJ "Incident Report" form. A copy of the form may be obtained from the Departmental Administrator's office. Completion of this form facilitates proper follow-up medical care and compliance with state law. The Responsible Investigator is responsible for determining the cause of accidents that occur in the laboratory. EOHSS may be called upon to provide assistance, as necessary. These investigations will focus on methods which can be implemented to prevent the recurrence of similar accidents.

8.B EMPLOYEE HEALTH / OCCUPATIONAL PROGRAMS

The clinics listed below provide medical consultations for UMDNJ personnel who have workplace risks or exposures and is able to monitor potential health effects associated with laboratory exposures to etiologic agents, hazardous chemicals and lasers. All services are provided at no direct cost to employees.

Piscataway/New Brunswick - Employee Health Services (EHS), located in the EOHSI building, can be contacted at (732) 445-0123 x600. Information on Student Health Services is provided at: http://rwjms.umdnj.edu/education/current_students/office_directory/student_health.html. The phone number is (732) 235-5160.

Newark/Scotch Plains - Occupational Medicine Service, http://njms.umdnj.edu/departments/medicine/divisions/gmed/gmedoccupational.cfm can be contacted at (973) 972-2900. Student Health Services, http://njms.umdnj.edu/education/student_affairs/student_health.cfm can be reached at (973) 972-8219.

Stratford/ Camden - Employee and Student Health Services is located in the UEC Suite 2100 on the Stratford Campus and can be contacted at (856) 566-6825

Medical Consultation and Surveillance for Volunteers

Medical consultations, immunizations and surveillance described in this section of the Laboratory Safety Plan must be made available, independent of the employment status of personnel working in the laboratories. Services for volunteers and services which are not covered under the applicable student health service program is the responsibility of the Principal Investigator in whose laboratory the student works and may be negotiated with their department.

8.C MEDICAL SURVEILLANCE

Routine medical surveillance examinations are available for employees who wear respiratory protection, hearing protection or for employees with potential exposure to asbestos, antineoplastic agents, lasers (class III or IV), tuberculosis, biohazardous agents requiring medical surveillance, laboratory animals or hazardous chemicals as required by the relevant PEOSH/OSHA regulations. Principal Investigators are responsible for ensuring that only personnel who have received appropriate medical surveillance conduct activities where medical surveillance is required for employees. Costs for these student or volunteer medical services may be negotiated with the department. These Medical Surveillance services are available at the campus Health Services.

In addition, departments shall make medical consultation available for employees who wish to discuss workplace risks, reproductive hazards, allergies, workplace illnesses, or other workplace exposure matters with a physician. The Principal Investigator will ensure these services available for students and volunteers who work in the laboratory, as necessary and may negotiate arrangements with the department. Employee Health Services provides this type of medical consultations.

8.D Exposure Monitoring

Monitoring to determine employee exposure to chemicals shall be performed as necessary. In general, the Department of Environmental and Occupational Health and Safety Services (EOHSS) will be called upon to perform or oversee monitoring.

8.D.1 Initial Monitoring

Employee exposure assessment and monitoring for hazardous chemicals, regulated by PEOSH, will be performed if there is reason to believe that the action level (generally, the action level is half the regulated level) is being exceeded. In the absence of an established action level, monitoring will be conducted to determine if the permissible exposure limit (PEL) is being exceeded.

8.D.2 Periodic Monitoring

If the initial monitoring discloses employee exposure over the action level (or in the absence of an action level, the permissible exposure limit), the exposure monitoring provisions of the relevant standard shall be complied with. Steps will also be taken to ensure that exposure has been minimized to the maximum extent feasible using substitution, engineering (e.g., ventilation), and work practice controls.

8.D.3 Termination of Monitoring

Monitoring may be terminated in accordance with the requirements of the relevant standard, or when changes in control measures have been shown to provide a consistent reduction in exposure levels.

8.D.4 Monitoring for Circumstances Not Addressed by Regulations

Even when exposure to chemicals is below permissible levels, some personnel experience transient symptoms such as eye irritation. Occasionally, more serious effects may occur, such as allergic hypersensitivity to formaldehyde below levels which have been set by regulatory agencies or professional organization. In addition, in certain circumstances, personnel may be concerned about exposure to a chemical for which there are no regulations regarding permissible exposures. In these cases, monitoring results will be compared to applicable recommended limits, and EOHSS will make recommendations for reducing personnel exposures.

8.D.5 Notification of Results

The Responsible Investigator shall ensure that exposure monitoring results are posted, where personnel can view them, or that they are provided in writing. Whenever possible, personnel will be notified of the results of monitoring within 3 working days of the receipt of the results. The PEOSH-mandated maximum allowable time of 15 working days, between receipt and notification, shall at no time be exceeded.

8.E THE FORMALDEHYDE STANDARD

PEOSH/OSHA regulates exposures to formaldehyde (29 CFR 1910.1048). The formaldehyde standard includes requirements for engineering and work practice controls, labeling, training, medical surveillance, and exposure monitoring. The

permissible exposure limit (PEL) for formaldehyde is 0.75 ppm measured as an 8-hour time weighted average (TWA). The standard also includes a 2 ppm short-term exposure limit (STEL) (i.e., maximum exposure allowed during a 15-minute period). The "action level" is 0.5 ppm measured over 8 hours.

The employer is required to conduct initial monitoring to identify all employees who are exposed to formaldehyde at or above the action level or STEL and to accurately determine the exposure of each employee so identified. Paragraph (d) of the standard requires employers to determine their employees' exposure to formaldehyde if any mixture or solution present in the workplace contains 0.1 percent or more of formaldehyde, or if materials capable of releasing formaldehyde into the workplace air result in employees being exposed to formaldehyde at concentrations reaching or exceeding 0.1 ppm. It is important to note, however, that regardless of employee exposure level, if there are employee health complaints, the employer is required to take action to determine employee exposure.

The exposure determination must consist of actual measurements unless the employer can produce objective data to document that no employee will be exposed to formaldehyde at concentrations exceeding the 0.5 ppm (TWA) action level (AL), or the 2 ppm STEL under foreseeable conditions of use. Industry-wide studies or generic exposure estimates may be a source of objective data; however, the use of such data must accurately characterize actual employee exposures.

Each laboratory using formaldehyde is required to be in compliance with the PEOSH/OSHA formaldehyde standard. EOHSS shall provide exposure monitoring and technical guidance on other aspects of compliance with the formaldehyde standard, as required.

8.E.1 Formaldehyde Exposure Monitoring Results

As required by NJ Public Employees OSHA, EOHSS has conducted air monitoring while UMDNJ laboratory personnel were doing a typical tasks using formaldehyde solutions. These air monitoring results are summarized in Table 8.1. All exposures were well below all regulatory limits.

Table 8.1 Formaldehyde Exposure Monitoring in UMDNJ Research Laboratories					
Activity/ Description	**Use of Ducted Hood**	**Sample Time (min)**	**TWA Lab Results (ppm)***	**15-minute STEL Results (ppm)***	**8-hour TWA Results (ppm)***
Denaturing RNA Preparation of formaldehyde gel: 1) 5.4 ml of 37% formaldehyde pipetted to buffer and stirred 2) solution poured into casting apparatus; 3) empty beaker rinsed out in sink	Yes	5-m	0.04	0.04	None
Preparation of formaldehyde gel: 1) 0.6 ml of 37% formaldehyde added to 35 ml of buffer; Preparation of running buffer: 2) 4.25 ml of 37% formaldehyde added to 250 ml of buffer	Yes	55-m	0.01	0.02	0.002
Perfusion 1) mice perfused inside hood for ~ 10 m each; 2) brain removed and placed in 4% paraformaldehyde solution	Yes	265-m	0.007	0.01	0.009

Table 8.1 Formaldehyde Exposure Monitoring in UMDNJ Research Laboratories (cont.)					
Activity/ Description	**Use of Ducted Hood**	**Sample Time (min)**	**TWA Lab Results (ppm)***	**15-minute STEL Results (ppm)***	**8-hour TWA Results (ppm)***
Fixing mammalian cell lines 1) pipetting micro-liter amounts of pre-prepared 4% paraformaldehyde into 4 ml disks containing cell lines; 2) pipette off excess paraformaldehyde solution into waste container; 3) wash with PBS buffer	Yes	135-m	0.01	<0.01	0.002
	Yes	15-m	<0.01	<0.01	None
	Yes	40-m	0.01	0.006	0.0005
Preparation of paraformaldehyde solutions, 2%, 4% and 8% solutions: 1) paraformaldehyde powder scooped up with spatula and weighed into small dish on scale ; 2) powder dissolved into water; 3) solution stirred until cleared; 4) covered in paraffin and refrigerated for later use.	2%: - No hood used	2%: - No hood used	0.08	0.08	None
	4%: - Hood turned off while weighing powder	4%: - Hood turned off while weighing powder	<0.01	<0.01	None
	8%: - Powder weighed outside ducted hood	8%: - Powder weighed outside ducted hood	0.026	0.1	None

*** Permissible Exposure Limits for Formaldehyde**: 15-minute short term exposure limit (STEL) = 2.0 ppm; 8-hour time weighted average limit (TWA) = 0.75 ppm

SECTION 9 - HAZARDOUS WASTE MANAGEMENT

9.A INTRODUCTION

Planning for chemical waste disposal begins in the design-phase of an experiment and before ordering the required chemicals. Civil and criminal statutes govern disposal of hazardous chemicals, and fines for non-compliance can be high.

EOHSS has a comprehensive program in place to identify, collect and disposal of all materials that are considered hazardous waste. Employees working in laboratories should presume that all hazardous chemicals must be disposed through the University's hazardous waste vendor.

9.B COST OF HAZARDOUS WASTE DISPOSAL

In most situations, there is no additional cost to the Researcher for disposal of chemicals. Departments are assessed direct charges only when there are extraordinary costs, e.g., for disposal of large quantities of chemicals remaining from a vacated lab.

9.C WASTE MINIMIZATION

Each person generating hazardous waste has an obligation to implement practices and procedures that minimize the amount hazardous waste generated. UMDNJ certifies that the University has tried, to the extent feasible, minimized the amount of hazardous waste generated at our institution.

Meeting the objectives of waste minimization at UMDNJ requires the cooperation of everyone producing hazardous wastes. Waste minimization means any process modification that results in the prevention or reduction of hazardous chemical waste. General principles for waste minimization, in order of priority, are:

- **Elimination** - ending a procedure or stopping the use of a hazardous substance that would result in the generation of hazardous waste.
- **Substitution** - replacing a hazardous substance with a less hazardous material, e.g., substituting ethanol for methanol as a solvent, since dilute ethanol is not a hazardous waste.
- **Scale Reduction** - reducing the amount of a hazardous materials used in a procedure.

- **Recycling** - the reuse of spent material s either back into the same process or into a different process.
- **Reclamation** - any process that removes and reuses a hazardous material, e.g., purification, such as solvent distillation.

9.D HOW TO DETERMINE IF A WASTE IS HAZARDOUS

Individuals using c hemicals must first determi ne if the resultant chemical waste is a hazardous waste. It is a hazardous waste if it one of 500 chemicals listed by the EPA (listings available from EOHSS) or has one of the following characteristics:

Ignitability

- Flashpoint below 140°F (toluene)
- Solids that can cause fire by fricti on, absorption of water, burns vigorously when ignited (picric acid)
- Oxidizing chemicals (nitrates)
- Flammable compressed gases

Corrosivity

- pH less than or equal to 2
- pH greater than or equal to 12.5

Toxic

- Contains certain heavy metals or organic constituents

Reactivity

- Substances that react violently with water (sodium)
- Chemicals containing cyanide or sulfide which create toxic gases in contact with pH between 2 and 12.5 (potassium cyanide)
- Explosive or unstable

Contact EOHSS with any questions about whet her a chemical waste is consider ed hazardous waste.

9.E LABORATORY HAZARDOUS WASTE OPERATING PROCEDURES

9.E.1 Storage Containers

- Chose containers that are chemically compatible with the waste to be stored in them. (For example, hydrofluoric acid should not be stored in a glass container.)
- Empty food containers must never be used to store hazardous waste.
- The best source of suitable containers is the reuse of cleaned, empty 1-gallon chemical bottles. Contact EOHSS if you are in need of a container.
- Never collect waste in a container larger than 5-gallons.
- In most cases, the container will not be returned to the laboratory.

9.E.2 Labeling of Containers

Each hazardous waste container must have a UMDNJ Hazardous Waste Label (see Figure 9.1) as soon as you start putting waste into the container. Use the information in Table 9.1 to assist you in determining the hazard class of the substance. Contact the Campus EOHSS office with any questions about the hazard classification.

Figure 9.1 - Example of a Hazardous Waste Label

HAZARDOUS WASTE - UMDNJ

Container Full Date:_____ Campus:_____

Department:_____ Bldg/Rm:_____

Generator Name: Extension:

Chemical Name/Constituents	%

Hazard Class (circle): Ignitible Corrosive Toxic Oxidizer Reactive

- List the percentage that each ingredient makes up of the solution.
- List all ingredients including water. Spell out the full chemical name of each ingredient - No abbreviations.
- Indicate the Hazard Class of each ingredient

Table 9.1. Hazard Class Listing for Select Chemicals

Chemical	Hazard Class	Chemical	Hazard Class	Chemical	Hazard Class
Acetaldehyde	I, T	Dichloromethane	T	Mercury[2]	T
Acetic acid	I, C, T	Dimethyl sulfoxide	T	Methanol	I, T
Acetone	I, T	Dimethylformamide	T	Methyl ethyl ketone	I, T
Acetonitrile	I, T	Dioxane[1]	I, T	Nitric acid	C, O, T
Acrylamide	T	Ethanol	I, T	Osmium tetroxide[2]	T, C
Acrylonitrile	I, T, C	Ethidium bromide	T	Perchloric acid[1,3]	O, C, T
Aluminum trichloride	C, R	Ethyl acetate	I, T	Phenol	T, C
Ammonia (anhydrous)	C, T	Ethyl ether[1,3]	I,T	Potassium hydroxide	C
Ammonium hydroxide	C	Formaldehyde	T	Pyridine	I, T
Cacodylic acid	T	Formic Acid	C, T	Sodium azide[2,3]	T, R
Carbon disulfide[2]	I, T	Hexane	I, T	Sodium hydroxide	C
Carbon tetrachloride	T	Hydrazine	I, T	Sulfuric acid	C, T
Chloroform	T	Hydrochloric acid	C, R, T	Tetrahydrofuran[1]	I, T
Chromium trioxide	O, T, C	Hydrofluoric acid	T	Toluene	I, T
Coomassie Blue	T	Hydrogen peroxide	O	Trifluoroacetic acid	C, T
Cyanogen bromide	T	Iodine	T, C	Tryptan Blue Stain	T

Legend: I - Ignitable C - Corrosive T - Toxic O - Oxidizer R - Reactive

Notes: [1]May form explosive peroxides [2]EPA Acute Hazardous Waste - empty containers should be given to EOHSS without rinsing. See Table 9-2 below for other Acute Hazardous Wastes. [3]Specific information concerning the use and storage of this chemical is located elsewhere in this Plan.

9.E.3 Container Storage

- Keep all containers closed with an appropriate lid/cap (not a funnel) on at all times, with the exception of when filling the container.
- Containers do not need to be stored in the chemical hood. Instead, store the containers with compatible chemicals (e.g. acid wastes with acids).
- The outside of the container must be free of precipitate and drips.
- When a container is full, contact EOHSS to so that the waste can be moved into the hazardous waste storage room within 3 DAYS of the container full date.

9.F PEROXIDE-FORMING CHEMICALS

Most chemicals used in research laboratories are stable and non-explosive at the time of purchase. Over time, certain chemicals can oxidize, become contaminated, dry out, or otherwise destabilize, becoming a potentially explosive chemical (PEC). Such chemicals can then literally detonate when exposed to heat, light, friction, or mechanical shock.

Commonly used chemicals that form peroxides as they age include: ethyl ether, isopropyl ether, butadiene, cyclohexene, tetrahydrofuran and dioxane. Such chemicals will contain a stabilizing agent or inhibitor in them, which extends the shelf life. However, peroxides can still form over time. As a result, many of these chemicals will have an expiration date on the container. **It is incumbent on the laboratory to give peroxide-forming chemicals to EOHSS for disposal at least 3 months before the expiration date, so they can be disposed of properly.**

Please note: Department of Transportation (DOT) regulations forbid transportation of unstable containers of hazardous chemical waste. If a peroxide-forming chemical is past its expiration date, UMDNJ must hire a vendor who handles highly hazardous materials to stabilize the containers. The department generating the waste will be charged for this service.

9.G EMPTY CONTAINER DISPOSAL

Bring empty compressed gas cylinders to the loading dock for storage before reclamation to the vendor. All other chemical containers may be disposed of in the trash if they meet the following requirements:

- The container is completely empty (no liquid remains in the container) **AND**;

- Refer to the Acute Hazard Table (Table 9.2) below to determine if the EPA considers the chemical Acute Hazardous Waste.
  - If **yes**, give the empty container to EOHSS as a hazardous waste.
  - If **no,** rinse bottle out, write "EMPTY" across label and arrange for disposal through Environmental Services.

9.H NON-HAZARDOUS WASTE DISPOSAL

Although the majority of chemicals used in a research lab will be treated as hazardous waste, the following materials are non-hazardous waste and may be disposed as described below.

9.H.1 Drain Disposal

You may dispose of the following liquid wastes down a sink drain:

- Weak acids and buffers with pH of 5.5 - 9.0 *if no other hazardous components are present*.
- Ethanol/water mixtures of less than 10% ethanol *if no other hazardous components are present*. Do not dilute solutions of greater than 10% ethanol in order to dispose of them via the drain.
- Ethidium bromide aqueous solution ***after*** filtering through an extractor. The extractor is disposed of as hazardous waste. These extractors are available through lab supply vendors. Contact EOHSS or for more information on ethidium bromide disposal.

9.H.2 Trash Disposal

You may dispose of the following solid wastes in the trash:

- Alkaline batteries.
- Ethidium bromide-stained agarose gels (*with trace amounts of Ethidium Bromide and no other hazardous components present*).
- Small quantities of solid *non-hazardous* wastes may be disposed of in the trash. Examples of non-hazardous wastes include: sugars, salts, minerals, starches, amino acids, and enzymes. Contact EOHSS to determine if a waste stream is non-hazardous.

Table 9.2 Acute Hazard Wastes

1-(o-Chlorophenyl)thiourea
1-Acetyl-2-thiourea
1,2-Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]-,(R)-
1,2-Propylenimine
1,2,3-Propanetriol,trinitrate(R)
1,4,5,8-Dimethanonaphthalene-
1,2,3,4,10,10-hexa-chloro-1,4,4a,5,8,8a-hexahydro-,
(1alpha, 4alpha,4abeta,5alpha,8alpha,8abeta)-
1,4,5,8-Dimethanonaphthalene,1,2,3,4,10,10-hexa-chloro-
1,4,4a,5,8,8a-hecahydro-,(1alpha,4alpha,
4abeta,5beta,8beta,8abeta)-2-Propenal
2-Propen-1-ol
2-Propanone, 1-bromo-
2-Cyclohecyl-4,6-dinitrophenol
2-Butanone, 3,3-dimethyl-1-(methylthio)-,O-[methylamino)
carbonyl] oxime
2-Methyllactonitrile
2-Propyn-1-ol
2,4-Dinitrophenol
2,7:3,6-Dimethanonaphth[2,3-b]oxirene,3,4,5,6,9,
9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-,
(1aalpha,2beta,2abeta,3alpha,6alpha,
6abeta,7beta,7aalpha)-& metabolites
2,7:3,6-Dimethanonaphth[2,3-b]oxirene,
3,4,5,6,9,9-hexachloro-1a,2,2a,3,
6,6a,7,7a-octhydro-,(1aalpha,2beta,2aalpha,
3beta,6beta,6aalpha,7beta,7aalpha)-
2H-1 Benzopyran-2-one,4-hydroxy-3-(3-oxo-1 phenylbutyl)-
& salts, when present at concentrations greater than 0.3%
3-Chloropropionitrile
3(2H)-Isoxazolone, 5-(aminomethyl)-
4-Pyridinamine
4-Aminopyridine
4,6-Dinitro-o-cresol, & salts
4,7-Methano-1H-indene,
1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-
5-(Aminomethyl)-3-isoxazolol
6,9-Methano-2,4,3-benzodioxathiepin,6,7,8,9,10,10-
hexachloro-1,5,5a,6,9,9a-hexahydro-,3-oxide
7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylicacid
Acetaldehyde, chloro-
Acetamide, N-(aminothioxomethyl)-
Acetamide, 2-fluoro-
Acetic acid, fluoro-, sodium salt
Acrolein
Aldicarb
Aldrin
Allyl alcohol
alpha-Naphthylthiourea
Alpha,alpha-Dimethylphenethylamine
Aluminum phosphide (R,T)
Ammonium picrate (R)
Ammoniumvanadate
Argentate(1-),bis(cyano-C)-,potassium
Arsenic oxide As2O3
Arsenic oxide As2O5
Arsenic trioxide
Arsenic acid H3AsO4
Arsenic pentoxide
Arsine, diethyl-
Arsonous dichloride, phenyl-
Aziridine
Aziridine,2-methyl-
Barium cyanide
Benzenamine, 4-chloro-
Benzenamine,4-nitro-
Benzene, (chloromethyl)-
Benzeneethanamine, alpha, alpha-dimethyl-
Benzenethiol
Benzyl chloride
Beryllium
Bromoacetone
Brucine
Calcium cyanide Ca(CN)2
Calcium cyanide
Carbon disulfide
Carbonicdichloride
Chloroacetaldehyde
Copper cyanide Cu(CN)
Copper cyanide
Cyanides (soluble cyanide salts), not otherwise specified
Cyanogen chloride (CN) Cl
Cyanogen
Cyanogen chloride
Dichloromethyl ether
Dichlorophenylarsine
Dieldrin
Diethyl-p-nitrophenyl phosphate
Diethylarsine
Diisopropylfluorophosphate (DFP)
Dimethoate
Dinoseb

Table 9.2 Acute Hazard Wastes (cont.)

Diphosphoramide,octamethyl-
Disphosphoricacid,tetraethylester
Disulfoton
Dithiobiuret
Endosulfan
Endothall
Endrin
Endrin, & metabolites
Epinephrine
Ethanedinitrile
Ethanimidothioicacid,N-[[(methylamino)carbonyl]oxy]-,methylester
Ethylcyanide
Ethyleneimine
Famphur
Fluorine
Fluoroacetamide
Fluoroacetic acid, sodium salt
Fulminicacid,mercury (2+) salt (R,T)
Heptachlor
Hexaethyltetraphosphate
Hydrazinecarbonthioamide
Hydrazine,methyl- Hydrocyanicacid
Hydrogencyanide
Hydrogenphosphide
Isodrin
Mercury, (acetato-O) phenyl-
Mercuryfulminate(R,T)
Methane, oxybis[chloro-
Methane,isocyanato-
Methane,tetranitro-(R)
Methanethiol,trichloro-
Methanimine,N-methyl-N-nitroso-
Methomyl
Methylhydrazine
Methylisocyanate
Methylparathion
N-Nitrosomethylvinylamine
N-Nitrosodimethylamine
Nickelcarbonyl
NickelcarbonylNi(CO)4,(T-4)-
Nickelcyanide
NickelcyanideNi(CN)2
Nicotine, & salts
Nitricoxide
Nitrogendioxide
Nitrogenoxide NO
Nitrogenoxide NO2
Nitrogylcerine(R)
Octamethylpyrophosphoramide
O,O-Diethyl O-pyrazinyl phosphorothioate
Osium tetroxide
OsmiumoxideOsO4,(T-4)-
p-Chloroaniline
p-Nitroaniline
Parathion
Phenol, 2-methyl-4,6-dinitro-, & salts
Phenol, 2,4,6-trinitro-,ammonium salt (R)
Phenol, 2,4-dinitro-
Phenol, 2-cyclohexyl-4,6-dinitro
Phenol, 2-(1-methylpropyl)-4,6-dinitro
Phenylmercuryacetate
Phenylthiourea
Phorate
Phosgene
Phosphine
Phosphoric acid, diethyl 4-nitrophenyl ester
Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester
Phosphorodithioic acid, O,O-dimethyl S-[2-(methylamino)-2-oxoethyl] ester
Phosphorodithioicacid,O,O-diethylS-[(ethylthio)methyl]ester
Phosphorofluoridic acid, bis(1-methylethyl)ester
Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester
PhosphorothioicacidO-[4-[(dimethylamino)1 sulfonyl]phenyl]O,O-dimethylester
Phosphorothioicacid,O,O,-dimethylO-(4-nitrophenyl)ester
Phosphorothioicacid,O,O-diethyl-O-(4-nitrophenyl)ester
Plumbane,tetraethyl-
Potassiumcyanide
PotassiumcyanideK(CN)
Potassiumsilvercyanide
Propanal,2-methyl-2-(methylthio)-, O-[(methylamino)carbonyl]oxime
Propanenitrile, 3-chloro-
Propanenitrile
Propanenitrile,2-hydroxy-2-methyl-

Table 9.2 Acute Hazard Wastes (cont.)

Propargylalcohol
Pyridine,3-(1-methyl-2-pyrrolidinyl)-,(S)-,&salts
Seleniousacid,dithallium(1+)salt
Selenourea
Silver cyanide
Silver cyanideAg (CN) P105
Sodium azide
Sodiumcyanide Sodiumcyanide Na(CN)
StrontiumsulfideSrS
Strychnidin-10-one, 2,3-dimethoxy-
Strychnidin-10-one, & salts
Strychnine, & salts
Sulfuricacid,dithallium(1+)salt
Tetraethyldithiopyraphosphate
Tetraethyllead
Tetraethylpyrophosphate
Tetranitromethane(R)
Tetraphosphoricacid,hexaethylester
Thallicoxide
Thallium(I)selenite
Thallium(I)sulfate
Thalliumoxide (Tl2O3)
Thiodiphosphoricacid,tetraethylester
Thiofanox
Thioimidodicarbonic diamide [(H2N)C(S)]2NH
Thiophenol
Thiosemicarbazide Thiourea, (2-chlorophenyl)-
Thiourea,1-naphthlenyl-
Thiourea,phenyl-
Toxaphene
Trichloromethanethiol
Vanadicacid,ammonium salt
VanadiumoxideV2O5
Vanadiumpentoxide
Vinylamine,N-methyl-N-nitroso Warfarin, & salts, when present at concentrations greater than 0.3%
Zinccyanide
Zinccyanide Zn(CN)2
Zincphosphide (Zn3P2),when present at concentrations >10%(R,T)

9.I SPECIAL TYPES OF HAZARDOUS MATERIALS

Certain types of hazardous waste pose particular problems for disposal. They may be impossible to dispose of or may require handling and storage by a specialized hazardous waste vendor. **Therefore, consult EOHSS and the Radiation Safety Officer before generating the following wastes:**

- mixed radioactive/hazardous chemical waste
- mixed radioactive/biological waste
- uranyl acetate and uranyl nitrate/hazardous chemical mixtures

Consult EOHSS in advance before generating chemical wastes mixed with human body fluids, to ensure that a disposal option exists. Treat Petri dishes, syringes, hypodermic needles and test tubes as Regulated Medical Waste. Do not dispose of biological wastes in the chemical waste stream. Do not dispose of chemical waste in the biological (regulated "red bag") waste stream.

9.J RADIOGRAPHIC WASTE AND PHOTOGRAPHIC FILMS

9.J.1 Options for Managing Liquid Radiography Waste

a. Run used fixer solutions through a silver recovery unit, ensuring that the silver recovery unit is changed often enough to ensure the discharge meets the EPA limit.

For Piscataway, New Brunswick and Stratford facilities:

RWJMS Shared Equipment Services (732-235-4455) has a contract with a vendor to provide silver recovery services at a group rate. Shared Equipment Services will ensure that the silver recovery units are changed as often as necessary, will ensure testing to determine when the cartridges are becoming spent and will maintain copies of all required documentation. (Each department must also maintain documentation).

For Camden facilities:

Collect and dispose of used fixer solutions through EOHSS. See 9.J.1b, below, for more information.

For Newark facilities:

Contact the vendor, Dennis Kearney, ofKearney Reclaiming Systems (973-835-1978) to provide silver recovery services.

Departments who purchase silver recoveryservices individually must ensure and document that their silver recovery unit(s) meet regulatory limits. The vendor should provide service records at the time of service and a bill of lading and certificate of recycling eac h time silver is removed. This information should be kept on file for three years.

b. Collect and dispose of used fixer solutions through EOHSS.

Departments not employing silver recovery must collect the used fixer solutions for disposal through EOHSS. Follow applicable hazardous waste procedures outlined in the University Hazardous Waste Management Program. This includes:

- Collecting waste in a container < 5 gallons with a screw-top cap.
- Only open the container when adding waste to it.
- Affix a hazardous waste label and start filling in the ingredients upon use.
- Keep the container clean and sound, and store with label facing out.
- Date the container when it is full.
- Arrange to transfer the full waste container to EOHSS hazardous waste room within three days.

9.J.2 Photographic Films

Used photographic films must be collected as a hazardous waste due to the residual silver content. Bag or box the film, and write “used silver-containing films" on the hazardous waste label.

9.K REDUCING METHANOL USE IN TRANSFER BUFFER

Methanol is routinely used in biomedic al re search laboratories for protein electro-transfers; it increases the hydrophobicity of proteins, thereby enhancing membrane binding. However, methanol is listed by the state of New Jersey Department of Environmental Protection as an acute poison. This means that transfer buffer, which

typically contains approximately 20% methanol, must be collected and disposed of as a hazardous chemical waste.

9.K.1 Use PVDF instead of Nitrocellulose Membranes

Frequently used, nitrocellulose membranes are highly hydrophillic and bind proteins electrostatically. This requires methanol in the transfer buffer to prevent sample "blow-through."

PVDF (polyvinylidene fluoride) membranes bind proteins hydrophobically, and a small amount of methanol is necessary to enhance the efficiency of protein binding to the membrane, it is not required in the transfer buffer when using PVDF membranes. Inherent properties of the PVDF membrane, such as higher internal surface area and cationic surface, make the use of methanol in the transfer buffer an unnecessary (and, ultimately expensive) ingredient. However, the PVDF membrane must be thoroughly soaked in 100% methanol for about 15 seconds prior to use with aqueous solutions as dry spots can inhibit protein transfer.

Application-wise, there is no advantage to using nitrocellulose over PVDF. In fact, PVDF will bind samples more tightly than nitrocellulose, making it more preferable for applications such as protein sequencing and mass spectrometry. Additionally, PVDF has chemical-resistant properties which make it resilient against chemicals that are commonly used in de-staining procedures.

9.K.2 Switch from a Tank Transfer System to a Semi-Dry Transfer System

Another option for reducing the amount of methanol waste generated would be to switch from a tank transfer system to a semi-dry transfer system. The advantages and disadvantages of each system is summarized below in Table 9.3.

Table 9.3 Comparing the Use of a Tank-Transfer System to Semi-Dry Transfer

Transfer System	Advantages	Disadvantages
Tank transfer	1. The large amount of buffer in the chamber allows long transfer times, since the buffer will not completely evaporate. 2. Ample buffer is available for the long transfer times associated with large fragments.	1. The large amount of buffer (up to 4 liters) required to fill the tank can be considered excessive use of materials. 2. Tank electroblotters are usually complicated to set up. 3. Because of the large chamber, transfer generally takes a long time, even for small fragments.
Semi-dry transfer	1. Very little buffer is needed, just enough to thoroughly soak the blot stack (around 100mL). 2. Generally easier to set up. 3. Because of the plate design, there is a very high current density and a uniform current path, resulting in fast transfers.	1. Large fragments take longer to transfer, and the limited buffer supply may evaporate before large fragments have enough time to fully transfer. Choosing the proper buffer composition can prevent this. 2. Semi-dry electroblotters are more likely to allow the sample to blow through the membrane. This can be minimized with buffer adjustments. 3. The blot stack conditions for semi-dry electroblotters can be complicated, depending on many variables including gel composition, buffer composition, fragment size, current density, and type of blotting paper. Once these conditions are optimized, however, transfer is simpler and faster than with tank blotters.

If you would like to know if PVDF membraneswould work for your specific application, call Bio-Rad Laboratories, Inc., at 1-800-424-6723, option 2. To make arrangements

for disposal of used methanol-containing transfer buffer, contact your campus EOHSS office.

9.LFOR FURTHER ASSISTANCE

Contact your campus EOHSS if you would like assistance on chemical waste issues such as waste minimization, storage, segregation, recycling, labeling, disposal or other details of the University's Hazardous Waste Management Program.

(Page intentionally left blank)

SECTION 10 - BIOSAFETY PLAN

10.A INTRODUCTION

The UMDNJ Laboratory Biosafety Plan is intended to be a resource for information, guidelines, policies, and procedures that will enable and encourage those working in the laboratory environment to work safely and reduce or eliminate the potential for exposure to biological hazards. The information contained in this Biosafety Plan should enable researchers to conduct their activities in a manner that:

- Complies with all Federal and Local regulations for the use of biohazards,
- Prevents contamination of the environment and promotes environmental quality,
- Protects their specimens and keeps other research material free of contamination,
- Conforms to prudent biosafety practices, and
- Prevents employees and their families from acquiring laboratory-associated infectious diseases.

This Plan was developed by the Department of Environmental and Occupational Health and Safety Services (EOHSS), with input and approval of the UMDNJ Laboratory Safety Committees and Institutional Biosafety Committees (IBCs). Guidelines developed by the National Institutes of Health (NIH) and the Centers for Disease Control and Prevention (CDC) form the basis for the safe work practices included in this Laboratory Biosafety Plan. The guidelines from CDC-NIH, Biosafety in Microbiological and Biomedical Laboratories (BMBL) (available at: http://www.cdc.gov/od/ohs/biosfty/bmbl4/bmbl4toc.htm) addresses the appropriate measures and facilities for work with all microbial agents, including bacterial, viral, fungal, parasitic, and rickettsial agents. It is important to note that these guidelines must be followed to ensure the continuation of grant funds from federal agencies.

Information on bloodborne pathogens, shipping procedures for infectious materials and disposal of regulated medical waste is also included in this plan to ensure compliance with State and Federal laws that carry sanctions for non-compliance. These requirements are further described in the UMDNJ Laboratory Exposure Control Plan. The UMDNJ Laboratory Bloodborne Pathogens Exposure Control Plan is attached in a separate tabbed section of this binder.

Laboratories working with materials that may pose a potential risk for exposure to bloodborne pathogens as defined by the Occupational Safety and Health Administration (OSHA) must have a written Bloodborne Pathogens Standard Exposure Control Plan

that describes how universal precautions will be employed and how exposures to blood, body fluids, semen, unfixed tissues, and specimens containing visible blood and biological waste will be managed and controlled.

In addition to an Exposure Control Plan, OSHA requires that employees working with bloodborne pathogens attend training sessions in compliance with their standard. RI's are responsible for their ensuring that their staff attend mandatory training for these regulations. EOHSS provides bloodborne pathogens training for laboratory staff. Contact your campus EOHSS office for scheduling information.

The Centers for Disease Control and Prevention (CDC), the Department of Transportation (DOT), as well as the International Air Transport Association (IATA) have requirements regarding shipment of "dangerous goods." Infectious substances, genetically modified organisms and dry ice are listed as dangerous goods and must be packaged and shipped accordingly. Detailed information to ensure the safe and compliant transport of infectious materials is included in Section 10.J of this plan.

Requirements for packaging and shipment of biomedical materials are also provided in the Public Health Service regulation 42 CFR Part 72 *Interstate Shipment of Etiologic Agents* (http://www.cdc.gov/od/ohs/biosfty/shipregs.htm) and parts of the Department of Transportation Hazardous Materials regulation 49 CFR, Parts 171-180.

Handling and disposal of biohazardous waste is regulated and monitored by the NJ Department of Environmental Protection under the Regulated Medical Waste rules found in the NJ Administrative Code at 7: 26-3A. Refer to Appendix I "Protocol for Disposal of Regulated Medical Waste at UMDNJ and Regulated Medical Waste Classifications."

Many laboratory safety issues may be specific to the organism and procedures in use in a particular laboratory. As no single document can address every contingency, when additional activity or agent-specific information is required, EOHSS and the campus Laboratory Safety Committee and/or Institutional Biosafety Committee are prepared to assist investigators in developing and implementing the appropriate practices to minimize the risk of laboratory infection or environmental contamination. It is the responsibility of Principal Investigators to seek out these, and other resources. The RI must also ensure that all their personnel are informed of applicable regulations and guidelines and that they are capable, as a result of academic background and hands-on experience, of working in a manner consistent with them.

Part 2 of the Laboratory Safety Plan Survey (See Section 1 of this plan) must be completed for all laboratories where BL2 or higher materials are used. Information on biological safety levels for infectious microorganisms can be found at the EOHSS

website http://www.umdnj.edu/eohssweb/publications/external.htm#Biological, in the Biosafety Safety section.

10.B BIOHAZARDS: IDENTITY AND RISK ASSESSMENT IDENTITY

10.B.1 Identification of Biohazards

Laboratory-acquired infections have been documented since microbiology's emergence as a distinct discipline in the 19th century. The knowledge, techniques, and the equipment to prevent most laboratory infections are, however, available. The practices and tools outlined in CDC's Biosafety in Microbiology and Biomedical Laboratories (BMBL) publication have become the basis for the safe handling of potentially ***infectious materials*** in all laboratory settings.

The emergence of Hepatitis B, Hepatitis C, and HIV obligate clinicians and researchers to handle clinical materials, with their undefined microbial population, as a possible source of serious infections. Universal Precautions, (treating all human blood and body fluids as if known to be infectious for HIV, HBV, and other bloodborne pathogens) is necessary for working with clinical specimens. The requirements for working with clinical specimens carry over into activities involving the use of human and non-human primate cell lines in recognition of the ability of these materials to carry adventitious viruses and other microorganisms. These activities are covered in 10.I of this plan, "Working with Tissue and Cell Culture."

Recombinant DNA molecules are defined as molecules that are constructed outside living cells by joining natural or synthetic DNA segments to DNA molecules that can replicate in a living cell. The hazards associated with these materials that must be considered include: gene product effects, toxicity, physiological activity, allergenicity, cell tropism of virus, oncogenic potential, ability to alter cell cycle, integration into host genome, amplification potential, probability of generating replication-competent viruses, operations and quantity. The University's Laboratory Safety Policy (#00-01-45-55:00) requires that Recombinant DNA research be in compliance with the NIH Guidelines on Recombinant DNA and requires prior notification and approval of the appropriate campus Institutional Biosafety Committee for specific categories of recombinant DNA research.

Section 10.K "Recombinant DNA," describes the types of activities requiring notification or approval. A Recombinant DNA registration form can be found in Appendix J.

Work with potentially infectious materials requiring BL-2 containment or higher **ALSO** require registration with an Institutional Biosafety Committee (IBC). Each IBC, in conjunction with EOHSS and the school's Research Office, maintains a registry of all

research laboratories and **research** personnel working with BL2 and higher materials. This registration is intended for all research laboratories growing, processing, handling or characterizing organisms capable of causing disease in humans. The purpose of this registration is 1) to maintain a listing of laboratories and individuals working with human pathogens, 2) to provide a system for checking that containment practices and facilities are appropriate and adequate for the health and safety of workers in the laboratory and immediate environment and 3) to comply with the requirement of certain funding agencies for registration of biohazardous materials.

The Responsible Investigator (a faculty member who has been assigned the laboratory space) is responsible for completing and updating the appropriate sections of the registration document. A registration form should be completed and forwarded to EOHSS within one week of initiation of work. However, prior approval is required for any new organisms, which require a higher biosafety level (BL) than that which is required for organisms currently in use in the laboratory. URL address for forms for registration of BL2 and higher materials are included in Appendix K.

10.B.2 Risk Assessment

Risk implies the probability that harm, injury or disease will occur. In the laboratory, the assessment of risk focuses on the prevention of lab-acquired illnesses. Risk assessments for biohazardous agents are not straightforward and will depend on several factors. First, an assessment of risk must start with collecting information about the agent, including Agent Hazard Class (from the NIH Recombinant DNA Guidelines) and Recommended Biosafety Level from the CDC's BMBL. Links to these resources are available online at http://www.umdnj.edu/eohssweb/publications/external.htm#Biological. In addition, all of the other factors below need to be evaluated before a final determination for the safe use of the agent is made.

1. Pathogenicity

The ability of a pathogenic agent to cause disease, including disease incidence and severity (e.g., an agent that causes mild illness versus an agent that causes high mortality or an agent that might cause an acute self-limiting disease versus one that might cause a chronic disease) must be evaluated.

2. Route of Transmission

How the agent may be transmitted must be evaluated (e.g., airborne [inhalation], ingestion [eating/drinking], parenteral [through the skin], mucous membranes [through the eyes, nose or mouth]). Agents that are highly transmissible via the aerosol route have caused the most laboratory infections

3. Agent Stability

The agent's ability to survive over time in the environment is defined as agent stability. Factors such as effects of sunlight (UV rays), chemical disinfectants, drying, buffering effects (pH) and the ability of the agent to form spores can all affect its stability and the infectivity and transmissibility of the agent.

4. Infectious Dose

The infectious dose is defined as the number of individual units required to cause an infection or illness.

5. Origin

Origin may refer to geographic location (e.g., domestic or foreign); host (e.g., infected or uninfected human or animal); or nature of source (potential zoonotic or associated with a disease outbreak).

All of the above factors are inherent to a particular microbe; external factors to be considered in a risk assessment include:

6. Concentration

Number of infectious organisms per unit volume. Consider the milieu containing the organism (e.g., solid tissue, viscous blood or sputum, or liquid medium) and the lab activity (e.g., agent amplification, sonication, or centrifugation).

7. Host Factors

In order for a microbiological agent to be a pathogen it requires a susceptible host. The agent must be able to infect a suitable host. There are many microbial agents that are pathogenic for animals but not for humans. There are some microbial agents that are species specific and will only infect a particular species of animal. A laboratory worker's *immune status* is also directly related to his/her susceptibility to disease when working with an infectious agent.

8. Health Status of at-risk Employees:

The health status of the host is also critical for determining the risk of an agent.

Many pathogenic agents pose a higher risk to pregnant women, young children, the elderly and individuals who are immuno-compromised.

9. Availability of an effective prophylaxis or therapeutic intervention

In some instances, immunization may affect the biosafety level required. Immunization only serves as an additional layer of protection beyond engineering controls, proper practices and procedures, and the use of personal protective equipment. Work with a pathogenic agent may need to be carried out at a higher level because there are no effective treatments available for the pathogenic agent or the agent may be resistant to normal treatment regiments (e.g., multi-drug resistant *Mycobacterium tuberculosis*).

10. Evaluation of Skill Level of Employees

A determination of the educational and skill level of the employee and their ability to implement safe work practices with the pathogenic agent.

11. Animal studies

Laboratory studies involving animals may present many different kinds of physical, environmental, and biological hazards. The specific hazards present in any particular animal facility are unique, varying according to the species involved and the nature of the research activity. The requirements and approval form for the use of infectious materials in animals are found in Appendix L, “Protocol for the Use of Infectious Agents in Animals.” A similar set of four biosafety levels are provided for work with vertebrate animals infected with agents that may infect humans. These Animal Biosafety Levels (ABSL) 1 thru 4, provide for practices, equipment, and facilities that are comparable to the laboratory biosafety levels. There are unique hazards associated with infected animals that must be understood by those personnel with animal contact and addressed by the animal facility.

10.C CONTAINMENT AND BIOSAFETY LEVELS

10.C.1 Containment

The goal of biosafety engineering must be the prevention of laboratory worker exposure to infection or injury by controlling worker exposure to the infectious or biohazardous agent utilizing primary and secondary barriers. **"Containment"** describes safe methods for managing infectious materials in the laboratory environment where they are handled or maintained. Primary containment includes laboratory practices and technique as well

as safety equipment. Secondary containment includes facility design and laboratory operational practices. The overall purpose of containment is to reduce or eliminate exposure of laboratory workers, other persons, and the outside environment to potentially hazardous agents. The elements of containment include **laboratory practice and technique, safety equipment, and facility design**. A risk assessment of the work to be performed with a specific agent will determine the appropriate combination of these elements. A further discussion appears below.

Primary containment referring to protection of personnel and the immediate laboratory environment from exposure to infectious agents, is provided by both good microbiological technique and the use of appropriate safety equipment. The use of vaccines may provide an increased level of personal protection.

Secondary containment refers to protection of the environment external to the laboratory from exposure to infectious materials and is provided by a combination of facility design and operational practices.

The three elements of containment include:

- **Laboratory practice and technique** are considered the most important element of containment. The basis is strict adherence to standard microbiology practices and techniques. Awareness of potential hazards and related information gained from training or academic experience is an equal partner with hands-on proficiency in for empowering an individual to work safely.

- **Safety equipment** includes Biological Safety Cabinets (BSCs); "sharps" containers; centrifuge safety devices; and, other devices designed to remove or minimize exposures to hazardous materials. BSCs also provide protection from contamination for research materials used in them.

- **Facility design and construction** (secondary barriers) refers to building features that, for research personnel, enhance the protection provided by safety equipment and provide a barrier to protect persons outside of the laboratory and the environment from infection. Examples include separation of work areas from general access, availability of autoclaves, and handwashing facilities.

10.C.2 Biosafety Levels

Microorganisms and clinical materials are assigned to one of four Biological Safety Levels (BSLs). Each BSL consists of combinations of safety equipment, facility design features, and laboratory practices and techniques that will reduce the risk of laboratory-acquired infections. The recommended Biosafety level(s) for organisms can be found in Section VII (Agent Summary Statements) of the BMBL. These BSLs represent those conditions under which the agent ordinarily can be safely handled. The laboratory director is specifically and primarily responsible for assessing the risks and appropriately applying the recommended biosafety levels. Generally, work with known agents should be conducted at the biosafety level recommended in the BMBL. When specific information is available to suggest that virulence, pathogenicity, antibiotic resistance patterns, vaccine and treatment availability, or other factors are significantly altered, more (or less) stringent practices may be specified, by the IBC.

TABLE 10.1 - Biosafety Levels and Appropriate Protective Measures

BSL	Agents	Practices	Safety Equipment (Primary Barriers)	Facilities (Secondary Barriers)
1	Not known to consistently cause disease in healthy adults	Standard Microbiological Practices	None required	Open bench top sink required
2	Associated with human disease, hazard = percutaneous injury, ingestion, mucous membrane exposure	BSL-1 practice plus: Limited access Biohazard warning signs "Sharps" precautions Biosafety manual defining any needed waste decontamination or medical surveillance policies	Primary barriers = Class I or II BSCs or other physical containment devices used for all manipulations of agents that cause splashes or aerosols of infectious materials; PPEs: laboratory coats; gloves; face protection as needed	BSL-1 plus: Autoclave available
3	Indigenous or exotic agents with potential for aerosol transmission; disease may have serious or lethal consequences	BSL-2 practice plus: -Controlled access - Decontamination of all waste - Decontamination of lab clothing before laundering - Baseline serum	Primary barriers = Class I or II BCSs or other physical containment devices used for all open manipulations of agents; PPEs: protective lab clothing; gloves; respiratory protection as needed	BSL-2 plus: - Physical separation from access corridors - Self-closing, double-door access - Exhausted air not recirculated - Negative airflow into laboratory
4	Dangerous/ exotic agents which pose high risk of life-threatening disease, aerosol-transmitted lab infections; or related agents with unknown risk of transmission	BSL-3 practices plus: Clothing change before entering Shower on exit All material decontaminated on exit from facility	Primary barriers = All procedures conducted in Class III BSCs or Class I or II BSCs <u>in combination with</u> full-body, air-supplied, positive pressure personnel suit	BSL-3 plus: -Separate building or isolated zone -Dedicated supply and exhaust, vacuum, and decon systems Other requirements outlined in the text

10.D ENGINEERING CONTROLS

"Engineering Controls" refers to devices or processes that isolate or contain a hazard. The best engineering controls function in an automatic matter with a minimum of user input. When available, they are given a higher priority than protective equipment or work practices because these two areas are subject to human error or material defects.

10.D.1 Biological Safety Cabinets (BSCs)

Biological Safety Cabinets (BSCs) are one type of engineering control. BSCs are designed to provide personnel, environmental and product protection, from aerosolized microorganisms, when appropriate practices and procedures are followed. High efficiency particulate air (HEPA) filters are used in the exhaust and/or supply systems of biological safety cabinets. HEPA filters are effective at trapping particulates and infectious agents, but not at capturing volatile chemicals or gases.

Three kinds of biological safety cabinets, designated as Class I, II and III, have been developed to meet varying research, clinical, and safety needs, and care should be exercised in choosing the appropriate one for the intended use of the materials. EOHSS should be consulted if any questions arise in the selection of appropriate containment equipment.

CAUTION: Be aware that air-sampling studies have shown that most of the common manipulations of bacterial and viral cultures in research laboratories release **aerosols of viable organisms.** This must be considered when evaluating the need for use of the biological safety cabinet or other physical containment device. Aerosols can be generated by manipulation of liquids, tissue fragmentation, preparation of bacterial plates or the improper use of laboratory equipment including centrifuges, or breakage of containers with cell cultures. Procedures with a potential for **creating infectious aerosols** or splashes may include:

- Centrifuging
- Grinding
- Blending
- Vigorous shaking or mixing
- Pipetting
- Sonic disruption
- Opening containers of infectious materials
- Inoculating animals intranasally
- Harvesting infected tissues from animals or embryonate eggs

Such materials may be centrifuged in open laboratory if sealed rotor heads or centrifuge safety cups are used, and if these rotors or safety cups are opened only in a biological

safety cabinet.

Laminar Flow Cabinets are not biological safety cabinets. They are devices that use a High Efficiency Particulate Filter (HEPA) to filter air going into the cabinet. It is used to protect the product from contamination and **offers no protection to the worker** from the product.

There are two types of laminar flow cabinets: Horizontal Laminar Flow and Vertical Laminar Flow Cabinets. Since these cabinets blow air into the breathing zone of the worker, these cabinets should **never** be used when handling hazardous chemicals or potentially infectious materials including human cell lines.

10.D.2 Effective and Safe Use of Biological Safety Cabinets

1. Certification - BSC must be certified upon installation, yearly, after a cabinet is moved, the HEPA filter is changed, or when there is a possibility that servicing may have affected the containment ability. Semi-annual certification is recommended when cabinets are routinely used for work with airborne-transmitted organisms or other high-risk pathogens.

2. The RWJMS Shared Equipment Services Program (732-235-4455) offers a competitive, pooled service for testing, inspection and decontamination of biological safety cabinets. On the Newark Campus, contact EOHSS for vendor information.

Only BSCs that are exhausted to the exterior of the building should be used when working with volatile toxic chemicals. Class I cabinets may be connected to the building exhaust system or have air recirculated back into the room depending on use. Varying quantities of these materials may be used in Class II (Type B) cabinets because these devices are ducted to building exhaust systems (see Tables 10.2 and 10. 3). When using large amounts of volatile chemicals, a chemical hood should be used. Chemical hoods are connected to an independent exhaust system and operate with single pass air which is ducted directly outside the building.

10.D.3 Decontamination

Biological safety cabinets must be decontaminated by an outside vendor before being moved. BSCs must also be decontaminated before HEPA filters are changed or internal repair work is done. The outside vendor uses procedures as required by National Sanitation Foundation Standard 49.

1. The work surface, the interior walls (not including the supply filter diffuser), and the

interior surface of the window should be wiped with 70% ethanol (EtOH), a 1:100 dilution of household bleach (i.e., 0.05% sodium hypochlorite), or other disinfectant as determined by the investigator to meet the requirements of the particular activity. When bleach is used, a second wiping with sterile water is needed to remove the residual chlorine, which may eventually corrode stainless steel surfaces. Note: The use of 70% alcohol as a general disinfectant should be discouraged because of flammability issues.

2. The surfaces of all materials and containers placed into the cabinet should be wiped with 70% EtOH to reduce the introduction of contaminants to the cabinet environment. This simple step will reduce introduction of mold spores and thereby minimize contamination of cultures.

Table 10.2 - Selection of a Safety Cabinet Through Risk Assessment

Biological Risk Assessed	Protection Provided			BSC Class
	Personnel	Product	Environmental	
BSL 1-3	YES	NO	YES	I
BSL 1-3	YES	YES	YES	II (A, B1, B2, B3)
BSL 4	YES	YES	YES	III B1, B2

Table 10.3 - Comparison of Biosafety Cabinet Characteristics

BSC	Face Velocity	Airflow Pattern	Applications	
			Nonvolatile	Volatile Toxic
I	75	In at front; exhausted through HEPA to the outside or into the room through HEPA	Yes	Yes[1]
II, A	75	70% recirculated to the cabinet work area through HEPA; 30% balance can be exhausted through HEPA back into the room or to the outside through a thimble unit.	Yes	No
II, B	100	Exhaust cabinet air must pass through a dedicated duct to the outside through a HEPA filter.	Yes	Yes[2] (minute amounts)
II, B2	100	No recirculation; total exhaust to the outside through hard-duct and a HEPA filter.	Yes	Yes (small amounts)
II, B3	100	Same as II, A, but plenums are under negative pressure to room; exhaust air is thimble-ducted to the outside through a HEPA filter	Yes	Yes[2] (small amounts)
III	N/A	Supply air inlets and hard-duct exhausted to outside through two HEPA filters in series	Yes	Yes (small amounts)

(1) Installation may require a special duct to the outside, an in-line charcoal filter, and a spark proof (explosion proof) motor and other electrical components in the cabinet. Discharge of a Class I cabinet in to a room should not occur if volatile chemicals are used.

(2) In no circumstances should the chemical concentration approach the lower explosion limits of the compound.

3. Check the Magnahelic gauge (indicates pressure drop across the HEPA filter) on the cabinet regularly; a sharp change in position may indicate a malfunction. If a significant change is noted, contact the company that does the annual certifications to service the unit.

4. Conduct activities 4-6 inches from the front of the cabinet; avoid rapid arm movements.

5. Allow cabinet to run for 5 minutes prior to starting work;

6. Do not block front air intake grill and minimize the amount of material inside the cabinet; this compromises proper air flow through the unit.

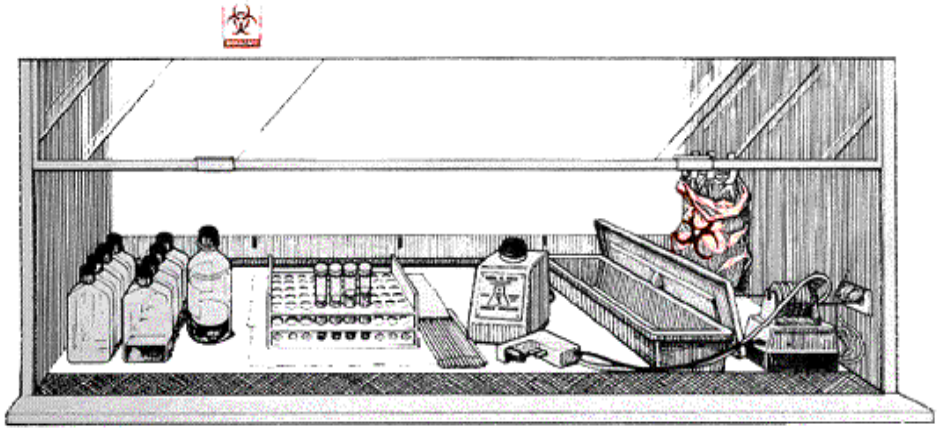


Figure 10.1 - Working "Clean to Dirty" Within a Class II BSC

In order to minimize arm movement in and out of the cabinet, place all needed materials in BSC at the start of procedures, arranging them to so that 'dirty' items do not pass over 'clean' ones. Clean cultures (left) can be inoculated (center); contaminated pipettes can be discarded in the shallow pan and other contaminated materials can be placed in the biohazard bag (right).

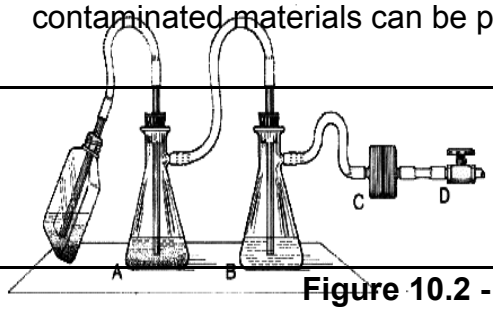


Figure 10.2 - Vacuum Line Protection

A - Collection flask with disinfectant
B - Back-up flask (optional)
C - In-line HEPA filter
D - Connection to building vacuum

7. Cover work surface with absorbent pad (moistened with disinfectant for high risk activities), making sure not block front or rear grilles.

8. Protect vacuum lines: Aspirator bottles should be connected to an overflow collection flask containing appropriate disinfectant, and to an in-line HEPA or equivalent filter.

9. Turn off UV lights when the cabinet is in use. These lights usually contain mercury and they must be disposed through EOHSS's hazardous waste program.

10. Locate BSCs in low-traffic areas and away from supply ventilation grilles and doors (e.g., locate more than 10 ft from a doorway); drafts produced by these situations may disrupt the protective airflow.

11. Close the room door when working in a BSC located near the laboratory entrance because drafts may interrupt and compromise the cabinet's airflow pattern.

12. Small spills within the BSC can be handled immediately by removing the contaminated absorbent paper toweling and placing it into the biohazard bag.

10.D.4 Eliminate Use of Gas Bunsen Burners Within BSC

1. Open flames are not necessary in a biological safety cabinet. An open flame in a BSC creates turbulence that disrupts the pattern of HEPA-filtered air supplied to the work surface. Heat from Bunsen burners may also damage HEPA filters. When absolutely necessary, touch-plate microburners may be used. Use extreme caution to ensure that the gas is not on when the burner is not lit. If this occurs turn off the gas and wait at least 10 minutes for the gas to dissipate before trying to light the burner.

2. Small electric "furnaces" are available for decontaminating bacteriological loops and needles and are preferable to an open flame inside the BSC.

3. The use of disposable inoculating supplies combined with the sterile atmosphere of the BSC should eliminate the need for heat decontamination throughout the procedure.

4. Each biosafety cabinet has a sign on it that flammable liquids should not be used in the cabinet. BSCs contain an ignition source. There have been many fires and explosions when the gas was turned on without the burner being lit.

10.D.5 Sharps Containers

Needles, razors, scalpels, glass Pasteur pipettes and similar items must be discarded as Regulated Medical Waste in puncture-resistant containers; a cardboard box is unsuitable and illegal for the disposal of these items. Sharps containers should be located as close as possible to their point of use, within arm's reach if possible. At UMDNJ, the Environmental Services Department distributes containers and collects Regulated Medical Waste; they should be contacted if there are any problems in the provision of disposal equipment. Glass items (pipettes, tubes) should be replaced whenever possible by equivalent plastic items. Similarly, the use of needles should be limited. See Appendix I for more information.

10.D.6 Centrifuge Safety

Centrifuge accidents have the potential for the release of large volumes of infectious aerosolized material. Use safety cups or gasket-covered containers into which tubes are placed during centrifugation. If a tube breaks, the safety cup or cover contains the material, preventing contamination of the rotor and/or chamber. When centrifuging infectious materials, fill tubes, and load/unload rotors or safety cups inside a biological safety cabinet. See Section 2.O for additional centrifuge safety information.

10.E PERSONAL PROTECTIVE EQUIPMENT

It has long been recognized that working environments using biohazardous materials may be inherently dangerous. OSHA requires that personal protective equipment be provided to employees to control their exposure to hazardous materials.

10.E.1 Selection of Appropriate PPE

It is the responsibility of the employer to determine, based upon a risk assessment, the appropriate PPE required to perform the work safely, to provide equipment that is in good working order and to ensure that training is conducted. Once these hazards have been determined and the appropriate PPE chosen, the employee is required by law to wear the appropriate PPE. The employee must:

- Understand the biohazard procedure or process, the nature of the biohazard and the need for the equipment;
- Be trained in the use of the PPE, be familiar with the equipment and be fit tested for respirators (if respiratory protection is required) to ensure a proper fit;
- Understand that it is his/her responsibility to correctly use the PPE provided in the function of his/her work.

10.E.2 Types of PPE

The types of Personal Protective Equipment may include but are not limited to:

Protective Outerwear: Laboratory coats, disposable gowns, Tyvek coveralls, or other type of uniform must be worn when in the laboratory area to protect individuals from contact with infectious or toxic materials or physical hazards. Long sleeves are required on all lab clothing; Laboratory coats and gowns must be fully fastened (closed). Lab coats must not be worn outside of the laboratory if they were

used during work with infectious materials. Wear coats that are resistant to liquid penetration for activities with splash potential or use a plasticized apron. For high risk activities, use a rear-fastening lab coat.

Eye Protection: At a minimum, safety glasses with permanently affixed side-shields should be worn in the laboratory area, if potential for aerosols is present. Face shields or goggles may be required as additional protection based on the task being performed (with a potential for aerosol, splashes sprays or aerosols) as well as any additional hazards which might also be present (e.g., corrosives).

Safety glasses with side shields: the minimum level of protection of handling any hazardous material;

Goggles: for activities with any splash hazard or when working with organisms transmissible through mucous membrane exposure; and

Goggles with a face shield: when an elevated risk of large quantity splashes exists.

Hand Protection: Gloves must be worn whenever handling clinical specimens, human blood or body fluids, culture dishes or other equipment potentially contaminated with BSL-2 or BSL-3 pathogens, infected animals or infectious waste. The type of glove that can be selected ranges from rubber gloves for minimum protection to other types of gloves (e.g., latex surgical gloves) for maximum protection against bloodborne pathogens, animals or other types of physical hazard. It should be noted that for those individuals with latex allergies, nitrile gloves may be used for protection against biohazards. Those who prefer latex should use only powder-free gloves that are designated "low protein" by the manufacturer. Corrosives and solvents may penetrate gloves or diminish their protective ability; it may be necessary to stock more than one type of glove for the full range of a laboratory's activities.

Natural Latex or Rubber Gloves: Provide protection from most water solutions of acids, alkalis, salts, and ketones. These gloves have excellent wearing qualities, pliability, and comfort and are a good general-purpose glove.

Nitrile Rubber Gloves: Provide protection from chlorinated solvents (trichloroethylene, perchloroethylene). They are intended for jobs requiring dexterity and sensitivity, yet they stand up under mechanical use even after prolonged exposure to substances that cause other glove materials to deteriorate. They also resist abrasion, puncturing, snagging, and tearing.

When using any glove with infectious materials:

- Check for visible tears and other defects.
- Do not allow rings or other jewelry to rip gloves.
- Protective ability diminishes as gloves are worn due to stretching and abrasion; change gloves regularly or as soon as possible if they are overtly contaminated.
- Wash hands immediately after removing gloves.
- Remove gloves when leaving the laboratory; even if they are "clean", their presence outside the laboratory **justifiably** worries other building occupants.
- Proper Packaging and Transport of Infectious Materials, should eliminate the perceived need to wear gloves when transporting infectious materials on campus.

Foot Protection: Paper booties or plastic shoes should be worn when there is the possibility of contaminated materials being present on the lab floor or to minimize the chance of tracking a biohazard from a lab to a clean area. Open toed shoes/sandals should not be used in a laboratory, due to potential risk posed to dropped objects and skin exposure.

Respiratory Protection (mucous membranes and lungs)

Surgical masks will help prevent ingestion and protect the mucous membrane of the nose and mouth from splashes. They **do not** provide protection against inhalation of organisms transmitted by aerosols.

Respirators are used when there is the risk of airborne exposure to BL-3 organisms (ex. mycobacterium tuberculosis) that can be transmitted by inhalation. Respirators may only be worn after the employees has been medically certified, trained, and fit tested. These services can be arranged through Employee Health Services and EOHSS.

10.F DECONTAMINATION/CLEANING/DISINFECTION

The Principal Investigator's designee and the laboratory staff are required to develop and implement a written schedule for cleaningand decontaminating work surfaces. All work surfaces and equipment that come into contact with blood, body fluids, and any infectious agent or materials must be disinfected daily, upon completion of work, with an appropriate disinfectant. Additionally, work surfaces and equipment must be disinfected after any overt spill. Work surfaces should be covered with plastic-backed absorbent toweling to facilitate clean up and reduce production of aerosols as a result

of the spill. Spills within work areas are to be cleaned up by laboratory or research personnel.

10.F.1 Cleaning Schedule

A pre-existing Cleaning Schedule (See Table 10.4) can be substituted for this one if it includes the same details, regardless of the format.

10.F.2 Terminology

- **Sterilization** - the destruction of all microbial life, including bacterial endospores.
- **Disinfection** - the elimination of virtually all pathogenic microorganisms on inanimate objects with the exception of large numbers of bacterial endospores, reducing the level of microbial contamination to an acceptably safe level. Microorganisms can be grouped as following in terms of decreasing resistance to disinfectants: bacterial endospores (*B. subtilis, clostridium spp*); Mycobacteria; nonlipid or small viruses (poliovirus, rhinovirus); fungi; vegetative bacteria; and, lipid or medium sized virus (herpes simplex, HIV, HBV).
- **Antisepsis** - the application of a chemical to living tissue to prevent infection.
- **Decontamination** - includes all of the above. Decontamination is any activity that reduces the microbial lode to prevent inadvertent contamination or infection. The appropriateness of a decontamination procedure is situational-dependent. For example, surgical instruments must be sterile but this level of microbial killing is unnecessary for environmental surfaces such as floors and walls.
- **Dry heat** is used for materials (some glassware, instruments, anhydrous materials) that are sensitive to moisture or the corrosion it may cause. Consult the manufacturers of such items for recommendations for appropriate sterilization procedures. Dry heat is less effective than steam autoclaving and this method requires higher temperatures and a longer exposure time. For example, the recommended exposure time for dry heat sterilization is 2-4 hours at a temperature of 160 degrees C, compared to 30 minutes at 121 degrees C in an autoclave.

Table 10.4 - Cleaning Schedule

Area (benchtop, centrifuge, safety cabinet)	**Scheduled Cleaning Times***	**Cleaners & Disinfectants Used**	**Specific Instructions**
	completion of procedures; after overt contamination; end of work shift, if needed; AND:		
	completion of procedures; after overt contamination; end of work shift, if needed; AND:		
	completion of procedures; after overt contamination; end of work shift, if needed; AND:		
	completion of procedures; after overt contamination; end of work shift, if needed; AND:		

Note: A list of approved sterilants and disinfectants* can be obtained from the Environmental Protection Agency (EPA) at (800-447-6349) or by contacting EOHSS.

* Approved refers to a manufacturer's right to use terms such as disinfectant, tuberculocidal, sporicidal, etc. on the product label. It is based on demonstrated anti-microbial activity in specified testing protocols. In addition, a 10% solution of household bleach, prepared fresh weekly, will provide effective decontamination for routine housekeeping and routine spill response.

- **Chemical sterilization** is chiefly used for heat-sensitive patient care instruments that enter body cavities or normally sterile areas. This process requires prolonged contact times with high concentrations of chemical decontaminating solutions. Chemical sterilants, e.g., 2% glutaraldehyde, are frequently used at a relatively high concentration posing a toxicity hazard. Carefully follow manufacturers directions regarding dilution, contact time, personal protective equipment. Some sterilants require that specific ventilation systems be in place to remove hazardous gases and vapors.

10.F.3 Disinfection

Disinfection encompasses a continuum of outcomes in terms of the types of microorganisms destroyed. Microorganisms can be grouped as following in terms of decreasing resistance to disinfectants: bacterial endospores (*B. subtilis, clostridium spp*); Mycobacteria; nonlipid or small viruses (poliovirus, rhinovirus); fungi; vegetative bacteria; and, lipid or medium sized virus (herpes simplex, HIV, HBV).

Table 10.5 a framework for the selection of the appropriate disinfectant. The label on commercial products will note the types of 'cidal' action of the disinfectant, (e.g., 'tuberculocidal', 'sterilant'). These claims may not appear on the label unless the manufacturer has submitted data to the EPA supporting such claims. The lists of EPA registered disinfectants can be obtained from your campus EOHSS office or found at http://ace.orst.edu/info/nain/lists.htm.

Note that the EPA does not independently audit such results and research indicates that in real life situations some products do not perform as claimed. This results from manufacturers testing their products in best-case situations, e.g., on a smooth surface, at an optimal pH, in a buffer solution instead of a solution containing organic material which partially inactivates some disinfectants. For high risk pathogens, investigators may wish devise their own test to confirm a product's claim.

- Follow label instructions regarding dilution and contact time necessary to achieve the desired level of disinfection.
- Disinfectants that require pre-use dilution should be treated as hazardous chemicals during mixing.
- Wear a lab coat and goggles, not glasses.
- Select a glove that provides protection against permeation by the disinfectant (e.g., glutaraldehyde rapidly penetrates some latex gloves).
- Decontaminate work surfaces with an appropriate disinfectant after completion of procedures, immediately when overtly contaminated, after any spill of blood or other potentially infectious materials, and at the end of the work shift when surfaces have become contaminated since the last cleaning.

- Remove and replace protective coverings such as plastic wrap and aluminum foil when contaminated.
- Inspect and decontaminate, on a regular basis, reusable receptacles such as bins, pails, and cans that have a likelihood for becoming contaminated. When contamination is visible, clean and decontaminate receptacles immediately, or as soon as feasible.
- Place regulated waste in closable and labeled or color-coded containers. When storing, handling, transporting or shipping, place other regulated waste in containers that are constructed to prevent leakage.
- When discarding contaminated sharps, place them in containers that are closable, puncture-resistant, appropriately labeled or color-coded, and leak-proof on the sides and bottom.
- Discard all regulated waste according to UMDNJ policy. Contact the Environmental Services/Physical Plant Department or EOHSS if there are any questions.

Considerations for selecting and using disinfectants

- **Nature of surface** - Rough surfaces will require a longer contact time for effective treatment.
- **Surface compatibility** - Bleach will corrode many metals, rinse with water after use; instruments vary in their ability to withstand disinfectants based on their composition.
- **Organic matter** will inactivate some disinfectants; a second application may be necessary once visible contamination (and hence, most organic debris) has been removed. **The removal of visible soil may be the single most critical factor in assuring effective decontamination.**
- **Resistance of microorganisms**, e.g. bacterial endospore vs. vegetative bacteria.
- **Contact time** necessary for desired level of decontamination.
- Select the disinfectant with the **lowest toxicity** possible.
- **Number of microorganisms** present, overnight culture vs. a recently inoculated one.
- A 1/10 dilution of household bleach, prepared fresh daily, will suit most disinfectant needs. These solutions lose potency over time and should be prepared fresh daily.

Table 10.5 - Summary of Disinfectant Activities

Disinfectant	Disinfection Level	Bacteria	Lipophil. Viruses	Hydrophylic Viruses	M.tuberculosis	Fungi	Comments
Alcohols(ethyl and isopropyl) 60-85%	Intermediate	+++	+		+++		Not sporicidal; evaporates quickly so that adequate contact time may not be achieved, high concentrations of organic matter diminish efficacy; flammable
Phenolics(0.4-5%)	Intermediate	+++	+	+	+	+++	Not sporicidal;phenol penetrates latex gloves; eye/skin irritant; remains active upon contact with organic soil; may leave residue
Glutaraldehyde (2.5%	High	+++			+++	+++	Used to sterilize surgical instruments that can not be autoclaved; strong odor; sensitizer; use with adequate ventilation. Not for use on enfironmental surfaces.
Quaternary Ammonium (0.5-1.5%)	Low	+	+	=	=	+/-	May be ineffective against Psuedomonas and other gram bacteria; recommentation limited to environmental sanitation (floors, walls). Low odor, irritation.
Iodophhors (30-1000 ppm iodine)	Intermediate	+	+	+	+/-	+/-	Inactivated by organic matter.

Chlorine (100-1000ppm)	Intermediate	+	+	+	+/-	+

10.G BIOHAZARD SPILL PROCEDURES

Laboratories that are handling biohazardous or infectious materials should assume that accidents will occur and must develop spill response plans for safely managing those events.

10.G.1 Spill Clean-up Materials

The following materials should be assembled in one place in laboratories using infectious materials; all personnel must know of their location.

- **Disinfectant Solution** - A 1/10 dilution of household bleach, prepared fresh weekly is effective in most situations; contact EOHSS for more information about selection of disinfectants, particularly for any organisms suspected of being atypical in their sensitivity to disinfectants. USE ONLY THOSE DISINFECTANTS OR STERILANTS WITH PROVEN EFFICACY AGAINST THE SPECIFIC BIOHAZARDOUS AGENT(S) YOU ARE USING
- **Forceps, Tongs, Broom, Dust Pan**
- **Goggles or Face Shield, Utility Gloves, Wrap-around Lab Coat, Shoe Covers** (optional)
- **'Biohazard' Bag, Sharps Container**
- **Paper Towels or Other Absorbent**

10.G.2 Laboratory Spill Clean-up Procedures

Spills inside a centrifuge

If a tube breaks inside a centrifuge, allow thirty minutes for any aerosols inside the chamber to settle before opening the lid. Don personal protective equipment as described above. Using a squeeze bottle, apply a disinfectant solution to all potentially contaminated surfaces, taking care to minimize splashing. Allow 20 minutes contact time, remove buckets and rotors to nearest Biological Safety Cabinet, aspirate residual disinfectant, and wipe down surfaces with clean water.

Place debris in red bags. Re-clean rotors and buckets in a BSC, follow manufacturer's directions for selection of disinfectants to use on rotors and buckets.

Spills involving a microorganism requiring BL1 containment (organisms not known to cause disease in healthy adult humans)

- Wear disposable gloves.
- Soak paper towels in disinfectant and place over spill area.
- Place towels in plastic bag for disposal.
- Clean spill area with fresh towels soaked in a disinfectant.

Spills involving microorganisms requiring BL-2 containment.

- Alert people in immediate vicinity to leave the area.
- Put on protective equipment.
- Cover an area twice the size of the spill with disinfectant soaked-paper towels. Or, surround spill with dry disinfectant as per label directions.
- Pour additional disinfectant solution onto the spill, starting at the perimeter and working inward working inward from the edges of the towels. Avoid splashing.
- Allow 20 minute contact period.
- Wipe down any contaminated stationary equipment or furniture twice with disinfectant.
- Use forceps, tongs, or broom to remove broken glass and other items; place in sharps container or red bag.
- Remove towels and re-clean area with disinfectant solution.
- Decontaminate (autoclave, chemical disinfectant) reusable clean-up items and other equipment as appropriate.
- Inform laboratory personnel when the clean-up is complete.

Procedures for BL-1 and BL-2 laboratories should incorporate a degree of flexibility. One could safely abridge the procedures above if 1 ml. were spilled over a small bench top area. However, dropping 50 ml. of culture on the floor clearly necessitates the more detailed procedure.

Spills involving microorganisms requiring BL-3 containment

- Alert people in the area to hold their breath, leave the room, and close the door.

- Notify Public Safety and leave them a phone number where you can be reached. Have them contact EOHSS.
- Wait at least thirty minutes before re-entering the room to allow for most of the infectious aerosols to settle.
- Return to room and clean-up as per directions in BSL-2 section above

WARNING: By definition BL-3 organisms are capable of transmission via inhalation. Laboratories working at BL-3 must develop and periodically update a spill response plan and insure that all personnel are trained in its implementation. It will probably be necessary to wear a respirator during such a response. Respirator use is covered by a detailed set of Federal regulations; anyone who may have to clean-up this type of spill should contact EOHSS for details about respiratory protection and spill-response training.

Spills inside a Biological Safety Cabinet

- Keep the cabinet running. A Biosafety Cabinet is designed to contain microorganisms that are released during work within the cabinet. Provided that the Biosafety Cabinet is operating properly and has been inspected and certified, aerosols produced by a spill within the cabinet should be contained.
- Clean-up as per directions in BL-2 section above, making sure to wipe down back and side walls of cabinet. If material has spilled into the catch basin beneath the work surface, add a volume of disinfectant equal to the quantity in the basin, wait 20 minutes, and absorb with paper towels. After completion, allow cabinet to run for ten minutes before resuming work.
- Decontaminate Biosafety Cabinet and HEPA filters. If the spill was significant the Biosafety Cabinet and filters may need to be decontaminated with paraformaldehyde gas. Because of the potential for exposure to chemical and biohazardous agents, this type of decontamination should only be done by trained personnel or a qualified vendor.

Spills Outside the Biosafety Cabinet Laboratory

Viable organisms requiring BL3 containment should only leave the laboratory in a primary (inside) container-secondary (outside) container system comparable to that required for shipment of such materials. This will ensure containment except in catastrophic circumstances.

Other materials should be transported in sturdy, well sealed primary and secondary containers with a closable top. A test-tube rack inside a shallow tray is not acceptable.

- Carry paper towels and gloves. Cover spill with paper towels but do not attempt a clean-up without appropriate disinfectant and personal protective equipment. Notify people in the immediate area and contact Public Safety to restrict traffic in the area. Collect clean-up material and proceed with clean-up.
- Report spills of blood in corridors and general access areas to the campus' Environmental Services Department.
- In the event of an accidental exposure to a biohazard:
  1. Remove contaminated clothing
  2. Vigorously wash exposed area with germicidal soap and water for one minute.
  3. If exposed to aerosols of infectious microorganisms, leave the immediate area
  4. In the event of exposure to the eyes, immediately flush eyeball and inner surface of eyelid with water for at least 15 minutes. Hold eye open to ensure effective wash behind eyelid
  5. Obtain medical attention

After appropriate decontamination procedures and clean-up have been performed, report to Employee Health Services or follow the appropriate site specific procedures if there is no on-site Medical Department immediately after the emergency situation is stabilized.

Save any offending sample(s) for further testing (e.g., unknown tissue or blood sample, monkey blood or tissue, etc.). Follow the site procedure regarding sample testing. If physical exposure has occurred, personnel **may need** to be medically monitored and quarantined until released by the attending physician or medical staff.

All spills and exposures:

a) Shall be reported to your supervisor, documented and investigated; and,

b) Remedial action, when necessary, shall immediately be addressed and documented.

All exposures must also be reported to your supervisor. An incident report must be completed and provided to the Risk and Claims Department as soon as possible. A copy of the incident report must be sent to EOHSS.

10.H SIGNAGE, POSTING, AND LABELING REQUIREMENTS

Biological hazard posting is used as a means to prevent accidental injury or illness to employees who are occupationally exposed to biohazardous or potentially biohazardous

conditions, equipment or operations which are out of the ordinary, unexpected or not readily apparent.

- Warning signs must be posted at the entrances to work areas where work with biohazardous materials is performed or where biohazardous materials or waste are stored.
- The caution sign on the front door of the room must bear the signal word **"BIOHAZARD"** or **"BIOLOGICAL HAZARD"**, the universal **"BIOHAZARD"** symbol, the **BIOSAFETY LEVEL** of the room as well as any special precautions or requirements for entering the area, and the name and telephone number of the responsible person (Principal Investigator or Director).
- Biological hazard warning tags or labels must be used to identify containers of infectious materials, infectious waste, refrigerators, incubators and/or freezers where biohazards are stored, infectious waste containers, equipment which may be contaminated through normal use of biohazards, laboratory animals (cages) which are potentially infectious or combinations thereof which are contaminated with biohazardous materials. These labels or tags should be affixed as close as safely possible to the container, refrigerator/freezer, equipment, animal cage or other container by a positive means such as string, wire or adhesive that prevents their loss or unintentional removal.

The following lists the types of equipment and places where biohazard warning labels are to be affixed:

- At entrances to areas where biohazards are used;
- At entrances to areas where biohazards are stored;
- On refrigerators or freezers where biohazards are stored;
- To containers of infectious waste;
- To containers of biohazardous material;
- To the outside of packages in which biohazards are shipped;
- To containers used to store or transport biohazards;
- On equipment which may be potentially contaminated with biohazardous material (e.g., centrifuges, incubators, biosafety cabinets, homogenizers, vortices, etc.); and
- To any item which may bepotentially infectious (e.g., animal cages if moved outside of biohazard areas, used sharps, used containers which may have contained biohazards).

10.I WORKING WITH TISSUE CULTURES & CELL LINES

10.I.1 Human Cell Lines: Biosafety Level and Bloodborne Pathogen Program Applicability

Human cell lines and human cell strains from primary explants must be handled at Biosafety Level 2 (BSL2). Human cell lines obtained from commercial sources, even when they have been screened for bloodborne pathogens may become contaminated with adventitious agents while they are in use in the laboratory. Cell lines obtained from non-commercial sources (colleagues passing along an interesting clinical specimen) undergo even less screening. Therefore, all cell cultures should be handled at BSL2 and contaminated materials must be autoclaved before disposal in Regulated Medical Waste containers. Conducting operations at BSL 2 will also reduce the chances of the culture contamination. A checklist of BSL2 facility and work practice requirements is available at:

http://www.umdnj.edu/eohssweb/publications/index.htm#Biosafety

Laboratories using primary explants and human cell strains (non-transformed cells) and cell lines propagated from primary explants must also comply with the provisions of the Bloodborne Pathogens standard unless the strains have been characterized* to be free of bloodborne pathogens.

*__Characterization of human cell lines__ for inclusion or exclusion from compliance with the OSHA BBP Standard, would include screening of the cells lines or "strains" for viruses characterized as bloodborne pathogens by the Standard, including human immunodeficiency viruses, hepatitis viruses or EBV, if the cells are capable of propagating such viruses. Most cell lines are screened for human mycoplasmas and are free of bacterial and mycotic contaminants. Testing may include antigenic screening for viral or agent markers, co-cultivation with various indicator cells that allow contaminants to grow, or using molecular technology (polymerase chain reaction or nucleic acid hybridization) to identify latent viruses capable of infecting humans such as Herpesviruses (e.g., EBV), or papilloma members of the Papovavirus group, etc. Cell lines that are procured from commercial vendors or other sources with documented testing to be free of human bloodborne pathogens and which have been protected by the employer from environmental contamination may be excluded from the bloodborne pathogen program. It is important to note that some commercial vendors such as ATCC, screen for bacteria, mycoplasma, and fungi but not viruses other than those categorized as 'Bloodborne Pathogens' (see ATCC position statement below).

10.I.2 Materials Excluded From the Bloodborne Pathogen Program

Established human cell lines which are characterized (see definition above) to be free of contamination are not covered by the Bloodborne Pathogen Standard as long as documentation that such cell lines do not contain bloodborne pathogens is available and is kept in the laboratory.

For example, in order to handle human HeLa cells, without having to comply with the requirements of the bloodborne pathogens standard (BPS), human HeLa cells should be documented to be pure HeLa cells and shown to be free of bloodborne pathogens by testing.

10.I.3 For activities with materials not known to contain infectious agents

BSL-2 is appropriate for activities with: all normal human and primate cell lines, even well established ones, unless tested to confirm that they are not contaminated; all cells derived from human/primate lymphoid or tumor tissues; all primate tissue; all human clinical material** ; cultured cells new to the laboratory until proven contaminant-free; and, cells exposed to or transformed by a primate oncogenic virus.

**Inclusion of these activities in the Bloodborne Pathogens program is required as would be the case for any cells purposely infected with or suspected of harboring agents defined as bloodborne pathogens. Laboratories using human cell strains (non-transformed cells) propagated from primary explants must comply with the provisions of the Standard because these materials would be considered “unfixed human tissues” and therefore covered by the regulation. BSL-1 is appropriate for well-established lines of cells of sub-primate origin or non-human primates if they do not harbor a primate virus and are free of bacteria, fungi, and mycoplasma. HOWEVER working with theses materials at BSL-2 is recommended because of the additional degree of protection from contamination provided by BSL-2 practices, particularly the use of a Biological Safety Cabinet.

ATCC position on human cell lines

Since it is not possible for us to test every cell line for every possible virus, we rely on the tests performed by the depositor. We recommend that all human cell lines be accorded the same level of biosafety consideration as a line known to carry HIV. With infectious virus assays or viral antigen assays, even a negative test result may leave open the possible existence of a latent viral genome. Thus, it is best to use caution when handling any human cell line. Since it is not possible for us to test every cell line for every possible virus, we rely on the tests performed by the depositor. We recommend that all human cell lines be accorded the same level of biosafety consideration as a line known to carry HIV. With infectious virus assays or viral antigen assays, even a negative test result may leave open the possible existence of a latent viral genome. Thus, it is best to use caution when handling any human cell line.

ATCC information on their testing of cell lines for bloodborne pathogens is available at:

http://www.atcc.org/SearchCatalogs/faqCellBiology.cfm#Q53

Table 10.6 - Appendix H of the BMBL
Working with Human and Other Primate Cells and Tissues
http://www.cdc.gov/od/ohs/biosfty/bmbl5/BMBL_5th_Edition.pdf

At least 24 documented cases of infection of laboratory workers handling primary cell cultures (e.g., primary rhesus monkey kidney cells) have occurred in the past 30 years. While a limited number of laboratory-associated infections have been reported as resulting from the handling of human and other primate cells, there is a more significant risk to acquiring infection with HBV or HIV from exposure to human blood and other body fluids, and OSHA has developed a bloodborne pathogens standard. Procedures have been published to reduce contamination of cell cultures with microorganisms or other cells.

Potential Laboratory Hazards. The potential laboratory hazards associated with human cells and tissues include the bloodborne pathogens HBV and HIV, as well as agents such as *Mycobacterium tuberculosis* that may be present in human lung tissues. Other primate cells and tissues also present risks to laboratory workers. Potential hazards to laboratory workers are presented by cells transformed with viral agents, such as SV-40, EBV, or HBV, as well as cells carrying viral genomic material. Tumorigenic human cells also are potential hazards as a result of self-inoculation.

Recommended Practices. Human and other primate cells should be handled using Biosafety Level 2 practices and containment. All work should be performed in a biosafety cabinet, and all materials should be decontaminated by autoclaving or disinfection before discarding. All employees working with human cells and tissues should be enrolled in the institutional Bloodborne Pathogens Program, and should work under the policies and guidelines established by the institutions' Exposure Control Plan.—Employees should provide a baseline serum sample, be offered hepatitis B immunization, and be evaluated by a health care professional following an exposure incident.

10.J TRANSPORT OF INFECTIOUS MATERIALS

The Centers for Disease Control and Prevention (CDC), the Department of Transportation (DOT), as well as the International Air Transport Association (IATA) have requirements regarding shipment of hazardous materials, which are termed "dangerous goods." Infectious substances, genetically modified organisms and dry ice are listed as dangerous goods and must be packaged and shipped accordingly. Diagnostic specimens, not believed to be infectious, are not regulated as dangerous goods but still

must be packaged properly. Implementation of the International Air Transport Association (IATA) requirements ensures compliance with all of the other agencies' requirements.

Personnel who package and/or ship diagnostic specimens or infectious materials via U.S. Postal Service or other delivery services (e.g., Federal Express) must complete IATA training every two years. Those who receive shipment must also be trained.

Consult the EOHSS website for your campus IATA shipping training schedule. The course covers shipper's responsibilities and provides the necessary guidelines to ensure the safe transport of biological materials while complying with all applicable regulations.

10.J.1 Shipment via vendor

The materials must be classified according to biological hazard (ex. infectious substance, diagnostic specimen) as well as any additional hazards that may be present such as dry ice. Proper packaging materials must be used. These must meet UN specifications. EOHSS can also provide information regarding suppliers of approved packaging materials.

When shipping infectious substances, be sure to clearly label the specific hazard on the package and shipping documents as required by DOT and IATA.

Any necessary shipping forms must be completed. This may include importation permits and the Shipper's Declaration for Dangerous Goods (if applicable).

Shipper's Declaration of Dangerous Goods will include:

- Full address and phone number of shipper
- Full address and phone number of consignee
- Transport details; Shipment type: “X” out section that does not apply
- Dry ice - List as Dangerous
- Additional Handling
- Emergency phone Number. This number must be monitored 24 hours a day. UMDNJ uses Chel-tel. See the form at: http://www.umdnj.edu/eohssweb/publications/chemtel.htm

•

10.J.2 Safe packaging of refrigerants

Shipping with Dry Ice: Dry ice must never be placed in an air-tight container. The resulting pressure may cause a violent failure of the container and possible injury. Dry ice should be placed outside the secondary container as the outer package(s) will allow for dispersion of carbon dioxide. Dry ice used for shipments requiring Packing Instruction 602 must be listed as a dangerous good on the Declaration of Dangerous Goods.

10.J.3 Emergency Contact Phone Number

An emergency contact phone number must be provided when shipping hazardous materials. The University provides for the use of Chemtel as the emergency contact number. This phone number must be supplied on the "Shipper's Declaration for Dangerous Goods". The telephone number to be listed is 1-800-255-3924. The Chemtel Notification Form must be filled out if using this phone number as the 24-hour contact. The form is available on the EOHSS web site: http://www2.umdnj.edu/eohssweb/publications/chemtel.htm

10.J.4 Intra-Campus Transport between/within Buildings

- Place material in leak-proof, primary (inner) container; wipe the outer surface with an appropriate disinfectant.
- Put it in a leak-proof secondary (outer) container. Place enough absorbent material between the two containers to absorb all the liquid from the inner container if it breaks.
- The outer container, and preferably the inner one, must be break-resistant. A sealed plastic bag would be acceptable for carrying a microfuge tube but a glass test tube should be cushioned and placed inside a rigid container with a tight-fitting lid.
- Accompanying paperwork should not be in direct contact with the primary container.
- Only personnel cognizant of the hazards of the sample should carry these items.
- Go directly to the destination; at the destination, leave the package with someone who knows what to do with it. Do not just drop it off and leave.
- If a package will traverse 'public areas' (city streets, elevator lobbies), place the primary/secondary unit in a non-transparent container such as a cardboard box.
- The outermost package should be marked with the name and phone number of the laboratory from which it originates.

10.J.5 Transporting any infectious agents or human materials

These guidelines apply to both transport within and between campuses:

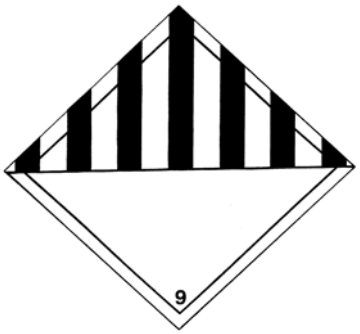
- Specimen containers should be watertight and leak-proof, All materials must be transported and stored in a secondary container to prevent breakage. A secondary container is capable of containing the materials if the primary container breaks or leaks. Absorbent materials should be included in the secondary container to absorb any liquids. Cushion the materials to prevent container breakage.
- If the specimen container is a tube, ensure it is tightly capped and placed in a rack to maintain an upright position.
- Place specimen containers and racks in robust, leak-proof plastic or metal transport boxes with secure, tight fitting covers.
- Secure the transport boxes in the transport vehicle.
- Label each transport box appropriately, consistent with its contents, a biohazard symbol, the name and telephone number of an emergency contact person, and the receiver's name address and telephone number.
- Specimen data forms and identification data should accompany each transport box.
- Keep a spill kit containing absorbent material, a chloride disinfectant, a leak-proof waste container and heavy reusable gloves in the transport vehicle.
- When transporting multiple primary containers, package them in a manner that will prevent damage to the containers. For example, if you are preparing to transport a number of vacutainers, place these in a rack that will prevent contact between the tubes. Only personnel cognizant of the hazards of the sample should carry these items.

NOTE: Universal precautions means that all human blood and certain body fluids are treated as if they contain human immunodeficiency virus (HIV), hepatitis B virus (HBV) and other blood borne pathogens.. While appropriate for laboratory operations, UP does not apply to shipping classifications. Example: a blood sample from a person with no clinical indications or risk factors for infectious disease would be handled as if known to be infectious under UP. But, for transport purposes, the shipper may follow the less restrictive and less costly Packing Instruction 650 provided that it is being shipped for purposes other than testing for pathogens. If the sample was being shipped to test for pathogens, Packing Instruction 602 would apply. Laboratories that regularly ship infectious substances or diagnostic specimens should document their procedures and the criteria they use in determining the classification of their shipments.

10.J.6 Training

Shippers of materials covered by IATA Dangerous Goods Regulations must receive initial and update training at least every two years. Employees who receive packages must also hazard awareness training. UM DNJ couriers should attend the training. EOHSS can provide IATA training to UMDNJ personnel.

Figure 10.3 - Labels and Packaging Materials



For Dry Ice

ACTUAL SIZE OF LABELS: 4" X 4"

EOHSS can provide the names of companies that sell the labels and packaging materials necessary for compliance with shipping regulations.

10.J.8 Shipping Resources on the Internet

- An EOHSS factsheet for Shipping of Diagnostic Specimens, Infectious Substances, Genetically Modified Organisms & Dry Ice is available at: http://www2.umdnj.edu/eohssweb/publications/shipping.pdf

- IATA, Dangerous Goods Information Online
  http://www.iata.org/cargo/dg/index.htm
- AIHA Laboratory Health and Safety Committee Shipping Links
  http://www2.umdnj.edu/eohssweb/aiha/technical/ biosafety.htm#Shipping
- IATA Infectious Substance Shipping Guidelines
  http://www.iataonline.com/shop/product.asp?sku=9052%2D03

10.J.9 Standard Operating Procedures for Receipt of Packages

The following provisions should be incorporated into the Standard Operating Procedures for receipt of packages containing infectious substances.

- **Leaking Packages:** Receiving should not handle a package that appears to be leaking or damaged. Receiving should isolate the area around the package, and then notify EOHSS as well as the recipient. If anyone has handled the package and may have been exposed to the leaking material, wash the affected area for 15 minutes and then contact Employee Health for additional medical follow-up. The recipient should clean up any spill and decontaminate the area according to procedures listed below.

- **Package Delivery:** The package should be delivered directly to the person who appears on the address label or to persons designated to receive hazardous material shipments. The Principal Investigator or personnel to whom the package is addressed should be notified of its arrival.

Before being opened the shipment should be examined for the following:

- **Package integrity** - The package should not be leaking or appear damaged in any way. If it is, notify the PI immediately. Disinfection & clean-up materials should be available for spills.

- **Proper paperwork and labeling** - The label and accompanying documentation should be examined and this information given to the PI, the recipient or other designated personnel.

Use the following precautions when opening the package:

- The package should be opened in a room that has the appropriate biosafety level rating for the material received (e.g., a lab receiving BSL 2 materials should have a BSL 2 notation on the door & meet BSL 2 requirements). A Class II biological safety cabinet provides the best protection and is most

suitable for opening and handling incoming specimens of Biosafety Level-2 (BL-2) organisms). Laboratory coats, gloves and appropriate eye protection must be worn. If the package appears leaking or damaged, it should only be opened in a biological safety cabinet by personnel trained in spill clean-up procedures wearing appropriate personal protective equipment.

The EOHSS flipchart entitled "Emergency Response Guide" should be posted in a conspicuous place for immediate reference. Handle damaged or leaking shipments as biological spills. Follow instructions on the Emergency Response Guide regarding how to deal with a biohazardous spill and regarding exposure of personnel to infectious materials by accidental injection, cuts, ingestion or inhalation. Contact EOHSS to obtain an Emergency Response Guide.

10.K RECOMBINANT DNA (rDNA)

The school/unit Institutional Biosafety Committee (IBC) is responsible for ensuring compliance with the latest edition of the NIH Recombinant DNA Guidelines. The mechanism for initiating the approval/notification process is the completion of the appropriate form. URL addresses of school specific forms are listed in Appendix K.

Return completed forms to the contact person listed on the form for your campus.

The latest version of the NIH GUIDELINES FOR RESEARCH INVOLVING RECOMBINANT DNA MOLECULES (NIH GUIDELINES) is available from the EOHSS home page:

http://www.umdnj.edu/eohssweb/publications/external.htm#Biological

Table 10.7, below, categorizes the need to notify the IBC of rDNA research conducted within laboratories and lists exemptions to the NIH guidelines. Contact EOHSS if assistance is required to categorize any RDNA activities.

Genetically modified micro-organisms are separable into: the host organism, in which the genetic information is inserted; the donor organism, from which the genetic information has been obtained; the vector which transfers the information between these organisms; the insert which contains one or more genes capable of displaying biological activity. Each of these parts, together with the final construct must be taken into consideration in order to obtain an accurate and proper risk assessment.

Vectors are, by definition, plasmids, bacteriophages, viruses and other DNA elements with a capacity for autonomous replication, in which a fragment of foreign DNA (insert) is inserted. A vector contains one or more replication sites and genes that confer a few phenotypic characters to the cells that contain it (e.g. antibiotic resistance). The vector

may or may not integrate into the host DNA.

Most of the viral vectors used today are derived from retroviruses (avian and murine), adenoviruses, adeno-associated viruses (AAV),parvovirus, herperviruses, poxviruses and lentiviruses.

Constructs generally contain marker genesfor antibiotic resistance and, depending on the circumstance, a large number of genes derived from pathogenic bacteria, viruses and other parasites belonging to all kingdoms of living or ganisms. The majority of constructs that are produced have never existed in nature and can therefore be potential causes of damage to the environment and to the health.

Activities with most vectors listed above require Biological Safety Level 2 containment and practices and may require notification of the Institutional BioSafety Committee in accordance with the NIH's *Guidelines for the Use of Recombinant DNA.*

Table 10.7 - Summary of Notification Requirement for rDNA

Experiments Requiring PRIOR IBC Approval:	Experiments Requiring IBC Notification upon Initiation:	Exempt Experiments Not Requiring Registration:
▸ Deliberate formation of recombinant DNA containing genes for the biosynthesis of toxin molecules lethal for vertebrates at an LD_{50} of less than 100 ng/kg body weight ▸ Experiments Using Risk Group 2, 3, 4, or Restricted Agents as Host-Vector Systems ▸ Experiments in Which DNA From Risk Group 2, 3, 4, or Restricted Agents is Cloned into Nonpathogenic Prokaryotic or Lower Eukaryotic Host-Vector Systems ▸ Experiments Involving the Use of Infectious DNA or RNA Viruses or Defective DNA or RNA Viruses in the Presence of Helper Virus in Tissue Culture Systems ▸ Experiments Involving Whole Animals or Whole Plants. ▸ For an experiment involving the deliberate transfer of recombinant DNA, or DNA or RNA derived from r DNA, into human research participants (human gene transfer)	▸ Experiments Involving the Formation of Recombinant DNA Molecules Containing No More than Two-Thirds of the Genome of any Eukaryotic Virus ▸ Experiments Involving Transgenic Rodents	▸ Those that are not in organisms or viruses. ▸ Those that consist entirely of DNA segments from a single nonchromosomal or viral DNA source, though one or more of the segments may be a synthetic equivalent. ▸ Those that consist entirely of DNA from a prokaryotic host including its indigenous plasmids or viruses when propagated only in that host or when transferred to another host by well established physiological means. ▸ Those that consist entirely of DNA from an eukaryotic host including its chloroplasts, mitochondria, or plasmids (but excluding viruses) when propagated only in that host (or a closely related strain of the same species)

10.L PATHOGEN AND TOXIN REGISTRY

Laboratories using microorganisms requiring work at BL-2 or B3, or materials capable of transmitting bloodborne diseases (HIV, HBV, HCV) must complete the appropriate form. URL addresses are listed in Appendix K. Biosafety Level determinations can be found in the CDC/NIH's *Biosafety in Microbiological and Biomedical Laboratories* or the NIH *Guidelines for Research Involving Recombinant DNA Molecules* (available from EOHSS). Registries must be updated annually or whenever new agents are introduced into the laboratory.

The Centers for Disease Control and Prevention regulates the possession of biological agents and toxins that have the potential to pose a severe threat to public health and safety. CDC's Select Agent Program oversees these activities. Any entity that possesses, uses, or will receive or transfer any select agent or toxin to or from entities within the US or outside the US (see Table 10.8 for a select agent list) is regulated by the New Select Agent Regulation, 42 CFR 73.0, "Possession, Use, and Transfer of Select Agents and Toxins," administered by the Centers for Disease Control (http://www.cdc.gov/od/sap/).

CDC prepared the select agent list for 42 CFR 73 after receiving extensive input from scientists representing 21 Federal government entities. The proposed list was published in the Federal Register for public comment on August 23, 2002. The HHS Secretary considered the following criteria for establishing the list as directed in 42 U.S.C. 262a (a)(1)(B):

- The effect on human health of exposure to the agent or toxin;
- The degree of contagiousness of the agent or toxin and the methods by which the agent or toxin is transferred to humans;
- The availability and effectiveness of pharmacotherapies and immunizations to treat and prevent any illness resulting from infection by the agent or toxin.

The current Select Agent Program requires facilities to register with CDC to register with CDC prior to transfer/receipt of select agents. The current registration process also requires submission of an application that certifies that the facility is in compliance with specific safety and security standards set forth in the regulation. All entities (except for Federal, State, or local governmental agencies), their Responsible Official (RO), alternate RO, and all individuals working with or having access to select agents or toxins must have an approved security risk assessment. An entity may not provide an individual access to a select agent or toxin unless the individual has been approved by the HHS Secretary or USDA Secretary based on this security risk assessment. Additional requirements of the "USA Patriot Act" and the "Public Health Security, Bioterrorism and Response Act of 2002" must also be satisfied. The specific components to include in the security plan as required by 42 CFR 73 are located in the regulation at § 73.11 and can be accessed at

http://www.cdc.gov/od/sap/docs/73_11.pdf. If you anticipate obtaining select agent materials, complete the appropriate form for your school submit it to the contact person listed on the form for your campus. Contact EOHSS for additional information and assistance.

Federal law requires that the CDC must be notified five (5) working days in advance of the **destruction or depletion of a select agents/toxin**. This notification must be coordinated through the Responsible Facility Official and EOHSS (Environmental Occupational Health and Safety Services).

Laboratories that do not use any BL-2 or BL-3 organisms or any of the toxins on the Select Agent list do not need to complete the Registry Form. They must, in the future, do so if any of these materials are introduced into the laboratory.

10.L.1 Guidance Documents

- FAQ for New Select Agent Regulation (42 CFR 73) (issued by the Centers for Disease Control and Prevention {CDC}) - http://www.cdc.gov/od/sap/docs/faq.pdf

- Laboratory Security and Emergency Response Guidance for Laboratories Working with Select Agents (guidance document issued by the CDC in December of 2002 through its Morbidity and Mortality Weekly Report) - http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5119a1.htm

- Select agent list - http://www.cdc.gov/od/sap/docs/salist.pdf

10.L.2 Regulations

- CDC: 42 CFR Part 73 Possession, Use, and Transfer of Select Agents and Toxins; Interim Final Rule - http://www.cdc.gov/od/sap/docs/42cfr73.pdf

- USDA: 7 CFR Part 331 9 CFR Part 121 Agricultural Bioterrorism Protecton Act of 2002; Possession, Use and Transfer of Biological Agents and Toxins; Interim Final Rule - http://www.aphis.usda.gov/vs/ncie/pdf/btarule.pdf

Table 10.8 - Select Agents, Toxins, High Consequence Livestock/Plant Pathogens

Viruses (HHS and USDA)

Akabane virus
African swine fever virus
African horse sickness virus
Avian influenza virus (highly pathogenic)
Blue tongue virus (Exotic)
Bovine spongiform encephalopathy agent
Camel pox virus
Central European Tick-borne encephalitis
Cercopithecine herpesvirus 1 (Herpes B virus)
Classical swine fever virus
Crimean-Congo hemorrhagic fever virus
Eastern Equine Encephalitis virus
Ebola viruses
Flexal
Foot and mouth disease virus
Goat pox virus
Guanarito
Japanese encephalitis virus
Junin
Kyasanur Forest disease
Lassa fever virus
Lumpy skin disease virus
Machupo
Malignant catarrhal fever virus (Exotic)
Marburg virus
Menangle virus
Monkeypox virus
Newcastle disease virus (VVND)
Nipah and Hendra Complex viruses
Omsk Hemorrhagic Fever
Peste Des Petits Ruminants virus
Rift Valley fever virus
Rinderpest virus
Russian Spring and Summer encephalitis
Sabia
Sheep pox virus
South American Hemorrhagic fever viruses
Swine vesicular disease virus
Tick-borne encephalitis complex (flavi) viruses
Variola major virus (Smallpox virus)
Variola minor virus (Alastrim)
Venezuelan Equine Encephalitis virus
Vesicular stomatitis virus (Exotic)

Bacteria (HHS and USDA)

Bacillus anthracis
Brucella abortus
Brucella melitensis
Brucella suis
Burkholderia mallei (formerlyPseudomona mallei)
Burkholderia pseudomallei
Botulinum neurotoxin producing species Clostridium
Cowdria ruminantium (Heartwater)
Coxiella burnetti
Francisella tularensis
Mycoplasma capricolum/ M.F38/M. mycoides capri
Mycoplasma mycoides mycoides
Rickettsia prowazekii
Rickettsia rickettsii
Yersinia pestis

Fungi

Coccidioides immitis
Coccidioides posadasii

Toxins (HHS and USDA)

Abrin
Botulinum neurotoxins
Conotoxins
Clostridium perfringens epsilon toxin
Diacetoxyscirpenol
Ricin
Saxitoxin
Shigatoxin, Shiga-like ribosome inactivating proteins
Staphylococcal enterotoxins
T-2 toxin
Tetrodotoxin

USDA Plant Pathogens

Liberobacter africanus
Liberobacter asiaticus
Peronosclerospora philippinensis
Phakopsora pachyrhizi
Plum Pox Potyvirus
Ralstonia solanacearum race 3, biovar 2
Schlerophthora rayssiae var zeae
Synchytrium endobioticum
Xanthomonas oryzae
Xylella fastidiosa (citrus variegated chlorosis strain)

Genetic Elements, Recombinant Nucleic Acids, and Recombinant Organisms:

* If your research involves rDNA, you must submit a registration form with the IBC. Contact EOHSS to obtain more information.

(1) Select agent viral nucleic acids (synthetic or naturally derived, contiguous or fragmented, in host chromosomes or in expression vectors) that can encode infectious and/or replication competent forms of any of the select agent viruses.

(2) Nucleic acids (synthetic or naturally derived) that encode for the functional form(s) of any of the toxins listed in if the nucleic acids: (i) are in a vector or host chromosome; (ii) can be expressed in vivo or in vitro; or (iii) are in a vector or host chromosome and can be expressed in vivo or in vitro.

(3) Viruses, bacteria, fungi, and toxins listed that have been genetically modified.

Exclusions: Toxin quantities, vaccine strains and diagnostic uses may be excluded. Contact EOHSS for more information.

APPENDIX A

UMDNJ POLICIES REFERRING TO HEALTH AND SAFETY

The following polices affect laboratory safety procedures at UMDNJ. Current versions of all UMDNJ Policies are available on the Office of Policy and Project Management website: http://www.umdnj.edu/oppmweb/Policies/contents.html

00-01-40-40:10	Chemoprophylaxis after Potential Occupational / Educational HIV Exposure
00-01-45-05:00	Environmental Pollution Control
00-01-45-15:00	Regulated Medical Waste
00-01-45-25:00	NJ Worker and Community Right to Know
00-01-45-35:00	Hazardous Waste Management
00-01-45-45:00	Chemical Spill Prevention and Mitigation
00-01-45-50:00	Bloodborne Pathogens
00-01-45-52:00	HIV, HBV and HCV
00-01-45-55:00	Laboratory Safety
00-01-45-60:00	Fire and Life Safety

00-01-50-65:00	Surplus Furniture and Equipment (disposal of unwanted laboratory equipment)
00-01-55-15:00	Requisition Processing (narcotics requisition)
00-0110-10:00	Select Biological Agents or Toxins

(Page intentionally left blank)

APPENDIX B

29 CFR 1910.1450 - OCCUPATIONAL EXPOSURE TO HAZARDOUS CHEMICALS IN LABORATORIES

1910.1450(a)

Scope and application.

1910.1450(a)(1)

This section shall apply to all employers engaged in the laboratory use of hazardous chemicals as defined below.

1910.1450(a)(2)

Where this section applies, it shall supersede, for laboratories, the requirements of all other OSHA health standards in 29 CFR part 1910, subpart Z, except as follows:

1910.1450(a)(2)(i)

For any OSHA health standard, only the requirement to limit employee exposure to the specific permissible exposure limit shall apply for laboratories, unless that particular standard states otherwise or unless the conditions of paragraph (a)(2)(iii) of this section apply.

1910.1450(a)(2)(ii)

Prohibition of eye and skin contact where specified by any OSHA health standard shall be observed.

1910.1450(a)(2)(iii)

Where the action level (or in the absence of an action level, the permissible exposure limit) is routinely exceeded for an OSHA regulated substance with exposure monitoring and medical surveillance requirements paragraphs (d) and (g)(1)(ii) of this section shall apply.

1910.1450(a)(3)

This section shall not apply to:

..1910.1450(a)(3)(i)

1910.1450(a)(3)(i)

Uses of hazardous chemicals which do not meet the definition of laboratory use, and in such cases, the employer shall comply with the relevant standard in 29 CFR part 1910, subpart 2, even if such use occurs in a laboratory.

1910.1450(a)(3)(ii)

Laboratory uses of hazardous chemicals which provide no potential for employee exposure. Examples of such conditions might include:

1910.1450(a)(3)(ii)(A)

Procedures using chemically-impregnated test media such as Dip-and-Read tests where a reagent strip is dipped into the specimen to be tested and the results are interpreted by comparing the color reaction to a color chart supplied by the manufacturer of the test strip;

and

1910.1450(a)(3)(ii)(B)

Commercially prepared kits such as those used in performing pregnancy tests in which all of the reagents needed to conduct the test are contained in the kit.

1910.1450(b)

Definitions -

"Action level" means a concentration designated in 29 CFR part 1910 for a specific substance, calculated as an eight (8)-hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

"Assistant Secretary" means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

"Carcinogen" (see "select carcinogen").

"Chemical Hygiene Officer" means an employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. This definition is not intended to place limitations on the position description or job classification that the designated individual shall hold within the employer's organizational structure.

"Chemical Hygiene Plan" means a written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices that (i) are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace and (ii) meets the requirements of paragraph (e) of this section.

"Combustible liquid" means any liquid having a flashpoint at or above 100 deg. F (37.8 deg. C), but below 200 deg. F (93.3 deg. C), except any mixture having components with flashpoints of 200 deg. F (93.3 deg. C), or higher, the total volume of which make up 99 percent or more of the total volume of the mixture.

"Compressed gas" means:

(i) A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70 deg. F (21.1 deg. C); or

(ii) A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130 deg. F (54.4 deg C) regardless of the pressure at 70 deg. F (21.1 deg. C); or

(iii) A liquid having a vapor pressure exceeding 40 psi at 100 deg. F (37.8 C) as determined by ASTM D-323-72.

"Designated area" means an area which may be used for work with "select carcinogens," reproductive toxins or substances which have a high degree of acute toxicity. A designated area may be the entire laboratory, an area of a laboratory or a device such as a laboratory hood.

"Emergency" means any occurrence such as, but not limited to, equipment failure, rupture of containers or failure of control equipment which results in an uncontrolled release of a hazardous chemical into the workplace.

"Employee" means an individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments.

"Explosive" means a chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

"Flammable" means a chemical that falls into one of the following categories:

(i) "Aerosol, flammable" means an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame protection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;

(ii) "Gas, flammable" means:

(A) A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent by volume or less; or

(B) A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12 percent by volume, regardless of the lower limit.

(iii) "Liquid, flammable" means any liquid having a flashpoint below 100 deg F (37.8 deg. C), except any mixture having components with flashpoints of 100 deg. C) or higher, the total of which make up 99 percent or more of the total volume of the mixture.

(iv) "Solid, flammable" means a solid, other than a blasting agent or explosive as defined in 1910.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

"Flashpoint" means the minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested as follows:

(i) Tagliabue Closed Tester (See American National Standard Method of Test for Flash Point by Tag Closed Tester, Z11.24 - 1979 (ASTM D 56-79)) - for liquids with a viscosity of less than 45 Saybolt Universal Seconds (SUS) at 100 deg. F (37.8 deg. C), that do not contain suspended solids and do not have a tendency to form a surface film under test; or

(ii) Pensky-Martens Closed Tester (See American National Standard Method of Test for Flashpoint by Pensky-Martens Closed Tester, Z11.7 - 1979 (ASTM D 93-79)) - for liquids with a viscosity equal to or greater than 45 SUS at 100 deg. F (37.8 deg. C), or that contain suspended solids, or that have a tendency to form a surface film under test; or

(iii) Setaflash Closed Tester (see American National Standard Method of test for Flash Point by Setaflash Closed Tester (ASTM D 3278-78)).

Organic peroxides, which undergo autoaccelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified above.

"Hazardous chemical" means a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.

Appendices A and B of the Hazard Communication Standard (29 CFR 1910.1200) provide further guidance in defining the scope of health hazards and determining whether or not a chemical is to be considered hazardous for purposes of this standard.

"Laboratory" means a facility where the "laboratory use of hazardous chemicals" occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.

"Laboratory scale" means work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safety manipulated by one person. "Laboratory scale" excludes those workplaces whose function is to produce commercial quantities of materials.

"Laboratory-type hood" means a device located in a laboratory, enclosure on five sides with a movable sash or fixed partial enclosed on the remaining side; constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory; and allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms.

Walk-in hoods with adjustable sashes meet the above definition provided that the sashes are adjusted during use so that the airflow and the exhaust of air contaminants are not compromised and employees do not work inside the enclosure during the release of airborne hazardous chemicals.

"Laboratory use of hazardous chemicals" means handling or use of such chemicals in which all of the following conditions are met:

(i) Chemical manipulations are carried out on a "laboratory scale;"

(ii) Multiple chemical procedures or chemicals are used;

(iii) The procedures involved are not part of a production process, nor in any way simulate a production process; and

(iv) "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

"Medical consultation" means a consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examinations or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.

"Organic peroxide" means an organic compound that contains the bivalent -O-O- structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.

"Oxidizer" means a chemical other than a blasting agent or explosive as defined in 1910.109(a), that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

"Physical hazard" means a chemical for which there is scientifically valid evidence tat it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer pyrophoric, unstable (reactive) or water-reactive.

"Protective laboratory practices and equipment" means those laboratory procedures, practices and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective, in minimizing the potential for employee exposure to hazardous chemicals.

"Reproductive toxins" means chemicals which affect the reproductive chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

"Select carcinogen" means any substance which meets one of the following criteria:

(i) It is regulated by OSHA as a carcinogen; or

(ii) It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP)(latest edition); or

(iii) It is listed under Group 1 ("carcinogenic to humans") by the International Agency for research on Cancer Monographs (IARC)(latest editions); or

(iv) It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

(A) After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m(3);

(B) After repeated skin application of less than 300 (mg/kg of body weight) per week; or

(C) After oral dosages of less than 50 mg/kg of body weight per day.

"Unstable (reactive)" means a chemical which is the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature.

"Water-reactive" means a chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

1910.1450(c)

Permissible exposure limits. For laboratory uses of OSHA regulated substances, the employer shall assure that laboratory employees' exposures to such substances do not exceed the permissible exposure limits specified in 29 CFR part 1910, subpart Z.

..1910.1450(d)

1910.1450(d)

Employee exposure determination -

1910.1450(d)(1)

Initial monitoring. The employer shall measure the employee's exposure to any substance regulated by a standard which requires monitoring if there is reason to believe that exposure levels for that substance routinely exceed the action level (or in the absence of an action level, the PEL).

1910.1450(d)(2)

Periodic monitoring. If the initial monitoring prescribed by paragraph (d)(1) of this section discloses employee exposure over the action level (or in the absence of an action level, the PEL), the employer shall immediately comply with the exposure monitoring provisions of the relevant standard.

1910.1450(d)(3)

Termination of monitoring. Monitoring may be terminated in accordance with the relevant standard.

1910.1450(d)(4)

Employee notification of monitoring results. The employer shall, within 15 working days after the receipt of any monitoring results, notify the employee of these results in writing either individually or by posting results in an appropriate location that is accessible to employees.

1910.1450(e)

Chemical hygiene plan - General. (Appendix A of this section is non-mandatory but provides guidance to assist employers in the development of the Chemical Hygiene Plan).

1910.1450(e)(1)

Where hazardous chemicals as defined by this standard are used in the workplace, the

employer shall develop and carry out the provisions of a written Chemical Hygiene Plan which is:

1910.1450(e)(1)(i)

Capable of protecting employees from health hazards associated with hazardous chemicals in that laboratory and

..1910.1450(e)(1)(ii)

1910.1450(e)(1)(ii)

Capable of keeping exposures below the limits specified in paragraph (c) of this section.

1910.1450(e)(2)

The Chemical Hygiene Plan shall be readily available to employees, employee representatives and, upon request, to the Assistant Secretary.

1910.1450(e)(3)

The Chemical Hygiene Plan shall include each of the following elements and shall indicate specific measures that the employer will take to ensure laboratory employee protection;

1910.1450(e)(3)(i)

Standard operating procedures relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals;

1910.1450(e)(3)(ii)

Criteria that the employer will use to determine and implement control measures to reduce employee exposure to hazardous chemicals including engineering controls, the use of personal protective equipment and hygiene practices; particular attention shall be given to the selection of control measures for chemicals that are known to be extremely hazardous;

1910.1450(e)(3)(iii)

A requirement that fume hoods and other protective equipment are functioning properly and specific measures that shall be taken to ensure proper and adequate performance of such equipment;

..1910.1450(e)(3)(iv)

1910.1450(e)(3)(iv)

Provisions for employee information and training as prescribed in paragraph (f) of this section;

1910.1450(e)(3)(v)

The circumstances under which a particular laboratory operation, procedure or activity shall require prior approval from the employer or the employer's designee before implementation;

1910.1450(e)(3)(vi)

Provisions for medical consultation and medical examinations in accordance with paragraph (g) of this section;

1910.1450(e)(3)(vii)

Designation of personnel responsible for implementation of the Chemical Hygiene Plan including the assignment of a Chemical Hygiene Officer, and, if appropriate, establishment of a Chemical Hygiene Committee; and

1910.1450(e)(3)(viii)

Provisions for additional employee protection for work with particularly hazardous substances. These include "select carcinogens," reproductive toxins and substances which

have a high degree of acute toxicity. Specific consideration shall be given to the following provisions which shall be included where appropriate:

1910.1450(e)(3)(viii)(A)

Establishment of a designated area;

1910.1450(e)(3)(viii)(B)

Use of containment devices such as fume hoods or glove boxes;

1910.1450(e)(3)(viii)(C)

Procedures for safe removal of contaminated waste; and

..1910.1450(e)(3)(viii)(D)

1910.1450(e)(3)(viii)(D)

Decontamination procedures.

1910.1450(e)(4)

The employer shall review and evaluate the effectiveness of the Chemical Hygiene Plan at least annually and update it as necessary.

1910.1450(f)

Employee information and training.

1910.1450(f)(1)

The employer shall provide employees with information and training to ensure that they are apprized of the hazards of chemicals present in their work area.

1910.1450(f)(2)

Such information shall be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations. The frequency of refresher information and training shall be determined by the employer.

1910.1450(f)(3)

Information. Employees shall be informed of:

1910.1450(f)(3)(i)

The contents of this standard and its appendices which shall be made available to employees;

1910.1450(f)(3)(ii)

the location and availability of the employer's Chemical Hygiene Plan;

..1910.1450(f)(3)(iii)

1910.1450(f)(3)(iii)

The permissible exposure limits for OSHA regulated substances or recommended exposure limits for other hazardous chemicals where there is no applicable OSHA standard;

1910.1450(f)(3)(iv)

Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory; and

1910.1450(f)(3)(v)

The location and availability of known reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not

limited to, Material Safety Data Sheets received from the chemical supplier.

1910.1450(f)(4)

Training.

1910.1450(f)(4)(i)

Employee training shall include:

1910.1450(f)(4)(i)(A)

Methods and observations that may be used to detect the presence or release of a hazardous chemical (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);

1910.1450(f)(4)(i)(B)

The physical and health hazards of chemicals in the work area; and

1910.1450(f)(4)(i)(C)

The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used.

..1910.1450(f)(4)(ii)

1910.1450(f)(4)(ii)

The employee shall be trained on the applicable details of the employer's written Chemical Hygiene Plan.

1910.1450(g)

Medical consultation and medical examinations.

1910.1450(g)(1)

The employer shall provide all employees who work with hazardous chemicals an opportunity to receive medical attention, including any follow-up examinations which the examining physician determines to be necessary, under the following circumstances:

1910.1450(g)(1)(i)

Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory, the employee shall be provided an opportunity to receive an appropriate medical examination.

1910.1450(g)(1)(ii)

Where exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements, medical surveillance shall be established for the affected employee as prescribed by the particular standard.

1910.1450(g)(1)(iii)

Whenever an event takes place in the work area such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure, the affected employee shall be provided an opportunity for a medical consultation. Such consultation shall be for the purpose of determining the need for a medical examination.

..1910.1450(g)(2)

1910.1450(g)(2)

All medical examinations and consultations shall be performed by or under the direct

supervision of a licensed physician and shall be provided without cost to the employee, without loss of pay and at a reasonable time and place.

1910.1450(g)(3)

Information provided to the physician. The employer shall provide the following information to the physician:

1910.1450(g)(3)(i)

The identity of the hazardous chemical(s) to which the employee may have been exposed;

1910.1450(g)(3)(ii)

A description of the conditions under which the exposure occurred including quantitative exposure data, if available; and

1910.1450(g)(3)(iii)

A description of the signs and symptoms of exposure that the employee is experiencing, if any.

1910.1450(g)(4)

Physician's written opinion.

1910.1450(g)(4)(i)

For examination or consultation required under this standard, the employer shall obtain a written opinion from the examining physician which shall include the following:

1910.1450(g)(4)(i)(A)

Any recommendation for further medical follow-up;

1910.1450(g)(4)(i)(B)

The results of the medical examination and any associated tests;

..1910.1450(g)(4)(i)(C)

1910.1450(g)(4)(i)(C)

Any medical condition which may be revealed in the course of the examination which may place the employee at increased risk as a result of exposure to a hazardous workplace; and

1910.1450(g)(4)(i)(D)

A statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.

1910.1450(g)(4)(ii)

The written opinion shall not reveal specific findings of diagnoses unrelated to occupational exposure.

1910.1450(h)

Hazard identification.

1910.1450(h)(1)

With respect to labels and material safety data sheets:

1910.1450(h)(1)(i)

Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced.

1910.1450(h)(1)(ii)

Employers shall maintain any material safety data sheets that are received with incoming shipments of hazardous chemicals, and ensure that they are readily accessible to laboratory employees.

1910.1450(h)(2)

The following provisions shall apply to chemical substances developed in the laboratory:

..1910.1450(h)(2)(i)

1910.1450(h)(2)(i)

If the composition of the chemical substance which is produced exclusively for the laboratory's use is known, the employer shall determine if it is a hazardous chemical as defined in paragraph (b) of this section. If the chemical is determined to be hazardous, the employer shall provide appropriate training as required under paragraph (f) of this section.

1910.1450(h)(2)(ii)

If the chemical produced is a byproduct whose composition is not known, the employer shall assume that the substance is hazardous and shall implement paragraph (e) of this section.

1910.1450(h)(2)(iii)

If the chemical substance is produced for another user outside of the laboratory, the employer shall comply with the Hazard Communication Standard (29 CFR 1910.1200) including the requirements for preparation of material safety data sheets and labeling.

1910.1450(i)

Use of respirators. Where the use of respirators is necessary to maintain exposure below permissible exposure limits, the employer shall provide, at no cost to the employee, the proper respiratory equipment. Respirators shall be selected and used in accordance with the requirements of 29 CFR 1910.134.

1910.1450(j)

Recordkeeping.

1910.1450(j)(1)

The employer shall establish and maintain for each employee an accurate record of any measurements taken to monitor employee exposures and any medical consultation and examinations including tests or written opinions required by this standard.

..1910.1450(j)(2)

1910.1450(j)(2)

The employer shall assure that such records are kept, transferred, and made available in accordance with 29 CFR 1910.1020.

1910.1450(k)

Dates -

1910.1450(k)(1)

Effective date. This section shall become effective May 1, 1990.

1910.1450(k)(2)

Start-up dates.

1910.1450(k)(2)(i)

Employers shall have developed and implemented a written Chemical Hygiene Plan no later than January 31, 1991.

1910.1450(k)(2)(ii)

Paragraph (a)(2) of this section shall not take effect until the employer has developed and implemented a written Chemical Hygiene Plan.

1910.1450(l)

Appendices. The information contained in the appendices is not intended, by itself, to create any additional obligations not otherwise imposed or to detract from any existing obligation.

[61 FR 5507, Feb. 13, 1996]

1910.1450 APPENDIX A

National Research Council Recommendations Concerning Chemical Hygiene in Laboratories (Non-Mandatory)

4. Chemicals of High Chronic Toxicity

5. Animal Work with Chemicals of High Chronic Toxicity

F. Safety Recommendations

G. Material Safety Data Sheets

Foreword

As guidance for each employer's development of an appropriate laboratory Chemical Hygiene Plan, the following non-mandatory recommendations are provided. They were extracted form "Prudent Practices" for Handling Hazardous Chemicals in Laboratories" (referred to below as "Prudent Practices"), which was published in 1981 by the National Research Council and is available from the National Academy Press, 2101 Constitution Ave., NW,. Washington DC 20418.

"Prudent Practices" is cited because of its wide distribution and acceptance and because of its preparation by members of the laboratory community through the sponsorship of the National Research Council. However, none of the recommendations given here will modify any requirements of the laboratory standard. This Appendix merely presents pertinent recommendations from "Prudent Practices", organized into a form convenient for quick reference during operation of a laboratory facility and during development and application of a Chemical Hygiene Plan. Users of this appendix should consult "Prudent Practices" for a more extended presentation and justification for each recommendation.

"Prudent Practices" deal with both safety and chemical hazards while the laboratory standard is concerned primarily with chemical hazards. Therefore, only those recommendations directed primarily toward control of toxic exposures are cited in this appendix, with the term "chemical Hygiene" being substituted for the word "safety". However, since conditions producing or threatening physical injury often pose toxic risks as well, page references concerning major categories of safety hazards in the laboratory are given in section F.

The recommendations from "Prudent Practices" have been paraphrased, combined, or otherwise reorganized, and headings have been added. However, their sense has not been changed.

Corresponding Sections of the Standard and this Appendix

The following table is given for the convenience of those who are developing a Chemical Hygiene Plan which will satisfy the requirements of paragraph (e) of the standard. It indicates those sections of this appendix which are most pertinent to each of the sections of paragraph (e) and related paragraphs.

Paragraph and topic in laboratory standard	Relevant appendix

	section
(e)(3)(i) Standard operating procedures for handling toxic chemicals.	C, D, E
(e)(3)(ii) Criteria to be used for implementation of measures to reduce exposures	D
(e) (3)(iii) Fume hood performance	C4b
(e)(3)(iv) Employee information and training (including emergency procedures).	D10, D9
(e)(3)(v) Requirements for prior approval of laboratory activities.	E2b, E4b
(e)(3)(vi) Medical consultation and medical examinations.	D5, E4f
(e)(3)(vii) Chemical hygiene responsibilities.	B
(e)(3)(viii)Special precautions for work with particularly hazardous substances.	E2, E3, E4

In this appendix, those recommendations directed primarily at administrators and supervisors are given in sections A-D. Those recommendations of primary concern to employees who are actually handling laboratory chemicals are given in section E. (Reference to page numbers in "Prudent Practices" are given in parentheses.)

A. General Principles for Work with Laboratory Chemicals

In addition to the more detailed recommendations listed below in sections B-E, "Prudent Practices" expresses certain general principles, including the following:

1. It is prudent to minimize all chemical exposures. Because few laboratory chemicals are without hazards, general precautions for handling all laboratory chemicals should be adopted, rather than specific guidelines for particular chemicals (2,10). Skin contact with chemicals should be avoided as a cardinal rule (198).

2. Avoid underestimation of risk. Even for substances of no known significant hazard, exposure should be minimized; for work with substances which present special hazards, special precautions should be taken (10, 37, 38). One should assume that any mixture will be more toxic than its most toxic component (30, 103) and that all substances of unknown toxicity are toxic (3, 34).

3. Provide adequate ventilation. The best way to prevent exposure to airborne substances is to prevent their escape into the working atmosphere by use of hoods and other ventilation devices (32, 198).

4. Institute a chemical hygiene program. A mandatory chemical hygiene program designed to minimize exposures is needed; it should be a regular, continuing effort, not merely a standby or short-term activity (6,11). Its recommendations should be followed in academic teaching laboratories as well as by full-time laboratory workers (13).

5. Observe the PELs, TLVs. The Permissible Exposure Limits of OSHA and the Threshold Limit Values of the American Conference of Governmental Industrial Hygienists should not be exceeded (13).

B. Chemical Hygiene Responsibilities

Responsibility for chemical hygiene rests at all levels (6, 11, 21) including the:

1. Chief executive officer, who has ultimate responsibility for chemical hygiene within the institution and must, with other administrators, provide continuing support for institutional

chemical hygiene (7, 11).

2. Supervisor of the department or other administrative unit, who is responsible for chemical hygiene in that unit (7).

3. chemical hygiene officer(s), whose appointment is essential (7) and who must:

(a) Work with administrators and other employees to develop and implement appropriate chemical hygiene policies and practices (7);

(b) Monitor procurement, use, and disposal of chemicals used in the lab (8);

(c) See that appropriate audits are maintained (8);

(d) Help project directors develop precautions and adequate facilities (10);

(e) Know the current legal requirements concerning regulated substances (50); and

(f) Seek ways to improve the chemical hygiene program (8, 11).

4. Laboratory supervisor, who has overall responsibility for chemical hygiene in the laboratory (21) including responsibility to:

(a) Ensure that workers know and follow the chemical hygiene rules, that protective equipment is available and in working order, and that appropriate training has been provided (21, 22);

(b) Provide regular, formal chemical hygiene and housekeeping inspections including routine inspections of emergency equipment (21, 171);

(c) Know the current legal requirements concerning regulated substances (50, 231);

(d) Determine the required levels of protective apparel and equipment (156, 160, 162); and

(e) Ensure that facilities and training for use of any material being ordered are adequate (215).

5. Project director or director of other specific operation, who has primary responsibility for chemical hygiene procedures for that operation (7).

6. Laboratory worker, who is responsible for:

(a) Planning and conducting each operation in accordance with the institutional chemical hygiene procedures (7, 21, 22, 230); and

(b) Developing good personal chemical hygiene habits (22).

C. The Laboratory Facility

1. Design. The laboratory facility should have:

(a) An appropriate general ventilation system (see C4 below) with air intakes and exhausts located so as to avoid intake of contaminated air (194);

(b) Adequate, well-ventilated stockrooms/storerooms (218, 219).

(c) Laboratory hoods and sinks (12, 162);

(d) Other safety equipment including eyewash fountains and drench showers (162, 169); and

(e) Arrangements for waste disposal (12, 240).

2. Maintenance. Chemical-hygiene-related equipment (hoods, incinerator, etc.) should undergo continual appraisal and be modified if inadequate (11, 12).

3. Usage. The work conducted (10) and its scale (12) must be appropriate to the physical facilities available and, especially, to the quality of ventilation (13).

4. Ventilation - (a) General laboratory ventilation. This system should: Provide a source of

air for breathing and for input to local ventilation devices (199); it should not be relied on for protection from toxic substances released into the laboratory (198); ensure that laboratory air is continually replaced, preventing increase of air concentrations of toxic substances during the working day (194); direct air flow into the laboratory from non-laboratory areas and out to the exterior of the building (194).

(b) Hoods. A laboratory hood with 2.5 linear feet of hood space per person should be provided for every 2 workers if they spend most of their time working with chemicals (199); each hood should have a continuous monitoring device to allow convenient confirmation of adequate hood performance before use (200, 209). If this is not possible, work with substances of unknown toxicity should be avoided (13) or other types of local ventilation devices should be provided (199). See pp. 201-206 for a discussion of hood design, construction, and evaluation.

(c) Other local ventilation devices. Ventilated storage cabinets, canopy hoods, snorkels, etc. should be provided as needed (199). Each canopy hood and snorkel should have a separate exhaust duct (207).

(d) Special ventilation areas. Exhaust air from glove boxes and isolation rooms should be passed through scrubbers or other treatment before release into the regular exhaust system (208). Cold rooms and warm rooms should have provisions for rapid escape and for escape in the event of electrical failure (209).

(e) Modifications. Any alteration of the ventilation system should be made only if thorough testing indicates that worker protection from airborne toxic substances will continue to be adequate (12, 193, 204).

(f) Performance. Rate: 4-12 room air changes/hour is normally adequate general ventilation if local exhaust systems such as hoods are used as the primary method of control (194).

(g) Quality. General air flow should not be turbulent and should be relatively uniform throughout the laboratory, with no high velocity or static areas (194, 195); airflow into and within the hood should not be excessively turbulent (200); hood face velocity should be adequate (typically 60-100 lfm) (200, 204).

(h) Evaluation. Quality and quantity of ventilation should be evaluated on installation (202), regularly monitored (at least every 3 months) (6, 12, 14, 195), and reevaluated whenever a change in local ventilation devices is made (12, 195, 207). See pp 195-198 for methods of evaluation and for calculation of estimated airborne contaminant concentrations.

D. Components of the Chemical Hygiene Plan

1. Basic Rules and Procedures (Recommendations for these are given in section E, below)

2. Chemical Procurement, Distribution, and Storage

(a) Procurement. Before a substance is received, information on proper handling, storage, and disposal should be known to those who will be involved (215, 216). No container should be accepted without an adequate identifying label (216). Preferably, all substances should be received in a central location (216).

(b) Stockrooms/storerooms. Toxic substances should be segregated in a well-identified area with local exhaust ventilation (221). Chemicals which are highly toxic (227) or other chemicals whose containers have been opened should be in unbreakable secondary containers (219). Stored chemicals should be examined periodically (at least annually) for replacement, deterioration, and container integrity (218-19).

Stockrooms/storerooms should not be used as preparation or repackaging areas, should be open during normal working hours, and should be controlled by one person (219).

(c) Distribution. When chemicals are hand carried, the container should be placed in an outside container or bucket. Freight-only elevators should be used if possible (223).

(d) Laboratory storage. Amounts permitted should be as small as practical. Storage on bench tops and in hoods is inadvisable. Exposure to heat or direct sunlight should be avoided. Periodic inventories should be conducted, with unneeded items being discarded or returned to the storeroom/stockroom (225-6, 229).

3. Environmental Monitoring

Regular instrumental monitoring of airborne concentrations is not usually justified or practical in laboratories but may be appropriate when testing or redesigning hoods or other ventilation devices (12) or when a highly toxic substance is stored or used regularly (e.g., 3 times/week) (13).

4. Housekeeping, Maintenance, and Inspections

(a) Cleaning. Floors should be cleaned regularly (24).

(b) Inspections. Formal housekeeping and chemical hygiene inspections should be held at least quarterly (6, 21) for units which have frequent personnel changes and semiannually for others; informal inspections should be continual (21).

(c) Maintenance. Eye wash fountains should be inspected at intervals of not less than 3 months (6). Respirators for routine use should be inspected periodically by the laboratory supervisor (169). Other safety equipment should be inspected regularly. (e.g., every 3-6 months) (6, 24, 171). Procedures to prevent restarting of out-of-service equipment should be established (25).

(d) Passageways. Stairways and hallways should not be used as storage areas (24). Access to exits, emergency equipment, and utility controls should never be blocked (24).

5. Medical Program

(a) Compliance with regulations. Regular medical surveillance should be established to the extent required by regulations (12).

(b) Routine surveillance. Anyone whose work involves regular and frequent handling of toxicologically significant quantities of a chemical should consult a qualified physician to determine on an individual basis whether a regular schedule of medical surveillance is desirable (11, 50).

(c) First aid. Personnel trained in first aid should be available during working hours and an emergency room with medical personnel should be nearby (173). See pp. 176-178 for description of some emergency first aid procedures.

6. Protective Apparel and Equipment

These should include for each laboratory:

(a) Protective apparel compatible with the required degree of protection for substances being handled (158-161);

(b) An easily accessible drench-type safety shower (162, 169);

(c) An eyewash fountain (162)

(d) A fire extinguisher (162-164);

(e) Respiratory protection (164-9), fire alarm and telephone for emergency use (162) should be available nearby; and

(f) Other items designated by the laboratory supervisor (156, 160).

7. Records

(a) Accident records should be written and retained (174).

(b) Chemical Hygiene Plan records should document that the facilities and precautions were compatible with current knowledge and regulations (7).

(c) Inventory and usage records for high-risk substances should be kept as specified in sections E3e below.

(d) Medical records should be retained by the institution in accordance with the requirements of state and federal regulations (12).

8. Signs and Labels

Prominent signs and labels of the following types should be posted:

(a) Emergency telephone numbers of emergency personnel/facilities, supervisors, and laboratory workers (28);

(b) Identity labels, showing contents of containers (including waste receptacles) and associated hazards (27, 48);

(c) Location signs for safety showers, eyewash stations, other safety and first aid equipment, exits (27) and areas where food and beverage consumption and storage are permitted (24); and

(d) Warnings at areas or equipment where special or unusual hazards exist (27).

9. Spills and Accidents

(a) A written emergency plan should be established and communicated to all personnel; it should include procedures for ventilation failure (200), evacuation, medical care, reporting, and drills (172).

(b) There should be an alarm system to alert people in all parts of the facility including isolation areas such as cold rooms (172).

(c) A spill control policy should be developed and should include consideration of prevention, containment, cleanup, and reporting (175).

(d) All accidents or near accidents should be carefully analyzed with the results distributed to all who might benefit (8, 28).

10. Information and Training Program

(a) Aim: To assure that all individuals at risk are adequately informed about the work in the laboratory, its risks, and what to do if an accident occurs (5, 15).

(b) Emergency and Personal Protection Training: Every laboratory worker should know the location and proper use of available protective apparel and equipment (154, 169).

Some of the full-time personnel of the laboratory should be trained in the proper use of emergency equipment and procedures (6).

Such training as well as first aid instruction should be available to (154) and encouraged for (176) everyone who might need it.

(c) Receiving and stockroom/storeroom personnel should know about hazards, handling equipment, protective apparel, and relevant regulations (217).

(d) Frequency of Training: The training and education program should be a regular, continuing activity - not simply an annual presentation (15).

(e) Literature/Consultation: Literature and consulting advice concerning chemical hygiene should be readily available to laboratory personnel, who should be encouraged to use these information resources (14).

11. Waste Disposal Program.

(a) Aim: To assure that minimal harm to people, other organisms, and the environment will result from the disposal of waste laboratory chemicals (5).

(b) Content (14, 232, 233, 240): The waste disposal program should specify how waste is to be collected, segregated, stored, and transported and include consideration of what materials can be incinerated. Transport from the institution must be in accordance with DOT regulations (244).

(c) Discarding Chemical Stocks: Unlabeled containers of chemicals and solutions should undergo prompt disposal; if partially used, they should not be opened (24, 27).

Before a worker's employment in the laboratory ends, chemicals for which that person was responsible should be discarded or returned to storage (226).

(d) Frequency of Disposal: Waste should be removed from laboratories to a central waste storage area at least once per week and from the central waste storage area at regular intervals (14).

(e) Method of Disposal: Incineration in an environmentally acceptable manner is the most practical disposal method for combustible laboratory waste (14, 238, 241).

Indiscriminate disposal by pouring waste chemicals down the drain (14, 231, 242) or adding them to mixed refuse for landfill burial is unacceptable (14).

Hoods should not be used as a means of disposal for volatile chemicals (40, 200).

Disposal by recycling (233, 243) or chemical decontamination (40, 230) should be used when possible.

E. Basic Rules and Procedures for Working with Chemicals

The Chemical Hygiene Plan should require that laboratory workers know and follow its rules and procedures. In addition to the procedures of the sub programs mentioned above, these should include the rules listed below.

1. General Rules

The following should be used for essentially all laboratory work with chemicals:

(a) Accidents and spills - Eye Contact: Promptly flush eyes with water for a prolonged period (15 minutes) and seek medical attention (33, 172).

Ingestion: Encourage the victim to drink large amounts of water (178).

Skin Contact: Promptly flush the affected area with water (33, 172, 178) and remove any contaminated clothing (172, 178). If symptoms persist after washing, seek medical attention (33).

Clean-up. Promptly clean up spills, using appropriate protective apparel and equipment and proper disposal (24, 33). See pp. 233-237 for specific clean-up recommendations.

(b) Avoidance of "routine" exposure: Develop and encourage safe habits (23); avoid unnecessary exposure to chemicals by any route (23);

Do not smell or taste chemicals (32). Vent apparatus which may discharge toxic chemicals (vacuum pumps, distillation columns, etc.) into local exhaust devices (199).

Inspect gloves (157) and test glove boxes (208) before use.

Do not allow release of toxic substances in cold rooms and warm rooms, since these have contained recirculated atmospheres (209).

(c) Choice of chemicals: Use only those chemicals for which the quality of the available ventilation system is appropriate (13).

(d) Eating, smoking, etc.: Avoid eating, drinking, smoking, gum chewing, or application of cosmetics in areas where laboratory chemicals are present (22, 24, 32, 40); wash hands before conducting these activities (23, 24).

Avoid storage, handling, or consumption of food or beverages in storage areas, refrigerators, glassware or utensils which are also used for laboratory operations (23, 24, 226).

(e) Equipment and glassware: Handle and store laboratory glassware with care to avoid damage; do not use damaged glassware (25). Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain chemicals and fragments should implosion occur (25). Use equipment only for its designed purpose (23, 26).

(f) Exiting: Wash areas of exposed skin well before leaving the laboratory (23).

(g) Horseplay: Avoid practical jokes or other behavior which might confuse, startle or distract another worker (23).

(h) Mouth suction: Do not use mouth suction for pipeting or starting a siphon (23, 32).

(i) Personal apparel: Confine long hair and loose clothing (23, 158). Wear shoes at all times in the laboratory but do not wear sandals, perforated shoes, or sneakers (158).

(j) Personal housekeeping: Keep the work area clean and uncluttered, with chemicals and equipment being properly labeled and stored; clean up the work area on completion of an operation or at the end of each day (24).

(k) Personal protection: Assure that appropriate eye protection (154-156) is worn by all persons, including visitors, where chemicals are stored or handled (22, 23, 33, 154).

Wear appropriate gloves when the potential for contact with toxic materials exists (157); inspect the gloves before each use, wash them before removal, and replace them periodically (157). (A table of resistance to chemicals of common glove materials is given p. 159).

Use appropriate (164-168) respiratory equipment when air contaminant concentrations are not

sufficiently restricted by engineering controls (164-5), inspecting the respirator before use (169).

Use any other protective and emergency apparel and equipment as appropriate (22, 157-162).

Avoid use of contact lenses in the laboratory unless necessary; if they are used, inform supervisor so special precautions can be taken (155).

Remove laboratory coats immediately on significant contamination (161).

(l) Planning: Seek information and advice about hazards (7), plan appropriate protective procedures, and plan positioning of equipment before beginning any new operation (22, 23).

(m) Unattended operations: Leave lights on, place an appropriate sign on the door, and provide for containment of toxic substances in the event of failure of a utility service (such as cooling water) to an unattended operation (27, 128).

(n) Use of hood: Use the hood for operations which might result in release of toxic chemical vapors or dust (198-9).

As a rule of thumb, use a hood or other local ventilation device when working with any appreciably volatile substance with a TLV of less than 50 ppm (13).

Confirm adequate hood performance before use; keep hood closed at all times except when adjustments within the hood are being made (200); keep materials stored in hoods to a minimum and do not allow them to block vents or air flow (200).

Leave the hood "on" when it is not in active use if toxic substances are stored in it or if it is uncertain whether adequate general laboratory ventilation will be maintained when it is "off" (200).

(o) Vigilance: Be alert to unsafe conditions and see that they are corrected when detected (22).

(p) Waste disposal: Assure that the plan for each laboratory operation includes plans and training for waste disposal (230).

Deposit chemical waste in appropriately labeled receptacles and follow all other waste disposal procedures of the Chemical Hygiene Plan (22, 24).

Do not discharge to the sewer concentrated acids or bases (231); highly toxic, malodorous, or lachrymatory substances (231); or any substances which might interfere with the biological activity of waste water treatment plants, create fire or explosion hazards, cause structural damage or obstruct flow (242).

(q) Working alone: Avoid working alone in a building; do not work alone in a laboratory if the procedures being conducted are hazardous (28).

2. Working with Allergens and Embryotoxins

(a) Allergens (examples: diazomethane, isocyanates, bichromates): Wear suitable gloves to prevent hand contact with allergens or substances of unknown allergenic activity (35).

(b) Embryotoxins (34-5) (examples: organomercurials, lead compounds, formamide): If you are a woman of childbearing age, handle these substances only in a hood whose satisfactory performance has been confirmed, using appropriate protective apparel (especially gloves) to prevent skin contact.

Review each use of these materials with the research supervisor and review continuing uses annually or whenever a procedural change is made.

Store these substances, properly labeled, in an adequately ventilated area in an unbreakable secondary container.

Notify supervisors of all incidents of exposure or spills; consult a qualified physician when appropriate.

3. Work with Chemicals of Moderate Chronic or High Acute Toxicity

Examples: diisopropylfluorophosphate (41), hydrofluoric acid (43), hydrogen cyanide (45).

Supplemental rules to be followed in addition to those mentioned above (Procedure B of "Prudent Practices", pp. 39-41):

(a) Aim: To minimize exposure to these toxic substances by any route using all reasonable precautions (39).

(b) Applicability: These precautions are appropriate for substances with moderate chronic or high acute toxicity used in significant quantities (39).

(c) Location: Use and store these substances only in areas of restricted access with special warning signs (40, 229).

Always use a hood (previously evaluated to confirm adequate performance with a face velocity of at least 60 linear feet per minute) (40) or other containment device for procedures which may result in the generation of aerosols or vapors containing the substance (39); trap released vapors to revent their discharge with the hood exhaust (40).

(d) Personal protection: Always avoid skin contact by use of gloves and long sleeves (and other protective apparel as appropriate) (39). Always wash hands and arms immediately after working with these materials (40).

(e) Records: Maintain records of the amounts of these materials on hand, amounts used, and the names of the workers involved (40, 229).

(f) Prevention of spills and accidents: Be prepared for accidents and spills (41).

Assure that at least 2 people are present at all times if a compound in use is highly toxic or of unknown toxicity (39).

Store breakable containers of these substances in chemically resistant trays; also work and mount apparatus above such trays or cover work and storage surfaces with removable, absorbent, plastic backed paper (40).

If a major spill occurs outside the hood, evacuate the area; assure that cleanup personnel wear suitable protective apparel and equipment (41).

(g) Waste: Thoroughly decontaminate or incinerate contaminated clothing or shoes (41). If possible, chemically decontaminate by chemical conversion (40).

Store contaminated waste in closed, suitably labeled, impervious containers (for liquids, in glass or plastic bottles half-filled with vermiculite) (40).

4. Work with Chemicals of High Chronic Toxicity

(Examples: dimethylmercury and nickel carbonyl (48), benzo-a-pyrene (51), N-nitrosodiethylamine (54), other human carcinogens or substances with high carcinogenic potency in animals (38).)

Further supplemental rules to be followed, in addition to all these mentioned above, for work with substances of known high chronic toxicity (in quantities above a few milligrams to a few grams, depending on the substance) (47). (Procedure A of "Prudent Practices" pp. 47-50).

(a) Access: Conduct all transfers and work with these substances in a "controlled area": a restricted access hood, glove box, or portion of a lab, designated for use of highly toxic substances, for which all people with access are aware of the substances being used and necessary precautions (48).

(b) Approvals: Prepare a plan for use and disposal of these materials and obtain the approval of the laboratory supervisor (48).

(c) Non-contamination/Decontamination: Protect vacuum pumps against contamination by scrubbers or HEPA filters and vent them into the hood (49). Decontaminate vacuum pumps or other contaminated equipment, including glassware, in the hood before removing them from the controlled area (49, 50).

Decontaminate the controlled area before normal work is resumed there (50).

(d) Exiting: On leaving a controlled area, remove any protective apparel (placing it in an appropriate, labeled container) and thoroughly wash hands, forearms, face, and neck (49).

(e) Housekeeping: Use a wet mop or a vacuum cleaner equipped with a HEPA filter instead of dry sweeping if the toxic substance was a dry powder (50).

(f) Medical surveillance: If using toxicologically significant quantities of such a substance on a regular basis (e.g., 3 times per week), consult a qualified physician concerning desirability of regular medical surveillance (50).

(g) Records: Keep accurate records of the amounts of these substances stored (229) and used, the dates of use, and names of users (48).

(h) Signs and labels: Assure that the controlled area is conspicuously marked with warning and

restricted access signs (49) and that all containers of these substances are appropriately labeled with identity and warning labels (48).

(i) Spills: Assure that contingency plans, equipment, and materials to minimize exposures of people and property in case of accident are available (233-4).

(j) Storage: Store containers of these chemicals only in a ventilated, limited access (48, 227, 229) area in appropriately labeled, unbreakable, chemically resistant, secondary containers (48, 229).

(k) Glove boxes: For a negative pressure glove box, ventilation rate must be at least 2 volume changes/hour and pressure at least 0.5 inches of water (48). For a positive pressure glove box, thoroughly check for leaks before each use (49). In either case, trap the exit gases or filter them through a HEPA filter and then release them into the hood (49).

(l) Waste: Use chemical decontamination whenever possible; ensure that containers of contaminated waste (including washings from contaminated flasks) are transferred from the controlled area in a secondary container under the supervision of authorized personnel (49, 50, 233).

5. Animal Work with Chemicals of High Chronic Toxicity

(a) Access: For large scale studies, special facilities with restricted access are preferable (56).

(b) Administration of the toxic substance: When possible, administer the substance by injection or gavage instead of in the diet. If administration is in the diet, use a caging system under negative pressure or under laminar air flow directed toward HEPA filters (56).

(c) Aerosol suppression: Devise procedures which minimize formation and dispersal of contaminated aerosols, including those from food, urine, and feces (e.g., use HEPA filtered vacuum equipment for cleaning, moisten contaminated bedding before removal from the cage, mix diets in closed containers in a hood) (55, 56).

(d) Personal protection: When working in the animal room, wear plastic or rubber gloves, fully buttoned laboratory coat or jumpsuit and, if needed because of incomplete suppression of aerosols, other apparel and equipment (shoe and head coverings, respirator) (56).

(e) Waste disposal: Dispose of contaminated animal tissues and excreta by incineration if the available incinerator can convert the contaminant to non-toxic products (238); otherwise, package the waste appropriately for burial in an EPA-approved site (239).

F. Safety Recommendations

The above recommendations from "Prudent Practices" do not include those which are directed primarily toward prevention of physical injury rather than toxic exposure. However, failure of precautions against injury will often have the secondary effect of causing toxic exposures. Therefore, we list below page references for recommendations concerning some of the major categories of safety hazards which also have implications for chemical hygiene:

1. Corrosive agents: (35-6) 2. Electrically powered laboratory apparatus: (179-92) 3. Fires, explosions: (26, 57-74, 162-64, 174-5, 219-20, 226-7) 4. Low temperature procedures: (26, 88) 5. Pressurized and vacuum operations (including use of compressed gas cylinders): (27, 75-101)

G. Material Safety Data Sheets

Material safety data sheets are presented in "Prudent Practices" for the chemicals listed below. (Asterisks denote that comprehensive material safety data sheets are provided).

o Acetyl peroxide (105) o Acrolein (106) o Acrylonitrile Ammonia (anhydrous)(91) o Aniline (109) o Benzene (110) o Benzo[a]pyrene (112) o Bis(chloromethyl) ether (113) Boron trichloride (91) Boron trifluoride (92) Bromine (114) o Tert-butyl hydroperoxide (148) o Carbon disulfide (116) Carbon monoxide (92) o Carbon tetrachloride (118) *Chlorine (119) Chlorine trifluoride (94) o Chloroform (121) Chloromethane (93) o Diethyl ether (122) Diisopropyl fluorophosphate (41) o Dimethylformamide (123) o Dimethyl sulfate (125) o Dioxane (126) o Ethylene dibromide (128) o Fluorine (95) o Formaldehyde (130) o Hydrazine and salts (132) Hydrofluoric acid (43) Hydrogen bromide (98) Hydrogen chloride (98) o Hydrogen cyanide (133) o Hydrogen sulfide (135) Mercury and compounds (52) o Methanol (137) o Morpholine (138) o Nickel carbonyl (99) o Nitrobenzene (139) Nitrogen dioxide (100) N-nitrosodiethylamine (54) o Peracetic acid (141) o Phenol (142) o Phosgene (143) o Pyridine (144) o

Sodium azide (145) o Sodium cyanide (147) Sulfur dioxide (101) o Trichloroethylene (149) o Vinyl chloride (150)

1910.1450 APPENDIX BReferences (Non-Mandatory)

The following references are provided to assist the employer in the development of a Chemical Hygiene Plan. The materials listed below are offered as non-mandatory guidance. References listed here do not imply specific endorsement of a book, opinion, technique, policy or a specific solution for a safety or health problem. Other references not listed here may better meet the needs of a specific laboratory. (a) Materials for the development of the Chemical Hygiene Plan:

1. American Chemical Society, Safety in Academic Chemistry Laboratories, 4th edition, 1985.

2. Fawcett, H.H. and W.S. Wood, Safety and Accident Prevention in Chemical Operations, 2nd edition, Wiley-Interscience, New York, 1982.

3. Flury, Patricia A., Environmental Health and Safety in the Hospital Laboratory, Charles C. Thomas Publisher, Springfield IL, 1978.

4. Green, Michael E. and Turk, Amos, Safety in Working with Chemicals, Macmillan Publishing Co., NY, 1978.

5. Kaufman, James A., Laboratory Safety Guidelines, Dow Chemical Co., Box 1713, Midland, MI 48640, 1977.

6. National Institutes of Health, NIH Guidelines for the Laboratory use of Chemical Carcinogens, NIH Pub. No. 81-2385, GPO, Washington, DC 20402, 1981.

7. National Research Council, Prudent Practices for Disposal of Chemicals from Laboratories, National Academy Press, Washington, DC, 1983.

8. National Research Council, Prudent Practices for Handling Hazardous Chemicals in Laboratories, National Academy Press, Washington, DC, 1981.

9. Renfrew, Malcolm, Ed., Safety in the Chemical Laboratory, Vol. IV, J. Chem. Ed., American Chemical Society, Easlon, PA, 1981.

10. Steere, Norman V., Ed., Safety in the Chemical Laboratory, J. Chem. Ed. American Chemical Society, Easlon, PA, 18042, Vol. I, 1967, Vol. II, 1971, Vol. III, 1974.

11. Steere, Norman V., Handbook of Laboratory Safety, the Chemical Rubber Company Cleveland, OH, 1971.

12. Young, Jay A., Ed., Improving Safety in the Chemical Laboratory, John Wiley & Sons, Inc. New York, 1987.

(b) Hazardous Substances Information:

1. American Conference of Governmental Industrial Hygienists, Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes, 6500 Glenway Avenue, Bldg. D-7, Cincinnati, OH 45211-4438.

2. Annual Report on Carcinogens, National Toxicology Program U.S. Department of Health and Human Services, Public Health Service, U.S. Government Printing Office, Washington, DC, (latest edition).

3. Best Company, Best Safety Directory, Vols. I and II, Oldwick, N.J., 1981.

4. Bretherick, L., Handbook of Reactive Chemical Hazards, 2nd edition, Butterworths, London, 1979.

5. Bretherick, L., Hazards in the Chemical Laboratory, 3rd edition, Royal Society of Chemistry, London, 1986.

6. Code of Federal Regulations, 29 CFR part 1910 subpart Z. U.S. Govt. Printing Office, Washington, DC 20402 (latest edition).

7. IARC Monographs on the Evaluation of the Carcinogenic Risk of chemicals to Man, World Health Organization Publications Center, 49 Sheridan Avenue, Albany, New York 12210 (latest editions).

8. NIOSH/OSHA Pocket Guide to Chemical Hazards. NIOSH Pub. No. 85-114, U.S. Government Printing Office, Washington, DC, 1985 (or latest edition).

9. Occupational Health Guidelines, NIOSH/OSHA. NIOSH Pub. No. 81-123 U.S. Government Printing Office, Washington, DC, 1981.

10. Patty, F.A., Industrial Hygiene and Toxicology, John Wiley & Sons, Inc., New York, NY (Five Volumes).

11. Registry of Toxic Effects of Chemical Substances, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Revised Annually, for sale from Superintendent of documents US. Govt. Printing Office, Washington, DC 20402.

12. The Merck Index: An Encyclopedia of Chemicals and Drugs. Merck and Company Inc. Rahway, N.J., 1976 (or latest edition).

13. Sax, N.I. Dangerous Properties of Industrial Materials, 5th edition, Van Nostrand Reinhold, NY., 1979.

14. Sittig, Marshall, Handbook of Toxic and Hazardous Chemicals, Noyes Publications. Park Ridge, NJ, 1981.

(c) Information on Ventilation:

1. American Conference of Governmental Industrial Hygienists Industrial Ventilation (latest edition), 6500 Glenway Avenue, Bldg. D-7, Cincinnati, Ohio 45211-4438.

2. American National Standards Institute, Inc. American National Standards Fundamentals Governing the Design and Operation of Local Exhaust Systems ANSI Z 9.2-1979 American National Standards Institute, N.Y. 1979.

3. Imad, A.P. and Watson, C.L. Ventilation Index: An Easy Way to Decide about Hazardous Liquids, Professional Safety pp 15-18, April 1980.

4. National Fire Protection Association, Fire Protection for Laboratories Using Chemicals NFPA-45, 1982.

Safety Standard for Laboratories in Health Related Institutions, NFPA, 56c, 1980.

Fire Protection Guide on Hazardous Materials, 7th edition, 1978.

National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

5. Scientific Apparatus Makers Association (SAMA), Standard for Laboratory Fume Hoods, SAMA LF7-1980, 1101 16th Street, NW., Washington, DC 20036.

(d) Information on Availability of Referenced Material:

1. American National Standards Institute (ANSI), 1430 Broadway, New York, NY 10018.

2. American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, PA 19103.

[55 FR 3327, Jan. 31, 1990; 57 FR 29204, July 1, 1992; 61 FR 5507, Feb. 13, 1996]

APPENDIX C

FORM FOR CONDUCTING A LABORATORY HEALTH AND SAFETY WALKTHROUGH FOR NEW PERSONNEL

Name of employee:		
Name of person conducting walkthrough:		
Date:		
Personal Safety		
Yes	**No**	Shown location and types of protective gloves available
Yes	**No**	Issued his/her own set of eye protection
Yes	**No**	Issued laboratory coat(s)
Chemical Safety		
Yes	**No**	Shown where hazardous chemicals and radioactive materials are used and stored.
Yes	**No**	Proper use of the chemical hood was demonstrated/discussed
Yes	**No**	Laboratory-specific standard operating or safety procedures were discussed. Paper copies, as available, were provided.
Biological Safety		
Yes	**No**	Has employee been made aware of what biohazards are in lab?
Yes	**No**	Has the employee been offered appropriate vaccinations?
Yes	**No**	Have the appropriate precautions for biohazards been discussed/demonstrated?
Yes	**No**	Proper use of the biological safety cabinet demonstrated/discussed
Yes	**No**	Shown where biological agents are used and stored.
Fire Safety		
Yes	**No**	Shown location of fire alarm pull station
Yes	**No**	Shown location of fire extinguishers

Emergency Preparedness		
Yes	**No**	Shown location of nearest eye wash
Yes	**No**	Shown location of nearest safety shower
Yes	**No**	Shown where the EOHSS Emergency Response Guide (flipchart) is posted
Yes	**No**	Shown the location of the chemical spill control/clean-up materials.
Yes	**No**	Shown the location of any emergency shut-off valves.
Lab-Specific Items (Fill in other health and safety items specific to this lab)		
Yes	**No**	
Yes	**No**	
Yes	**No**	
Yes	**No**	

Signature of employee
Signature of person conducting walkthrough

APPENDIX D

LABORATORY SAFETY AUDIT CHECKLIST

ROOM AND BUILDING: DATE:
RESPONSIBLE INVESTIGATOR:
PHONE: RI EMAIL:
LAB SAFETY OFFICER:
PHONE: LSO EMAIL:
EOHSS AUDITOR: PHONE:

1. Chemical Waste Disposal

		Comments
Chemical waste containers display UMDNJ hazardous waste label.	T **F** NA	
Chemical waste containers labeled with chemical contents, approximate percentage of each chemical, and the hazard class of each chemical.	T **F** NA	
The accumulation date or fill date (which is the date container became full) is listed on full containers.	T **F** NA	
No full waste containers stored more than three days beyond accumulation date.	T **F** NA	
Incompatible chemical waste streams are not mixed in the same container.	T **F** NA	
Containers have an appropriate lid/cap (not funnel) on at all times except when being filled.	T **F** NA	
Chemical waste stored in compatible containers.	T **F** NA	
Chemical waste stored away from ignition sources.	T **F** NA	
Personnel responsible for managing hazardous waste have undergone training.	T **F** NA	
Chemical waste area is properly maintained, with containers in good condition and free of precipitates/drips.	T **F** NA	
Chemical waste is not discarded in the trash or poured down the sink.	T **F** NA	

Less than one quart or 2.1 pounds of Acute Toxic waste is present.	T **F** NA	
No excess, old or expired chemicals are present.	T **F** NA	

2. Documentation

		Comments
Etiologic agent registry forms have been submitted for research labs working with human materials, human cell lines, BL2 or higher pathogens.	T **F** NA	
An up-to-date hazardous chemical inventory is available.	T **F** NA	

3. Electrical

		Comments
Procedures and warning signs for critical equipment are posted adequately.	T **F** NA	
Adequate clear space is maintained between equipment and flammable or combustible materials.	T **F** NA	
There are no frayed, cut wires, broken/defective plug or switch.	T **F** NA	
Extension cords are not used as a substitute for permanent wiring.	T **F** NA	
Extension cords do not extend through windows or doors or under carpeting.	T **F** NA	
All electrical wires are properly secured and do not pose a trip hazard.	T **F** NA	
Multiple outlet strips, other than for computer systems, are not used.	T **F** NA	
Power strips have built-in fuse or circuit breaker protection, have a minimum 12/3 gauge/wires label, maximum length of 6 feet, and are UL listed for the use.	T **F** NA	
Extension cords are not used in place of permanent outlets.	T **F** NA	
There are no cube taps for multiple connections from a single outlet.	T **F** NA	
All electrical wires are properly secured and do not pose a trip hazard.	T **F** NA	
Electric cords do not run through wet areas.	T **F** NA	
Portable electrical space heaters are not used.	T **F** NA	
Equipment is not draped with combustibles such as cloth or paper.	T **F** NA	

4. Emergency Equipment

		Comments
Eyewash is unobstructed.	T **F** NA	
Eyewash has up-to-date monthly inspection log.	T **F** NA	
Appropriate disinfectant/biological spill clean-up materials are available.	T **F** NA	
Appropriate chemical spill clean-up materials are available.	T **F** NA	
Nearest safety shower has up-to-date semi-annual inspection.	T **F** NA	

1. Fire Hazards

		Comments
No flammable or combustible liquids are stored in a standard refrigerator, freezer, or cold room.	T **F** NA	
No flammable or combustible liquids are stored near electrical equipment or bunsen burner.	T **F** NA	
Solvents, acids, and bases stored separately. Acids and bases in plastic trays.	T **F** NA	
Less than 10 gallons of flammables are present in the laboratory area.	T **F** NA	
Less than 30 gallons of combustible liquids are present in lab.	T **F** NA	
Flammable liquids not in active use are stored in UL or FM approved fire safety cabinet.	T **F** NA	
Maximum size of flammable liquid container is one gallon.	T **F** NA	
Ethers or other peroxide-forming material is dated upon receipt.	T **F** NA	
Ethers and other peroxide-forming chemicals disposed of three months prior to expiration date.	T **F** NA	
No excess paper, foam or other combustibles.	T **F** NA	

No bottles or chemicals stored on the floor or in the hallway.	T **F** NA	
Exit paths are unblocked in lab and in corridor.	T **F** NA	
The fire extinguisher is mounted near door and tag indicates up-to-date inspection.	T **F** NA	
Fire extinguisher is not obscured/location is clearly visible.	T **F** NA	
Bunsen burner hoses are in good condition; no latex hoses; hoses are less than 2 feet long.	T **F** NA	
Gas cylinders are secured, properly marked and grouped.	T **F** NA	
No storage within 2 feet of the ceiling or light fixtures.	T **F** NA	
General housekeeping is good, clutter is at a minimum.	T **F** NA	

6. Employ ee Health

		Comments
Appropriate gloves are available and worn when necessary.	T **F** NA	
Appropriate protective eyewear is available and worn when necessary.	T **F** NA	
Lab coats are available and worn when necessary.	T **F** NA	
No food or drink stored or consumed in lab.	T **F** NA	

1. Hazard Control Measures

		Comments
Completed Laboratory Safety Plan is available and information is up-to-date.	T **F** NA	
Completed BBP Exposure Control Plan is available and information is up-to-date.	T **F** NA	
Chemical Hood face velocity certified within the last 12 months.	T **F** NA	
Chemical Hood is not overcrowded with chemicals or other storage. No storage on top of hood.	T **F** NA	
Chemical Hood is used at or below indicated operating height.	T **F** NA	

All volatile, toxic chemicals are used in the chemical hood.	T **F** NA	
Biological Safety Cabinet has been certified within the last 12 months.	T **F** NA	
No hazardous or flammable chemicals used in the BSC. (Exception: alcohol for decontamination is OK)	T **F** NA	
No cryogenic liquids, gas cylinders, or hazardous chemicals in cold or warm rooms.	T **F** NA	
Corrosive and other hazardous chemicals stored below eye level.	T **F** NA	
All chemical containers labeled in accordance with New Jersey Right-to-Know regulations.	T **F** NA	
Sealed rotors or safety cups available for centrifuging blood and/or infectious agents.	T **F** NA	

2. Medical Waste

		Comments
Sharps containers are available and are being used.	T **F** NA	
Materials used in BL2 or higher labs are disinfected by chemical or heat methods before being placed in regulated medical waste container.	T **F** NA	
Medical waste containers are not overfull.	T **F** NA	
No chemical waste or chemical bottles in the medical waste containers.	T **F** NA	

3. Signage

		Comments
Up-to-date "Caution" sign on door, with emergency contact persons listed.	T **F** NA	
Biohazard symbol and biosafety level is on door of labs working with human cells or other human-derived materials, and/or BL2 or higher pathogens.	T **F** NA	

Designated areas are labeled for the use of carcinogens, reproductive toxins, and acutely toxic materials.	T **F** NA	
Refrigerators and Freezers bear a "No Food/No Flammables" sticker.	T **F** NA	
Up-to-date "Emergency Response Guide" (flipchart) is posted prominently.	T **F** NA	

4. Compressed and Liquified Gas Safety

		Comments
Maximum number of compressed gas cylinders (CGC) is limited to a two-month supply.	T **F** NA	
Flammable CGC are limited to only those in current use.	T **F** NA	
Excess CGC are stored in a separate ventilated room approved for that use.	T **F** NA	
Empty CGC are stored separate from the full cylinders.	T **F** NA	
All CGC are adequately secured with chains or by proper nesting.	T **F** NA	
All CGC are grouped according to their properties (e.g., flammables separated from oxidizing).	T **F** NA	
All CGC are kept away from fire- and spark-producing operations	T **F** NA	
Cryogenic liquid tanks (CLT) have not lost vacuum or insulation (look for a cold outside jacket)	T **F** NA	
CLT are free of any ice accumulation at the neck of the tank opening	T **F** NA	

APPENDIX E

SAMPLE PERMISSION SLIP FOR OFF-HOURS WORK

Instructions:

All undergraduate or non-degree students, working in laboratories at UMDNJ, are required to obtain written permission from the Responsible Investigator to work during non-business hours. Completed written permission forms must be kept in a designated location. For each person who must have written permission, the Responsible Investigator may decide to give a blanket permission to work during off-hours or may decide to impose restrictions.

_____

Name of student

has permission to work during non-business hours (6:00 pm to 6:30 am):

1. with no restrictions

2. with the following restrictions* :

_____ _____

Signature of Responsible Investigator **Date**

*** Examples of restrictions that might be imposed include:**

- Must get RI's permission to work with hazardous materials during off hours.
- Other, full-time personnel must be present when employee, student or volunteer is working
- Must get RI's permission to work with specific pieces of equipment, etc.
- Must get RI's permission each time the employee or student will work during off-hours
- Work may only be performed during specific time period (such as 6am - 6pm)
- Specific control measures that must be in place for use of acutely toxic materials

(Page intentionally left blank)

APPENDIX F

UMDNJ PROTOCOL FOR VACATING A LABORATORY

Introduction

Decommissioning a laboratory is a multi-step process which ensures that the laboratory is free of old chemicals, equipment, refuse, and chemical, radiological or biological contamination. This process allows for the orderly scheduling of renovations and turning over lab spaces to new occupants.

Principal Investigators are responsible for the proper disposition of all biological, chemical, and radioactive materials in the laboratory, as well as for the complete removal of all equipment and supplies. A laboratory will not be decommissioned by EOHSS until all of the items listed below have been completed or deemed not applicable.

A minimum of two weeks before the laboratory will be vacated, notify EOHSS, Radiation Safety (even if radiation is not currently in use), and Environmental Services of your intention to vacate a laboratory. The Radiation Safety Office requires four weeks notice if fixed equipment is to be moved or discarded, and in the event the laboratory is being decommissioned for a renovation.

EOHSS will work with the Laboratory Safety Officer (LSO) to identify chemicals for disposal. Laboratory personnel will be expected to label and inventory excess or unwanted chemicals for disposal through the University's Hazardous Waste Vendor. EOHSS and the LSO will make arrangements to transfer the waste chemicals to the Hazardous Waste Storage Area.

Following the decontamination of work surfaces and the removal of chemical, biological, and radiological hazards as well as all equipment and refuse, EOHSS will perform a final inspection to decommission the laboratory.

Information about Decommissioning a Laboratory

General Requirements

All areas of chemical and biological agent use or storage must be cleaned. This includes benchtops, chemical storage cabinets, chemical hoods, biological safety cabinets, shelves, ovens, incubators, refrigerators and freezers. Biological use areas should be cleaned using a 1:10 bleach solution. Chemical use areas should be cleaned with a detergent solution, and rinsed afterwards.

Assents Management

All of the requirements of UMDNJ's Office of Asset Management (see University Policy Number 00-01-50-65:00 "Surplus Furniture and Equipment" for more information) must be followed before discarding tagged laboratory equipment.

Refrigerator/Freezer

When moving or discarding a refrigerator or freezer, all materials must be removed from the refrigerator by laboratory personnel. Spills and other visible contamination must be removed by laboratory personnel. If the refrigerator or freezer was used to store biological or biohazardous materials, then all surfaces must be wiped with a 1:10 bleach solution prior to moving by Environmental Services. REHS must be contacted for instructions if radioactive materials have been stored in the unit.

If the refrigerator or freezer is to be discarded, in addition to the steps listed above, Physical Plant or Shared Equipment Services must be contacted to have the freon removed from the compressor. The cost of freon removal is the responsibility of the laboratory.

Biological Safety Cabinet

A biological safety cabinet may only be moved after decontamination by the University's vendor. Contact Shared Equipment Services at 732-235-4455 to arrange for this service. The cost of decontaminating the cabinet is the responsibility of the laboratory. Whenever a biological safety cabinet is moved, it must be re-certified prior to use.

Disposing of Unwanted Hazardous Materials

Hazardous waste and chemicals in original containers that are not needed or expired, or are in damaged containers must be disposed of through EOHSS prior to the move. The department will be responsible for the cost of disposal as explained in the Hazardous Waste Policy (00-01-45-35:00), Section VI.A.5.b. For chemicals in their original containers complete the removal/retention form posted at: http://eohwprod.umdnj.edu/eohss2.cfm

For hazardous waste, label each container with a hazardous waste label and complete the chemical disposal request form at: http://www2.umdnj.edu/eohssweb/publications/wastedisposal.htm

EOHSS will arrange to pick up these chemicals separate from the move.

Moving Hazardous Materials

Prior to scheduling a laboratory move involving hazardous chemicals, the person coordinating the move for the department, school, or unit must contact EOHSS to review the project. At that time, a determination will be made as to who will be moving chemicals, (as detailed below). If EOHSS determines that a hazmat vendor is required, EOHSS will bring in the UMDNJ vendor to scope out the job and provide a quote to the Department. The Department or School/Unit will be responsible for paying for the chemical moving services. One of the approaches listed below shall be employed based on the type of hazard the chemicals pose and their destination:

Non-hazardous chemicals or small quantities of low hazard chemicals (that do not meet the criteria of a DOT Hazardous Material:

UMDNJ contracted movers, using appropriate packing materials, may move all non-hazardous or small quantities of low hazard chemicals (e.g., no low hazard liquids and only a few pounds of low hazard solid material, no more than would fill one hand held secondary continment tray), whether on or off UMDNJ property. These are materials that do not meet the criteria for DOT hazardous materials as described in the EOHSS Glossary, http://www.umdnj.edu/eohssweb/publications/glossary2.htm#dot). Non-hazardous or small quantities of low hazard materials may be packed and unpacked by laboratory staff. Laboratory staff and/or UMDNJ contracted movers shall do the following, as appropriate:

- Before packing a chemical, check the caps/closures of each container to ensure that each is secure.
- Always pack chemicals in a vertical position with the caps/closures facing up.
- Never pack materials that cannot be adequately sealed.
- Never pack cracked or otherwise compromised containers.
- Do not pack glass bottles together without adequate packing material between the bottles.
- Report all spills to the Public Safety emergency number so that the situation can be appropriately assessed and handled by trained staff.

Moderate Amounts of DOT Hazardous Chemicals on contiguous UMDNJ Property:

EOHSS shall move moderate amounts of hazardous materials (e.g., 10 gallons of liquid and 20 pounds of solid material, approximately one large cart, as determined by EOHSS) within a building or between buildings as long as the route is on contiguous UMDNJ property (i.e., on the same campus). Staff from the department/school/unit requesting the service must provide a list of materials to be moved and must be available, in person, at the time of the move to provide answers to questions that may arise during the process. In addition to the procedures listed above, EOHSS also shall do the following:

- Use carts with raised sides.
- Place chemicals in secondary containment.
- Use appropriate packing materials, such as pads, booms, pillows, etc.

Large Quantities of DOT Hazardous Materials (over 1 cart) or any amount of a DOT Hazardous Material being moved to an other UMDNJ facility, a non UMDNJ facility or being transported to UMDNJ owned or property not owned by UMDNJ , and all other situations not otherwise specifically mentioned:

To move these materials, the Department must work with EOHSS to hire and schedule the permitted, licensed vendor under contract with UMDNJ. This vendor will segregate, label, package, transport and unpack hazardous chemical materials pursuant to DOT special procedures 49 CFR 172.101. To ensure that a project of this type is done in a manner suitable to all parties involved:

- The Department shall allot a minimum of one week for the vendor to generate a quote.
- The Department shall allot a minimum of two weeks for EOHSS to schedule the vendor to do the move.

Hazardous Waste Disposal

In most cases, chemicals cannot be moved to a new location by laboratory personnel. As you prepare for the move, segregate out any chemicals that are no longer wanted or have expired. Any chemicals that are in the original container and are in good shape can be offered to other researchers for their use. Any chemicals that remain after this process must be disposed of as hazardous waste through EOHSS.

Contact EOHSS early as possible, as this process takes time and can delay the moving process unnecessarily. Laboratory personnel will be expected to label and inventory excess or unwanted chemicals for disposal through the University's Hazardous Waste Vendor. EOHSS will provide you with labels, an inventory form, and technical guidance to assist you in the proper disposal of your unwanted/excess chemicals.

Preserved Specimen Disposal

Contact EOHSS for additional information if you need to dispose of preserved tissue specimens (human or otherwise).

Medical Waste Disposal

The medical waste disposal program is managed by Environmental Services. Contact Environmental Services on your campus for assistance. Also, see Appendix I of this plan for information on medical waste disposal.

Compressed Gases

Laboratory personnel are expected to return all used and unused gas cylinders to the supplier. Check with your campus representative from the Receiving Dock for additional information.

Chemical Hood

EOHSS and Physical Plant must be notified in writing if perchloric acid and/or metal azides were used in the lab. These can pose a hazard to tradespeople who work on plumbing or ventilation ducts. The surfaces on the inside of the hood should be cleaned with a detergent solution and rinsed.

Laboratory Equipment which contains a Radioactive Source

Contact the Radiation Safety Office for assistance.

Radiation Safety

The Radiation Safety Office must be contacted at least two weeks in advance of the planned moving date, even if radioactive materials are not currently in use. Note: Four weeks notice is needed if fixed equipment (like a lab bench) is to be moved or discarded, or if the laboratory is being decommissioned for a renovation.

Computers and other Lead-Containing Equipment

Physical Plant has a recycling program for computer monitors. Contact your campus' Physical Plant for more information.

EOHSS will assist in the disposal of other lead-containing equipment (e.g., shielding from around a radioactive source, rechargeable batteries from uninterruptible power sources).

Laboratory Vacating Questionnaire

The Principle Investigator or designee should fill in this questionnaire and fax it to EOHSS at least two weeks prior to the date that the laboratory will be vacated.

Who is the Principle Investigator for this laboratory?

Name: Phone:
Office/Laboratory Location:

Who should EOHSS contact for information and to coordinate lab vacating activities?

□ **Same as above OR**
Name: Phone:
Office/Laboratory Location:

This laboratory occupies room number(s):_____in Building:_____

What is the targeted moving date for this laboratory? _____

What is the contact information for the PI after the move is completed:

Name: Phone:
Office/Laboratory Address:

The lab is:

1. **Moving to a UMDNJ lab in the same building.** (**Note:** Lab occupants will likely be permitted to transport hazardous materials to the new location. Contact EOHSS for assistance.)
   New Location:
2. **Moving to a UMDNJ lab in a different building.** (**Note:** Consult with EOHSS to determine if lab occupants are able to transport hazardous chemicals/biological agents to the new location.)
   New Location:
3. **Moving off the UMDNJ campus.** (**Notes**: Hazardous materials must be moved by a licensed vendor under contract with UMDNJ. The laboratory can offer chemicals in original containers to neighboring labs for use or dispose of them as hazardous waste. Some commercial moving companies have a licence which allows them to package and transport hazardous materials. Any transport of infectious material must be in accordance with IATA regulations. Consult the EOHSS Biosafety Officer for additional information on infectious material transport).
1. **Completely disbanding. (e.g. due to a retirement.)** (**Notes:** Laboratory chemicals and equipment can be offered to neighboring labs for use. Any remaining chemicals must be disposed of as hazardous waste through EOHSS. Biohazardous materials to be disposed of as medical waste.)

This is the checklist that EOHSS will use to decommission a laboratory area, which should be used to guide you as you prepare to move. Other activities may be required, depending on the type of laboratory. If a highlighted item is checked, it requires attention before final clearance can be given.

Final Clearance Checklist

Room: **Building:**

□ Yes	**□ No**	□ N/A	Have all materials (equipment, supplies, chemicals, radioactive materials, and biological agents) been removed from the room?
□ Yes	**□ No**	□ N/A	Has the refuse been correctly sorted and placed in the appropriate containers for removal by Environmental Services?
□ Yes	**□ No**	□ N/A	Has all medical waste been removed from the laboratory?
□ Yes	**□ No**	□ N/A	Have the refrigerator(s) and freezer(s) been cleaned and decontaminated?
□ Yes	**□ No**	□ N/A	If the any refrigerator or freezer has been designated for disposal, has the freon been removed by Shared Equipment Services or Physical Plant?
□ Yes	**□ No**	□ N/A	Have all unwanted chemicals and/or chemical waste been transferred to the Chemical Waste Room?
□ Yes	**□ No**	□ N/A	Has the Biological Safety Cabinet been decontaminated by a licensed vendor?
□ Yes	**□ No**	□ N/A	Is documentation of the Biosafety Cabinet decontamination available?
□ Yes	**□ No**	□ N/A	Have all of this laboratory's material and equipment been removed from common rooms (i.e., warm and cold rooms, tissue culture rooms)?
□ Yes	□ No	□ N/A	Has unheated perchloric acid been used in the hood?
□ Yes	□ No	□ N/A	Has heated perchloric acid been used in the hood?
□ Yes	□ No	□ N/A	Have any metal azides (e.g., sodium azide) been used in the hood?

If laboratory is being vacated for a new user:

□ Yes	**□ No**	□ N/A	Have all surfaces in the room been wiped and analyzed for the presence of radiation prior to decommissioning by the Radiation Safety Officer?
□ Yes	**□ No**	□ N/A	If needed, have all contaminated surfaces been cleaned, wiped and reanalyzed prior to decommissioning by Radiation Safety Officer?
□ Yes	**□ No**	□ N/A	Have all potentially contaminated pieces of equipment been decommissioned by the Radiation Safety Officer prior to removal from the room?

If laboratory is being vacated for renovations:

□ Yes	**□ No**	□ N/A	Has REHS approved the removal of the fixed furniture?

EOHSS contacted _____ at Radiation Safety on _____ to confirm that appropriate decommissioning of this lab area has occurred.)

Postings:

□ Yes	□ **No**	□ N/A	Has the Caution sign been removed from the door by EOHSS?
□ Yes	□ **No**		Has the "Decommission Clearance" notice been posted?

EOHSS Staff Signature: Date:

(Page intentionally left blank)

APPENDIX G

PHONE NUMBERS FOR THE PISCATAWAY/ NEW BRUNSWICK CAMPUS

EOHSS . . . . . (732) 235-4058
- Environmental and Occupational Health and Safety Issues
- Training
- Laboratory Safety Services
- Hazardous Materials Handling and Disposal

ENVIRONMENTAL SERVICES, Piscataway . . . . . (732) 235-4213
ENVIRONMENTAL SERVICES, New Brunswick . . . . . (732) 235-6220
- Disposal of all non-chemical waste
- Disposal of Regulated Medical Waste
- Ordering and laundering of laboratory coats

INSTITUTIONAL ANIMAL CARE & USE COMMITTEE (IACUC) . . . . . (732) 235-4162
- Permission to work with live animals

INSTITUTIONAL REVIEW BOARD (IRB) . . . . . (732) 235-9806
- Permission to conduct research with human subjects

RWJMS INSTITUTIONAL BIOSAFETY COMMITTEE . . . . . (732) 235-4162
- Permission to work with recombinant DNA or etiologic agents

PHYSICAL PLANT . . . . . (732) 235-4663
- Heating, Ventilation, Air Conditioning, Plumbing
- Fire Extinguisher Maintenance
- Laboratory Renovations
- Alarms from Equipment (business hours)

PUBLIC SAFETY (EMERGENCY) . . . . . (732) 235-4000
- To report:
  - **DANGEROUS SITUATIONS**
  - **SUSPICIOUS PERSONS**
  - **FIRE OR SMOKE**
  - **RADIATION, CHEMICAL AND BIOHAZARD SPILLS**
  - **A MEDICAL EMERGENCY AND TO REQUEST AN AMBULANCE**

PUBLIC SAFETY (NON-EMERGENCY) . . . . . (732) 235-9365

- Night-time escort service
- Odor Complaints
- Alarms from equipment such as cold rooms (nights and weekends)

RISK AND CLAIMS . . . . . (973) 972-6277

- Schedule an appointment with a physician following an exposure to a hazardous material or following a minor injury

RUTGERS ENVIRONMENTAL HEALTH SERVICES (REHS) . . . . . (732) 445-2550

- Radiation Safety Services - http://rehs.rutgers.edu

SHARED EQUIPMENT SERVICES . . . . . (732) 235-4455

- Repairs of electrical and laboratory equipment
- Biological safety cabinet inspection and certification
- Silver Recovery Systems

MEDICAL SERVICES

EMPLOYEE HEALTH SERVICES . . . . . (732) 445-0123

RUTGERS HURTADO HEALTH CENTER. . . . . (732) 932-7402

- Health Services for joint Rutgers/UMDNJ-RWJMS students working towards a Masters or Ph.D.

STUDENT HEALTH SERVICES . . . . . (732) 235-5160

- Health Services for UMDNJ-RWJMS students working towards an MD or an MD-Ph.D.

PHONE NUMBERS FOR THE NEWARK CAMPUS

EOHSS . . . . . (973) 972-4812
- Environmental and Occupational Health and Safety Issues
- Training
- Laboratory Safety Services
- Hazardous Materials Handling and Disposal

ENVIRONMENTAL SERVICES, Newark . . . . . (973) 972-5400
- Disposal of all non-chemical waste
- Disposal of Regulated Medical Waste
- Ordering and laundering of laboratory coats

INSTITUTIONAL ANIMAL CARE & USE COMMITTEE (IACUC) . . . . . (973) 972-4669
- Permission to work with live animals

INSTITUTIONAL REVIEW BOARD (IRB) . . . . . (973) 972-3608
- Permission to conduct research with human subjects

NJMS INSTITUTIONAL BIOSAFETY COMMITTEE . . . . . (973) 972-4812
- Contact EOHSS for more information

PHYSICAL PLANT . . . . . (973) 972-5400
- Heating, Ventilation, Air Conditioning, Plumbing
- Fire Extinguisher Maintenance
- Laboratory Renovations
- Alarms from Equipment (business hours)

PUBLIC SAFETY (EMERGENCY) . . . . . 222 or (973) 972-4490

- To report:
  - **DANGEROUS SITUATIONS**
  - **SUSPICIOUS PERSONS**
  - **FIRE OR SMOKE**
  - **RADIATION, CHEMICAL AND BIOHAZARD SPILLS**
  - **A MEDICAL EMERGENCY AND TO REQUEST AN AMBULANCE**

PUBLIC SAFETY (NON-EMERGENCY) . . . . . (973) 972-4491

- Night-time escort service
- Odor Complaints
- Alarms from equipment such as cold rooms (nights and weekends)

RISK AND CLAIMS . . . . . (973) 972-6277

- Schedule an appointment with a physician following an exposure to a hazardous material or following a minor injury

Office of Radiation Safety Services (ORSS) . . . . . (973) 972-5305

- http://njms2.umdnj.edu/orssweb/

MEDICAL SERVICES

OCCUPATIONAL MEDICINE SERVICE . . . . . (973) 972-4595

STUDENT HEALTH SERVICES. . . . . (973) 972-8219

- http://njms.umdnj.edu/education/student_affairs/student_health.cfm

PHONE NUMBERS FOR THE STRATFORD CAMPUS

EOHSS ..... (856) 566-6189
- Environmental and Occupational Health and Safety Issues
- Training
- Laboratory Safety Services
- Hazardous Materials Handling and Disposal

ENVIRONMENTAL SERVICES ..... (856) 566-6028
- Disposal of all non-chemical waste
- Disposal of Regulated Medical Waste
- Ordering and laundering of laboratory coats

INSTITUTIONAL ANIMAL CARE & USE COMMITTEE (IACUC) ..... (856) 566-6117
- Permission to work with live animals

VIVARIUM ..... (856) 566-6119

INSTITUTIONAL REVIEW BOARD (IRB) ..... (856) 566-2712
- Permission to conduct research with human subjects

INSTITUTIONAL BIOSAFETY COMMITTEE ..... (732) 235-8376
- Permission to work with recombinant DNA or etiologic agents

PHYSICAL PLANT ..... (856) 566-6032
- Heating, Ventilation, Air Conditioning, Plumbing
- Fire Extinguisher Maintenance
- Laboratory Renovations
- Alarms from Equipment (business hours)

PUBLIC SAFETY (EMERGENCY) ..... (856) 757-7777
- To report:
  - **DANGEROUS SITUATIONS**
  - **SUSPICIOUS PERSONS**
  - **FIRE OR SMOKE**
  - **RADIATION, CHEMICAL AND BIOHAZARD SPILLS**
  - **A MEDICAL EMERGENCY AND TO REQUEST AN AMBULANCE**

PUBLIC SAFETY (NON-EMERGENCY) ..... (856) 757-7777
- Night-time escort service
- Odor Complaints
- Alarms from equipment such as cold rooms (nights and weekends)

RISK AND CLAIMS ..... (973) 972-6277
- Schedule an appointment with a physician following an exposure to a

hazardous material or following a minor injury

RADIATION SAFETY OFFICER . . . . . (856) 566-6189
- Radiation Safety Services

SHARED EQUIPMENT SERVICES . . . . . (732) 235-4455
- Repairs of electrical and laboratory equipment
- Silver Recovery Systems

MEDICAL SERVICES

EMPLOYEE AND STUDENT HEALTH SERVICES . . . . . (856) 566-6825

PHONE NUMBERS FOR THE CAMDEN CAMPUS

EOHSS ..... (856) 566-6189
- Environmental and Occupational Health and Safety Issues
- Training
- Laboratory Safety Services
- Hazardous Materials Handling and Disposal

ENVIRONMENTAL SERVICES ..... (856) 566-6028
- Disposal of all non-chemical waste
- Disposal of Regulated Medical Waste
- Ordering and laundering of laboratory coats

INSTITUTIONAL ANIMAL CARE & USE COMMITTEE (IACUC) ..... (732) 235-4162
- Permission to work with live animals

VIVARIUM ..... (856) 757-9650

INSTITUTIONAL REVIEW BOARD (IRB) ..... (856) 566-2712
- Permission to conduct research with human subjects

INSTITUTIONAL BIOSAFETY COMMITTEE ..... (732) 235-8376
- Permission to work with recombinant DNA or etiologic agents

PHYSICAL PLANT ..... (856) 566-6032
- Heating, Ventilation, Air Conditioning, Plumbing
- Fire Extinguisher Maintenance
- Laboratory Renovations
- Alarms from Equipment (business hours)

PUBLIC SAFETY (EMERGENCY) ..... (856) 757-7777
- To report:
  - **DANGEROUS SITUATIONS**
  - **SUSPICIOUS PERSONS**
  - **FIRE OR SMOKE**
  - **RADIATION, CHEMICAL AND BIOHAZARD SPILLS**
  - **A MEDICAL EMERGENCY AND TO REQUEST AN AMBULANCE**

PUBLIC SAFETY (NON-EMERGENCY) ..... (856) 757-7777
- Night-time escort service
- Odor Complaints
- Alarms from equipment such as cold rooms (nights and weekends)

RISK AND CLAIMS ..... (973) 972-6277
- Schedule an appointment with a physician following an exposure to a

hazardous material or following a minor injury

RADIATION SAFETY OFFICER . . . . . (856) 342-2723 or pager (856) 962-4360

SHARED EQUIPMENT SERVICES . . . . . (732) 235-4455

- Repairs of electrical and laboratory equipment
- Silver Recovery Systems

MEDICAL SERVICES

EMPLOYEE AND STUDENT HEALTH SERVICES . . . . . (856) 566-6825

(Page intentionally left blank)

APPENDIX H

BIOSAFETY WORK PRACTICES

All of the work practices listed below are required when working with BL2 or higher organisms.

	All BL2 and higher laboratories must have a door sign that states the name, office location and phone number of the PI, any entry restrictions, necessary precautions and the Biosafety Level as well as the universal Biohazards symbol (see below). Keep laboratory doors closed when working with BL-2 or -3 organisms. 
	All laboratory personnel should wash their hands following completion of laboratory activities, removal of protective clothing, before leaving the laboratory, and immediately upon contamination. Hand washing facilities and eye wash facilities shall be readily accessible to laboratory employees.
	Eating, drinking, smoking, handling contact lenses, and applying cosmetics or lip balm are prohibited in work areas that present a reasonable likelihood of occupational exposure to hazardous/infectious materials.
	Food and drink shall be stored outside the work areas in cabinets or refrigerators designated for this purpose and not in areas where blood or other potentially infectious materials are present.
	Know the most suitable disinfectant for decontaminating the pathogens you use. Be familiar with the instructions on the EOHSS Emergency Response Guide flipchart for managing an accidental spill of pathogenic materials. Always keep an appropriate spill kit available in the lab.
	Universal precautions shall be used in handling human specimens. Universal precautions means that all human blood and certain body fluids are treated as if they contain human immunodeficiency virus (HIV), hepatitis B virus (HBV) and other blood borne pathogens.
	Use only mechanical pipetting devices and cotton-plugged pipettes for hazardous materials; do not expel air through a pipet to mix suspensions containing infectious or toxic materials. When pipetting, expel liquids against the side-wall of a tube rather then let them splash against the tube bottom. Mouth pipetting is prohibited.
	All procedures involving the manipulation of blood or other potentially infectious materials shall be performed in such a manner as to minimize splashing, spraying and creation of aerosols. Use of biological safety cabinets and other primary

	containment devices (e.g., aerosol-free centrifuge cups, aerosol-free homogenizers) are required for procedures that have high potential for creating aerosols or infectious droplets. If aerosols of infectious materials will be generated, work in a BSC.
	Employees shall remove all personal protective equipment before leaving the laboratory work area. Lab coats must not be worn outside of the laboratory if they were used during work with infectious materials.
	Face protection, (e.g., goggles, masks, face shields or other splatter guards), shall be used for procedures which the potential for splashes or sprays of infectious material to the face exists.
	When biological safety cabinets (BSC) are used: a) They shall be decontaminated at the start and end of each clinical application and immediately following a spill or accident; b) The air flow shall be monitored while in use; and, c) BSC should be decontaminated before it is moved. Class I and II BSC shall be tested and certified in situ at the time of installation within the laboratory, at any time the BSC is moved, and at least annually thereafter. d) The BSC shall be certified according to the *National Sanitation Foundation (1992), Standard 49, Class II (laminar flow) Biohazard Cabinetry*, Ann Arbor, MI.
	Laboratories shall provide for cleaning and laundering and/or disposal of personal protective equipment at no cost to the employees. These items shall not be laundered at home or taken off the premises by laboratory personnel.
	Whenever possible, replace glass lab ware with plastic; glass Pastuer pipets are particularly prone to breakage and their use should be minimized.
	Laboratories shall provide appropriate personal protective equipment in adequate quantities, and ensure that such equipment is properly maintained and accessible at the work site.

	Laboratories shall comply with the following biosafety requirements: a) Needles shall not be recapped, or removed from syringes or other devices, unless it can be demonstrated that no alternative is feasible or that such action is required by a specific procedure (e.g., collection of blood gas specimens); b) When recapping or needle removal is necessary, a mechanical device or one-handed recapping or removal technique shall be used; and, c) Before disposal, used disposable needles shall not be bent, sheared, broken, removed from syringes or otherwise manipulated by hand, but shall be placed in a puncture-proof, leak-proof container used for sharps disposal. d) After use, place reusable sharps such as surgical instruments, in puncture-resistant containers labeled with the biohazard symbol. Detailed protocols must be developed for handling, cleaning, disinfecting and/or sterilizing reusable sharps.
	Cover work surfaces with bench-kote or other absorbent; use disinfectant-soaked towels when working with highly infectious material.
	Laboratory work surfaces shall be decontaminated with an appropriate disinfectant (Use of a 1:10 dilution of a 5.25% solution of sodium hypochlorite (household bleach), prepared daily or 1:5 dilution for solutions prepared weekly is recommended) following spills of potentially infectious material, and at the start and completion of work activities.
	All blood and body fluid spills shall be cleaned up immediately with an appropriate disinfectant. Know the most suitable disinfectant for decontaminating the pathogens you use. Be familiar with the laboratory plan for managing an accidental spill of pathogenic materials. Always keep an appropriate spill kit available in the lab.
	Equipment that may have been contaminated with blood or other potentially infectious materials shall be decontaminated and cleaned on a regular basis, before being repaired and before removal from the laboratory. It may be necessary to provide repair personnel with documentation to confirm that equipment has been decontaminated before repair.

	Disposable gloves shall be: a) Worn whenever it can be reasonably anticipated that the employee may have hand contact with blood, other potentially infectious materials, or when handling or touching contaminated items or surfaces; b) Used when the employee has cuts, scratches or other breaks on his or her skin; and, c) Removed and discarded if they become soiled.
	Supervisors are responsible for ensuring their employees are properly trained before permitting to perform biohazardous work. Lab personnel who work with BL2 and BL3 materials should receive training on the safe use of the autoclave and the necessary precautions to prevent exposure to hazardous/infectious material.

APPENDIX I

PROTOCOL FOR DISPOSAL OF REGULATED MEDICAL WASTE AND REGULATED MEDICAL WASTE CLASSIFICATIONS

This protocol complies with federal and state guidelines for disposal of items classified as Regulated Medical Waste. Where the guidelines are ambiguous, the protocol protects the institution from infractions of the regulations by adopting the stricter possible interpretation. It is also consistent with standards of microbiological practice set forth in the 6th edition of the Manual for Clinical Microbiology. Finally, the protocol attempts to find a common sense solution to disposal of regulated medical waste that protects workers from injury or infection while conserving space and numbers of containers.

1. For research, clinical and teaching laboratory material requiring BL1 or no biological containment conditions[1]:

   A. Discard all syringes, needles, scalpel blades, razor blades, disposable glass serological pipettes, disposable glass pasteur pipettes, unused petrie plates or culture plastic-ware and microscope slides or coverslips in puncture-proof "*Sharps*" containers which can be obtained from general stores[2]. Fill the container to the line. Attach the cover. Put it out in the area designated for pickup by Environmental Services staff.

   B. Discard all disposable plastic serological pipettes and disposable plastic pasteur pipettes in clear plastic bags (the autoclavable plastic bags from general stores are acceptable). When two-thirds full, close the top of the bag with tape and dispose of the bag in the reusable regulated medical waste container provided by the Environmental Services staff[4]. (When appropriate, 1.B & 1.C can be mixed in the same bag).

   C. Discard all petrie plates containing solid medium (based on agar or agarose) and other used disposable culture plastic-ware in clear plastic bags (the autoclavable plastic bags from general stores are acceptable). When two-thirds full, close the top of the bag with tape and dispose of the bag in the reusable regulated medical waste container provided by the Environmental Services staff[4].

D. Liquid cultures from tissue culture flasks or dishes and liquid cultures of bacteria or fungi should be disinfected before drain disposal[3]. These materials are classified as "*cultures and stocks*" in the medical waste regulations.

2. For research, clinical or teaching laboratory material requiring BL2 or BL2+ containment conditions:

A. Discard all syringes, needles, scalpel blades, razor blades, disposable glass serological pipettes, glass pasteur pipettes and microscope slides or coverslips in puncture-proof "Sharps" containers which can be obtained from general stores[2]. Fill the container to the line. Attach the cover. Autoclave[3]. Put it in the area designated for pickup by Environmental Services staff.

B. Discard all disposable plastic serological pipettes and disposable plastic pasteur pipettes in clear plastic bags (the autoclavable plastic bags from general stores are acceptable). When two-thirds full, transport in closed containers to the autoclave facility and autoclave in an autoclavable tub with the top of the bag open to allow steam to escape. When disinfected, close the top of the bag with tape and dispose of the bag in the reusable regulated medical waste container provided by the Environmental Services staff[4]. (When appropriate, 2.B & 2.C can be mixed.)

C. Discard all petrie plates containing solid medium (based on agar or agarose), and other used disposable culture plastic-ware in clear autoclavable plastic bags in the laboratory. When two-thirds full, transport in closed containers to the autoclave facility and autoclave in an autoclavable tub with the top of the bag open to allow steam to escape. When disinfected, close the top of the bag with tape and dispose of the autoclaved bag in a regulated medical waste container provided by the Environmental Services staff[4].

D. Liquid cultures (including bacteria or fungi) that fall into this class should be disinfected[3] before drain disposal.

E. Discard vacutainers containing blood (blood tubes) in puncture-proof *"Sharps"* containers which can be obtained from general stores[2]. Treat this material as in 2.A above.

F. Consult with the vivarium's procedures for disinfection and disposal of carcasses, body parts and bedding of animals known to have been exposed to infectious agents.

3. For research, clinical and teaching laboratories handling human tissues or specimens or other clinical materials, consult with the laboratory supervisor regarding the need for, and method of, disinfection before disposal in regulated medical waste containers:

A. Discard human pathological waste, including human tissues, organs, body parts and body fluids either removed during surgery or autopsy, or obtained as specimens in leak-proof containers in a reusable regulated medical waste container[4]. This material is classified as *"pathological wastes"* in the medical waste regulations.

B. Discard liquid products of human blood and any items saturated and/or dripping with human blood, or items caked with dried human blood in leak-proof containers placed in a reusable regulated medical waste container[4]. This material is classified as *"human blood and blood products"* in the medical waste regulations.

C. Discard material contaminated with highly communicable disease-causing organisms (classified as BL3 or above), including human or animal tissues, fluids or exudates or other biological products in leak-proof containers. This material should be disinfected by autoclaving or other appropriate means before placement in regulated medical waste containers[4] for pickup by Environmental Services staff. This material is classified as *"isolation wastes"* in the medical waste regulations.

Notes:

1. *Biosafety Level (BSL) is defined in the Definitions Section of this Laboratory Safety Plan.*
2. *Puncture-proof containers must be closable, puncture resistant, leakproof on sides and bottom, and must have an orange label which says "biohazard" and which has a biohazard symbol on it.*
3. *Information on autoclaving and other sterilization and disinfection methods are included in Section 10 - Biosafety Plan.*
4. *The lids should be left on the reusable regulated medical waste containers at all times.*

Regulated Medical Waste Classifications per NJAC 7:26-3A

Definition

Regulated Medical Waste is any solid waste generated in the diagnosis, treatment (e.g., provision of medical services) or immunization of human beings or animals, and in research pertaining thereto or in the production or testing of biologicals, that is not excluded or exempted under NJAC 7:26-3A,6(b) and that is listed in the table at NJAC 7:26-3A.6(a).

WASTE CLASS	REGULATED MEDICAL WASTE DESCRIPTION
1) Cultures and Stocks	Cultures and stocks of infectious agents and associated biologicals; including cultures from medical and pathological laboratories; cultures and stocks of infectious agents from research and industrial laboratories; wastes from the production of biologicals; discarded live and attenuated vaccines; and culture dishes and devices used to transfer, inoculate, and mix cultures.
2) Pathological Wastes	Human pathological wastes, including tissues, organs and body parts and body fluids that are removed during surgery or autopsy, or other medical procedures, and specimens of body fluids and their containers.
3) Human Blood and Blood Products	Liquid waste human blood; products of blood; items saturated and/or dripping with human blood that are now caked with dried human blood; including serum, plasma, and other blood components, and their containers, which were used or intended for use in either patient care, testing and laboratory analysis or the development of pharmaceuticals. Intravenous bags are also included in this category.
4) Sharps	Sharps that have been used in animal or human patient care or treatment or in medical research, or industrial laboratories, including hypodermic needles, syringes (with or without the attached needle), pasteur pipettes, scalpel blades, blood vials, needles with attached tubing, and culture dishes (regardless of presence of infectious agents). Also included are other types of broken or unbroken glassware that were in contact with infectious agents, such as used slides and cover slips.
5) Animal Waste	Contaminated animal carcasses, body parts, and bedding of

	animals that were known to have been exposed to infectious agents during research (including research in veterinary hospitals), production of biologicals, or testing of pharmaceuticals.
6) Isolation Wastes	Biological waste and discarded materials contaminated with blood, excretion, exudates, or secretions from humans who are isolated to protect others from certain highly communicable diseases, or isolated animals known to be infected with highly communicable diseases.
7) Unused Sharps	The following unused, discarded, sharps: hypodermic needles, suture needles, syringes, and scalpel blades.

(Page intentionally left blank)

APPENDIX J

URL ADDRESSES FOR RECOMBINANT DNA REGISTRATION INSTRUCTIONS AND FORMS

Camden - http://www.umdnj.edu/eohssweb/camden/camden_rdna.htm

Newark - http://www.umdnj.edu/eohssweb/nsp/nsp_registry.htm

Piscataway/New Brunswick - http://www.umdnj.edu/eohssweb/pisc/pisc_rdna.htm

Stratford - http://www.umdnj.edu/eohssweb/stratford/str_rdna.htm

APPENDIX K

URL ADDRESSES OF INSTRUCTIONS AND REGISTRATION FORMS FOR PATHOGEN, SELECT AGENT AND HUMAN CELLS/TISSUES

Camden http://www.umdnj.edu/eohssweb/camden/camden_registry.htm

Newark http://www.umdnj.edu/eohssweb/nsp/nsp_registry.htm

Piscataway/New Brunswick http://www.umdnj.edu/eohssweb/pisc/pisc_registry.htm

Stratford - http://www.umdnj.edu/eohssweb/stratford/str_registry.htm

APPENDIX L

BLOODBORNE PATHOGENS

The PEOSH* Bloodborne Pathogens Standard covers all employees with "reasonably anticipated" exposure to human blood, blood products, or other material capable of transmitting HIV, HBV, HCV and other bloodborne diseases. The law requires that employers develop and implement an Exposure Control Plan that:

- Identifies job titles and tasks where exposure may occur.
- Describes the procedures that will be used to minimize exposure risk: working at BL-2 with emphasis on engineering controls as the preferred type of control measure and adopting Universal Precautions (i.e., treating all human blood, certain body fluids, and other materials as if they were known to be infectious for bloodborne diseases).
- Details procedures to ensure rapid follow-up treatment consistent the current medical recommendations, paid for by the employer, in the event of an exposure incident.
- Offers affected employees the HBV vaccine free of charge.
- Provides a schedule for the regular cleaning and decontamination of work surfaces.
- Provides employees with initial and annual update training focused on work practices that will minimize their risk of exposure.
- PIs are responsible for their staff's attendance at mandatory bloodborne pathogens training sessions. Personnel working with infectious materials not formally covered by the OSHA Bloodborne Pathogens Standard are still strongly encouraged to attend training because of the applicability of the principles and techniques discussed at these sessions.

EOHSS provides bloodborne pathogens training for laboratory staff. Contact your campus EOHSS office for scheduling information. A generic Exposure Control Plan is available from EOHSS. Its fill-in-the-blank format enables each laboratory to produce a document with site (laboratory) specific information as required by the regulation.

* PEOSH: NJ Public Employees Occupational Safety and Health Program. As a State institution, UMDNJ is not covered by OSHA (a part of the Federal government). Typically, PEOSH adopts OSHA's Standards and is responsible for their enforcement.

LIST OF BLOODBORNE PATHOGENS, THEIR SYMPTOMS AND EPIDEMIOLOGY

Assume ALL human blood, serum, body fluids (semen, saliva, tears, cerebrospinal and amniotic fluid, milk and cervical secretions) and tissues to be contaminated with blood borne pathogens. Following are the two most common pathogens and their symptoms:

1. Human Immunodeficiency Virus (HIV) infection, which is caused by one of two viruses, HIV-1 or HIV-2. HIV-1 is the predominant form of the infection in the U.S. HIV-2 has only been reported in Africa or individuals coming from that area of the world. HIV-1 and HIV-2 are related but exhibit moderate DNA sequence differences. HIV belongs to the family *Lentiviridiae* and is responsible for

a disease affecting the immune system which renders the infected individual vulnerable to a wide range of debilitating progressive clinical disorders. HIV infects T cells, monocytes and macrophages and brain astrocytes where it may wait in latent form until something signals them to multiply with the result of destroying the cell. Within a month after exposure to HIV-1 an individual may exhibit acute retroviral symptoms (fever, enlargement of the lymph nodes, diarrhea, fatigue and rash). The symptoms usually goes away and is followed by the development of antibodies (HIV positive AB test usually within 6-12 weeks). The next phase may be no symptoms from months to years following infection. Most people who are infected will develop AIDS (Acquired Immune Deficiency Syndrome). The clinical symptoms of this stage vary widely (severe weight loss, chronic diarrhea, weakness and fever). Patients usually die from a secondary infection by any number of opportunistic infections (e.g., *Pneumocystis carinii* pneumonia, *Mycobacterium tuberculosis* (TB), *Hemophilus spp., Streptococcus*). There is no known cure although current treatment regiments have been shown to prolong the onset of the disease;

2. Hepatitis Viruses. There are many types of hepatitis viruses (Hepatitis A [HAV], B [HBV], C [HCV], delta, non-A non-B) all of which cause some form of disease in man. The most common are HAV and HBV this is the virus which infects most health-care workers). is called infectious hepatitis. Transmission of this virus is facilitated by poor personal hygiene, poor sanitation and intimate (sexual) contact. HBV is called serum hepatitis and is usually transmitted through the skin by cuts abrasions or sharps or through mucous membranes (mouth, nose, eyes) by exposure to infected blood or body fluids. The course of hepatitis infection is characterized by stages. 1: Incubation period (10-50 days) 2: Symptoms occurring (fever, nausea, vomiting). 3: Appearance of dark brown urine (bilirubinuria) followed by pale stools and jaundice (yellow skin and eyes). This stage can result in severe illness or even death. 4: Convalescent period. There is a HBV vaccine which is recommended for all workers exposed to human blood & body fluids.

Other bloodborne pathogens may also be present. These infectious diseases are characterized by a phase in which the causative agent may circulate in the blood for a prolonged period of time. The following lists some, but not all, of these other bloodborne pathogens:

3. Syphilis, a disease caused by infection with *Treponema pallidum*, a spirochete. This disease progresses through several stages and can result in severe debilitation and even death. Primary syphilis starts with a single lesion (chancre) after a 10-90 day incubation period. this is followed by enlarged lymph nodes near the lesion. The lesion may go away but then systemic dispersal of the organism results in more secondary lesions, penicillin is the drug of choice for treatment;

4. Malaria, a mosquito-borne parasitic infection caused by at least five strains of *Plasmodium species*. This disease results in periods of fever, chills, exhaustion and sweating which coincide with the release of the parasite into the blood stream. Normally this disease is limited to areas where certain types of mosquitoes breed (*Anopheles*), generally in the warmer climates. Chloroquine and primaquine phosphate are used to treat this disease;

5. Leptospirosis, a febrile illness caused by *Leptospira interrogans*, a spirochete. This disease is a zoonotic (can be transmitted from animal to man [and man to man]) and is transmitted by direct contact with blood or body fluids. The kidneys are the main infection site in man. Treatment is by penicillin, streptomycin, tetracycline and macrolid antibiotics;

6. Arboviral infections, viral infections caused by ticks do not normally transmit person-to-person

without the tick vector except for Colorado tick fever which has been shown to be transmitted by blood transfusion;

7. Relapsing fever, a febrile (fever causing) illness caused by the pathogenic microbe species *Borreliae*. This disease is tick-born but can be transmitted via blood transfusions. Treatment is by tetracyclines or chloramphenicol;

8. Herpes Simplex Virus (HSV) 1 & 2, are the causative agents of several human infections, HSV-1 infection is normally responsible for infections above the waist which result in fever blisters, cold sores, keratitis (inflammation of eye [cornea]) and encephalitis (disease of the central nervous system. HSV-2 is responsible for infections (causing lesions, vaginal or urethral discharge and local itching) below the waist and are generally sexually transmitted, both are considered opportunistic pathogens. Treatment is by Acyclovir or other antiviral drug (e.g., viderabine, trifluridine);

9. Human T Lymphotropic Virus (HTLV-1 and HTLV-2), a retrovirus found mostly among IV drug users which is transmitted by blood transfusion. HTLV-1 has been associated with T-cell leukemia and some other neurological disorders;

10. Viral Hemorrhagic Fever, associated with several viruses not normally found in the U.S. and causes severe fever, sore throat, cough, diarrhea, vomiting, hemorrhage and death. These viruses can be transmitted through blood and body fluids;

11. Tuberculosis, a disease caused by a bacteria *Mycobacterium tuberculosis*, is a progressive disease which affects all parts of the body (lungs, kidneys, vasculature). Symptoms range from fever and fatigue to chronic pulmonary disease (can be fatal) . TB is highly infectious to susceptible individuals through inhalation of aerosol droplets. TB can be treated effectively with isoniazid, rifampin, streptomycin and ethambutol;

12. Cytomegalovirus (CMV), an etiological agent for mononucleosis syndrome. CMV can be acquired through blood transfusions/organ transplants;

13. Creutzfeld-Jacob disease, a degenerative disease of the brain caused by a virus-like particle (thought to be similar to Scrapies and Kuru). Transmission is via blood & body fluids;

14. Babesiosis, a tick-borne parasitic disease, caused by the parasite *Babesia microti*;

15. Brucellosis, a febrile (fever causing) illness caused by members of the genus *Brucella*.

UNIVERSAL PRECAUTIONS FOR HANDLING HUMAN BLOOD, BODY FLUIDS & TISSUES IN THE CLINICAL & RESEARCH LABORATORY

1. Assume ALL human blood, plasma, serum, body fluids (semen, saliva, tears, cerebrospinal and amniotic fluid, milk and cervical secretions) and tissues to be contaminated with *Human Immunodeficiency Virus (HIV)* and/or *Hepatitis Viruses (e.g., HBV).* Handle them with appropriate care!
2. Gain knowledge - Be prepared:
   a. Personnel should understand their risk categorization (per Dept. of Labor and Health and Human Services) before initiating work:

      Category I: Personnel routinely handle blood, body fluids and tissues.

      Category II: Personnel occasionally handle or work around such materials.

      Category III: Personnel never work with or around such materials.

   b. Be familiar with the CDC/NIH Manual "Biosafety in Microbiological and Biomedical Laboratories", view biosafety videos and be familiar with the company's Biosafety Manuals. Ask your supervisor to explain any procedures or concepts not clear to you before beginning work.

   c. Category I and II personnel should get the new, safe and effective Hepatitis B vaccination.

1. Remember: The most susceptible route of laboratory infection for *HIV* and *HBV* is by accidental needle sticks, contamination of the mucous membranes, or through broken, abraded or irritated skin. Use appropriate caution and maximum protection to prevent such contact.
4. Avoid spilling, splashing or open aerosolization of human blood or body fluids. Wear latex gloves, protective lab garments and face and eye shields when handling human materials.
1. Understand the principles of good microbiological practice before working with biohazardous materials. Examples include use of aseptic technique, proper decontamination procedures, emergency biohazard spill management and proper use of biosafety equipment. Develop proficiency before beginning work.
2. Use *Biosafety Level-2* work practices, containment and laboratories when handling human materials where droplet and aerosol production are likely. Avoid aerosol-generating activities in handling human materials. When such procedures are necessary, use biosafety cabinets or other containment and personal protective equipment.
3. When culturing or manipulating known *HIV* or *HBV*, use *Biosafety Level-3 (BL-3)* procedures. Any procedure which requires concentration of *HIV* or *HBV* or other human viruses from human materials should be handled under *BL-3* containment and handling conditions. Use appropriate biosafety level conditions *(BL-2 or BL-3)* when handling non-human primates and other animals inoculated with human pathogenic materials.
4. Dispose of human and animal biohazardous waste or materials contaminated with them in accordance with CDC/NIH biosafety and institutional guidelines.
5. Decontaminate laboratory protective garments, gloves and protective equipment to render them non-infectious.
6. Clean all work areas and equipment used in handling human biohazardous materials with proven

disinfectant (e.g., 1:10 dilution of Clorox) when concluding work to protect personnel from accidental infection.

7. Assume that human serological and biological reagents (e.g., antibody, antigen or antisera) used in the laboratory are contaminated with *HIV* or other viruses and handle them accordingly.

8. Understand your institution's medical surveillance program and be familiar with the appropriate standard operating procedures for accidental exposure to human materials. Specific measures must be followed as per CDC/NIH Guidelines in the Universal Precautions. The specimens involved must be identified and tested for *HIV* and *HBV* and the procedures followed.

9. Report every accident to your supervisor and Occupational Medical Service personnel.

10. Responsibility for instituting, training and monitoring of biosafety practices in laboratories handling human materials, *HIV* or *HBV* rests with the Laboratory Director or the designated Principal Investigator (PI). These individuals must categorize positions, provide facilities, biosafety equipment, biosafety procedures and training to employees accepting such work assignments to permit the safe conduct of the work. These responsible individuals must ascertain the proficiency of the employee in performing the assigned task before permitting the work to begin.

11. Laboratory personnel have a clear responsibility to fully understand and consistently adhere to the biosafety practices detailed in the Biosafety and General Safety Manuals as well as to the biosafety guidelines detailed here and by the CDC and NIH. Responsibility for conscious or thoughtless non-compliance with or violation of these guidelines falls on the laboratory worker.

Source: Morbidity and Mortality Weekly Reports 37: No.S-4,1-19. April 1, 1988.

APPENDIX M

PERSONNEL RESPONSIBILITIES

A. Vice-Presidents and the Associate Dean for Research have the following responsibilities and authority:

1. Ensuring Unit/School level compliance with all components of the program as outlined in the UMDNJ Laboratory Safety Policy.

2. Serving as the Unit/School's primary interface with EOHSS, and other support departments within the school on program administration and compliance matters.

3. Maintaining copies of program documentation, Responsible Investigator and Laboratory Safety Officer rosters and any other relevant program information.

4. Sending copies of this Model Laboratory Safety Plan to all Department Chairpersons.

B. Department Chairpersons / Division Heads have the following responsibilities and authority concerning the Laboratory Safety Program:

1. Appoint at least one Laboratory Safety Officer per department.

2. Work with Laboratory Safety Officer(s) to effectively tailor the Laboratory Safety Plan.

3. Ensure that changes made to UMDNJ Model Laboratory Safety Plan by the school/unit and/or by department as well as updates are distributed to or made available to Responsible Investigators who must incorporate it into their Laboratory Safety Plans.

4. The Department Chairperson's designee is responsible for overseeing the vacating of laboratories to ensure that all chemicals and medical waste have been appropriately removed and that the laboratory is free of chemical or radioactive contamination before a laboratory is considered vacated.

5. Ensure that each laboratory in the department is covered under a Laboratory Safety Plan as outlined in this document and that these Plans are effectively implemented.

C. Laboratory Safety Officers assist with the implementation and annual review of the Laboratory Safety Plan covering each applicable laboratory in the department.

1. The criteria for selection of Laboratory Safety Officers is listed as follows:

   a. Laboratory Safety Officers will have sufficient knowledge, training and experience concerning the procedures being performed in the laboratory and will be up-to-date on required health and safety training sessions.

   b. Laboratory Safety Officers will have appropriate authority to assist in the tailoring and implementing of the Laboratory Safety Plan for the department or individual laboratories.

2. For laboratories that they are responsible for, Laboratory Safety Officers shall assist Administrators and Responsible Investigators in the implementation of the Laboratory Safety Plan. Laboratory Safety Officers shall interact with EOHSS on most safety matters for the laboratory. Duties will vary depending upon the department but will generally include the activities listed below.

   a. Assist Responsible Investigators in tailoring the Model Laboratory Safety Plan, by ensuring that information required in the Laboratory Safety Plan Survey is provided and making any other necessary revisions.

   b. In the UMDNJ Laboratory Safety Plan, various safety functions specific must be assigned to a specific individual. In most cases, the Laboratory Safety Officer will fulfill these functions directly or will ensure that other, designated personnel are appropriately carrying out those functions.

   c. Perform an annual review of specific provisions that have been incorporated into the Laboratory Safety Plan and update it to accommodate changes in 29 CFR 1910.1450, procedures, personnel, UMDNJ policy and other pertinent materials.

   d. Schools/Units, and Departments are encouraged to amend the UMDNJ Model Laboratory Safety Plan in order to tailor the Plan to specific situations. The Laboratory Safety Officer, along with the Responsible Investigator, shall insure that these changes in the Model Plan are incorporated into laboratory-specific Laboratory Safety Plans.

   e. Inform the Responsible Investigator of any unsafe conditions or procedures that are observed in the laboratory.

   f. Assist the Responsible Investigator in reviewing the cause of any accidents that occur to prevent recurrence.

   g. Review the chemical inventory for the laboratories for which he/she has responsibility on an annual basis and seek safe and effective substitutes for hazardous chemicals.

h. Work with EOHSS to determine ways of minimizing the volume of hazardous chemical waste.

3. Resources: The Laboratory Safety Officer may call upon departmental administrative personnel for administrative support, EOHSS for technical support, as well as Responsible Investigators who will provide specific information concerning their laboratories.

D. The Responsible Investigator is defined as a UMDNJ faculty member with assigned laboratory space. The Responsible Investigator has responsibility for safety in the laboratory including:

1. Ensuring that all laboratory personnel are up-to-date on all required health and safety training and have the understanding and knowledge to perform their jobs safely.

2. Ensuring that laboratory personnel receive laboratory specific training as specified in Section 2.A.5, and understand the training received by observation of their work, monitoring of accidents, discussions or other methods.

3. Ensuring that laboratory personnel are familiar with and adhere to applicable safety procedures and the Laboratory Safety Plan as it affects the laboratory.

4. Establishing proper laboratory procedure(s) for chemical management, handling and storage in accordance with the Laboratory Safety Plan.

5. Maintaining and updating the laboratory chemical inventory.

6. Tailoring Section 1.C of the Laboratory Safety Plan to make it specific to all aspects of proposed and on-going research activities that involve hazardous agents.

7. Ensuring that all personnel receive the medical examinations and protective equipment necessary for the safe performance of their job, as described in the Laboratory Safety Plan.

8. Consulting EOHSS to arrange for workplace air samples, swipes, or other tests where necessary, to determine the amount and nature of airborne and/or surface contamination. Informing employees of the results and for using the data to aid in the evaluation and maintenance of proper laboratory conditions.

9. Obtaining/providing the necessary prior authorizations for use of particularly hazardous substances and pyrophoric/reactive chemicals in accordance with Section 4, Prior Approval, of the Laboratory Safety Plan.

10. Replacing hazardous substances with safer substitutes if feasible.

11. Ensuring that the appropriate actions are taken to correct work practices and conditions that may result in an accident or chemical exposure.

12. Following up on accidents and on incidents that cause personnel to be exposed to hazardous chemicals or materials by filling out a UMDNJ Incident Report. Reporting spills or other releases that may constitute a danger of environmental contamination to the Public Safety emergency phone number. Working with EOHSS and the Laboratory Safety Officer to identify procedures that will be used to minimize the recurrence of that type of accident or incident.

13. Ensuring that unwanted and/or hazardous chemicals and materials are properly disposed of in accordance with the UMDNJ Hazardous Waste Management Policy (00-01-45-35:00).

14. Ensuring that biological materials are disposed of in accordance with the UMDNJ Regulated Medical Waste Policy (00-01-45-15:00).

15. Making copies of the Laboratory Safety Plan available to all laboratory personnel.

16. Ensuring that all procedures have been performed before leaving the University or relocating within the University in accordance with "Protocol for Vacating a Laboratory," Appendix D of this Plan.

17. Assisting EOHSS and the Radiation Safety Officer when necessary.

E. Laboratory personnel are those employees, students and volunteers under the direction of the Responsible Investigator, as defined by this Plan. Personnel not under the direction of the Responsible Investigator, but who work in an area under the direction of the Responsible Investigator, are also subject to this section and the Laboratory Safety Plan in effect in that area. Laboratory personnel as a whole are responsible for:

1. Becoming familiar with the contents of UMDNJ's Laboratory Safety Plan for each laboratory where they work.

2. Attending the training sessions required for and relevant to the types of procedures carried out in his/her laboratory(ies). Understanding the nature and physical/chemical properties of each hazardous material utilized in any new laboratory protocol before initiating the protocol, and asking for clarification by the Responsible Investigator, Laboratory Safety Officer or EOHSS if any procedures which could affect safety are not clearly understood.

3. Planning and conducting each operation in accordance with the policies and procedures described in the applicable Laboratory Safety Plan.

4. Being familiar with the procedures for responding to and reporting laboratory spills, accidents and other emergencies.

5. Understanding the function and proper use of all personal protective equipment. Wearing personal protective equipment when mandated or necessary.

6. Reporting to the Responsible Investigator and/or Laboratory Safety Officer any significant problems arising from the implementation of the Laboratory Safety Plan.

F. The Director of the Department of Environmental and Occupational Health and Safety Services is responsible for:

1. Ensuring continued University compliance with the Laboratory Safety Policy requirements and overseeing the coordination of this program with other campus safety programs.

2. Issuing program guidelines and updated reference material to the Campus Safety Manager and the appropriate Laboratory Safety Committees to assist them with program implementation.

3. Providing training guidelines and oversight of training programs conducted within Schools/Units by qualified trainers.

G. The Department of Environmental and Occupational Health and Safety Services (EOHSS) is responsible for:

1. Ensuring overall University compliance with the UMDNJ Laboratory Safety Policy requirements.

2. Working with appropriate University departments to ensure that the laboratory facilities and chemical fume hoods are designed, located, operated and maintained to promote a safe working environment.

3. Performing laboratory safety inspections and audits as necessary.

4. Working with Laboratory Safety officers and the relevant safety committees to find ways to minimize the volume of hazardous chemical waste that is generated.

5. Maintaining an appropriate data base to document attendance at health and safety training sessions.

6. Making recommendations to revise the UMDNJ Laboratory Safety Policy or the Model Laboratory Safety Plan annually or as needed.

H. Campus Safety Manager and the appropriate Laboratory Safety Committees are responsible for:

1. Ensuring school/unit level compliance with the UMDNJ Laboratory Safety Policy requirements.

2. Reviewing and recommending revisions to the UMDNJ Laboratory Safety Policy, Laboratory Safety Plan and the Model Laboratory Safety Plan, as necessary.

I. The Radiation Safety Officer

The Radiation Safety Officer ensures compliance with all applicable regulations concerning radionuclides and devices which emit ionizing radiation.

J. The Department of Operations is responsible for:

1. Assisting EOHSS with the investigation, the timely correction, and the restoration of a safe work environment to laboratory areas that have reported unsafe conditions attributed to facilities and/or ventilation systems.

2. Providing a testing and maintenance program for safety showers, fire safety equipment, electrical outlets, chemical fume hoods and other fixed equipment to maintain such equipment in safe working condition.

K. Student/Employee Medical Services are responsible for the administration of a medical program which includes consultation, examination, referrals, treatments, monitoring, and record keeping to prevent, track, and control incidence of harmful occupational hazards.. The medical program will consist of:

1. Specific criteria outlining the frequency and protocol for medical consultation and treatment to prevent illnesses due to occupational exposure to hazardous chemicals.

2. Identification of any outside departments or facilities which will provide any medical services including the associated protocols, procedures, and fees.

3. Reporting, documenting and record keeping in a manner that is consistent with the requirements outlined in the Laboratory Safety Policy and applicable regulations.

APPENDIX N
DEFINITIONS

(Additional definitions may be found in Appendix B- 29 CFR 1910.1450 "Occupational Exposure to Hazardous Chemicals in Laboratories.")

Action level: means a concentration designated in 29 CFR part 1910 (OSHA regulations) for a specific substance. The action level is calculated as an eight (8)-hour time-weighted average which initiates certain required activities such as exposure monitoring and medical surveillance.

Acutely toxic substances: Substances in this category meet the ANSI Z129.1 standard definition for high toxicity; due to the paucity of data for inhalation and dermal toxicity. In practice, this means having a rat oral LD_{50} of 50 mg/kg or less. In addition, microbial toxins with an LD50 less than 50 mg/kg are considered an acutely toxic substance. Also, Material Safety Data Sheets (MSDSs) generally employ the following keywords to designate an acutely toxic substance:

"Extremely toxic"

"Highly toxic"

"Very toxic"

Biosafety Level (BL): One of the four combinations of laboratory practices and techniques, safety equipment, and laboratory facilities recommended by the Centers for Disease Control and the National Institute of Health in *Biosafety in Microbiological and Biomedical Laboratories,* as being appropriate for minimizing the risk of infectious disease when microorganisms are worked with. The National Institute of Health's *Guidelines for Research Involving Recombinant DNA Molecules* also makes use of this classification system in its requirements for safety practices regarding laboratory activities invdving organisms that contain recombinant DNA.

Bloodborne Pathogens: means 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). Also includes established cell lines of human/primate origin (including those obtained from commercial sources) and Other Potentially Infectious Material (OPIM) (material with the potential for transmission of HIV, HBV, HCV, and other bloodborne diseases, including tissue from animals known to be infected with any of these agents, microbial stocks and cultures, certain body fluids, unfixed human tissue, primary tissue/cell cultures).

Carcinogen: (see "select carcinogen").

Designated area: means an area which may be used for work with "select carcinogens," reproductive toxins or substances which have a high degree of acute toxicity. A designated area may be the entire laboratory, an area of a laboratory or a device such as a laboratory hood.

Emergency: means any occurrence such as, but not limited to, equipment failure, rupture of containers or

failure of control equipment which results in an uncontrolled release of a hazardous chemical into the workplace.

Flammable Storage Cabinet: A cabinet for the storage of flammable and combustible liquids constructed in accordance with Section 4-3 of NFPA 30, Flammable and Combustible Liquids Code.

Hazardous chemical: means a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.

Laboratory: a facility where relatively small quantities of hazardous chemicals or biologicals are used on a non-production basis for clinical or research activities.

Laboratory Personnel: employees, students and other persons conducting research and clinical activities in UMDNJ Laboratories, regardless of UMDNJ employment status.

Laboratory Safety Officer: The Laboratory Safety Officer is a UMDNJ employee designated by the Department Chair who is qualified by training or experience, to provide technical guidance in the development and implementation of the school or unit Laboratory Safety Plan which has been tailored for each laboratory or group of laboratories in the department.

Laboratory Safety Plan: a written, lab-specific plan, based on the Model UMDNJ Laboratory Safety Plan, developed and implemented by the employer, and tailored for each laboratory or group of laboratories, which sets forth procedures, equipment and work practices that (i) are capable of protecting laboratory personnel from the health hazards presented by hazardous materials used in that particular workplace and (ii) meets the requirements of paragraph (e) of 29 CFR 1910.1450 "Occupational Exposure to Hazardous Chemicals in Laboratories."

Medical consultation: a consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examinations or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.

Minimum UMDNJ Laboratory Safety Standard: Mandatory Protocols and Procedures set forth in the Model UMDNJ Laboratory Safety Plan and denoted by directive phrases such as:

"shall"

"must"

"is prohibited"

"is required"

"is not permitted"

Model Laboratory Safety Plan (UMDNJ): A model, written Laboratory Safety Plan which sets forth minimum UMDNJ Laboratory Safety Standards and which is designed to be tailored for use by UMDNJ schools, units,

departments and laboratories.

Non-Exempt: The term applied to research involving recombinant DNA, where based on the National Institute of Health's, *Guidelines for Research Involving Recombinant DNA Molecules*, the level of risk for the transmission of infectious disease is such that it is required that the appropriate laboratory safety committee approve the protocol before research begins. Most research at UMDNJ involving recombinant DNA is exempt from this requirement.

Particularly Hazardous Substance: Any compound which meets the criteria of select carcinogen, mutagen, reproductive toxin, acutely toxic, and chemicals whose toxic properties are unknown.

Regulated Medical Waste: Cultures and stocks, pathological wastes, human blood and blood products, sharps, certain animal waste, isolation wastes, unused sharps as described in NJAC 7:26-3A. See Appendix I for more information.

Reproductive toxins: Chemicals which affect the reproductive capabilities of males or females including chromosomal damage (mutations) and effects on fetuses (teratogenesis). Material Safety Data Sheets generally employ the following keywords to designate a reproductive toxin:

congenital malformation	***mutagenic***
fetal toxicity	***maternal effects***
fetal death	***paternal effects***
fatal effects to the newborn	***fertility***
neoplastic	***infertility***
teratogenic	

Responsible Investigator: UMDNJ Faculty Member or Clinician with assigned research, teaching or clinical laboratory space.

Select carcinogen: means any substance which meets at least one of the following criteria:

(i) It is regulated by OSHA as a carcinogen; or

(ii) It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or

(iii) It is listed under Group I ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest edition); or

(iv) It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals.

Standard Operating Procedures: Work practices, personal protective equipment or protective devices as well as engineering controls which are employed to minimize contact with a hazardous material. The selection of the most effective set depends as much on the conditions of use of the material and the physical environment, as it does on the innate toxicological properties of the chemical.

Unattended Laboratory Operation: A laboratory procedure or operation during which there is no person present who is knowledgeable regarding the operation and emergency shutdown procedures.

Unknown Toxic Properties: A term describing a chemical for which there is no known statistically significant study conducted in accordance with established scientific principles that establish its toxicity.

Index