Biosafety Manual

Environmental Health & Safety

305 Student and Business Services Building, ext. 5711

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CONTENTS

Definitions

Aerosols - Colloids of liquid or solid particles less than 10 microns in diameter suspended in air.

Autoclave - A device designed to sterilize equipment or biological waste using heat, steam and pressure within a chamber.

Biological Agent - Infectious agents and recombinant DNA molecules.

Biohazardous Agent - means a replication capable pathogen which is a disease causing microorganism and is capable of causing diseases in humans including viruses, microbes and sub viral agents. The agent includes the agent, products of infectious agents, or the components of infectious agents presenting a risk of illness or injury.

Biohazardous Materials - are any materials that would harbor biohazardous agents such as human blood, body fluids, or tissues that may be contaminated with biohazardous agents.

Biological Barrier - An impediment (naturally occurring or introduced) to the infectivity and/or survival of a biohazardous agent.

Biological Safety Cabinet - A device enclosed on three sides, the top and bottom that is designed to draw air inward by means of mechanical ventilation. Exhaust air is filtered and or ducted to the outside. Used for the manipulation of biological and biohazardous agents.

Biosafety Level - laboratory practices, techniques, safety equipment and laboratory facilities appropriate for the operations performed and the hazards posed by the particular biohazard material. The National Institutes of Health (NIH) and the Centers for Disease Control and Prevention (CDC) define four levels of biosafety and four levels of animal biosafety. Biosafety levels of specific agents are listed in the Biosafety Levels For Infectious Agents and Infected Animals (Appendix A).

Bloodborne Pathogens - Pathogenic microorganisms that are present in human and other primate blood and can cause diseases in humans. These pathogens include, but are not limited to, Hepatitis B Virus (HBV), Hepatitis C Virus (HCV) and the Human Immunodeficiency Virus (HIV).

CDC - Centers for Disease Control and Prevention

Clinical Laboratory - A workplace where diagnostic or other screening procedures are performed on blood or Other Potentially Infectious Materials (OPIM).

Containment - The confinement of a biohazardous agent that is being cultured, stored, manipulated, transported or destroyed in order to prevent or limit its contact with people and/or the environment. Methods used to achieve this include physical and biological barriers and inactivation using physical or chemical means.

Decontamination - The removal or neutralization of toxic agents or the use of physical or chemical means to remove, inactivate or destroy living organisms on a surface or item so that the organisms are no longer capable of transmitting infectious particles and the surface or item is rendered safe for handling, use or disposal.

Diagnostic Specimen - Any human or animal material including, but not limited to, excreta, secreta, blood and its components, tissue and tissue fluids being analyzed for purposes of diagnosis. (CDC Interstate Shipment of Etiologic Agents)

Disinfection - A process by which viable biohazardous agents are reduced to a level unlikely to produce disease in healthy people, plants or animals.

Engineering Controls - Controls (e.g., sharps containers, self-sheathing needles) that isolate or remove pathogens from the workplace.

Exposure Incident - Contact with blood or OPIM that results from the performance of an employee's duties.

High Efficiency Particulate Air (HEPA) Filter - A disposable, extended, pleated-medium, dry-type filter with (1) a rigid casing enclosing the full depth of the pleats, (2) a minimum particulate removal of 99.97 percent for thermally generated monodisperse dioctylphthalate (DOP) smoke particles with a diameter of 0.3 um and (3) a maximum pressure drop of 1.0 in. Hg when clean and operated at rated airflow capacity.

Inactivation - Any process that destroys the ability of a specific biohazardous agent to self-replicate.

Laminar Airflow - Unidirectional airflow through the work area often referred to as (1) turbulence-free airflow, (2) steady unidirectional micro turbulence flow or (3) mass airflow.

Medical Waste Management Act (MWMA) - California Health and Safety Code, Division 20, Chapter 6.1, Commencing with Section 25015.

Mixed Waste - Waste that contains more than one type of hazardous constituent. For example, waste that is contaminated with biohazardous, radioactive and chemical substances is considered mixed waste.

NIH - National Institutes of Health.

Occupational Exposure - Reasonably anticipated skin, eye, mucous membrane or parenteral contact with blood or Other Potentially Infectious Material (OPIM) that may result from the performance of an employee's duties.

OSHA - Occupational Safety and Health Administrations.

Parenteral - Piercing mucous membrane or the skin barrier through events such as needlesticks, human bites, cuts and abrasions.

Pathogen - Any biohazardous agent that is capable of producing disease in healthy people, plants or animals.

Personal Protective Equipment (PPE) - Specialized clothing or equipment worn by an employee for protection against a hazard. General work clothes (e.g., uniforms, pants, shirts or blouses) not intended to function as protection against a hazard is not considered to be personal protective equipment.

Personal Protection - Techniques or devices designed to eliminate or significantly reduce employee risk.

Physical Barrier - Any equipment, facilities or devices designed to achieve containment or exclusion.

Plenum - An enclosure for flowing gases in a biosafety cabinet in which the static pressure at all points is relatively uniform.

Recombinant DNA (rDNA) - Either (1) molecules constructed outside living cells by joining natural or synthetic DNA segments to DNA molecules that can replicate in a living cell or (2) DNA molecules that result from the replication of those described above.

Sharps - Instruments, tools or items that have rigid, acute edges, protuberances or corners capable of cutting, piercing, ripping or puncturing such as syringes, blades and broken glass. Items that have the potential for shattering or breaking are also considered sharps.

Standard Precautions - Infection control Guidelines promulgated by the Centers for Disease Control and Prevention to mitigate the threat of employee exposure to human blood and/or certain body fluids.

Sterilize - The use of a physical or chemical procedure to destroy all microbial life including highly resistant bacterial endospores.

I. POLICIES AND RESPONSIBILITIES

A. Campus Policy

1. Biological agents shall be used in a manner that will not intentionally affect the health, safety and well-being of faculty, staff, students, visitors, neighboring human populations, wild and domestic animals, plants, or the environment in an adverse manner.

2. The U.S. Public Health Service publication Biosafety in Microbiological and Biomedical Laboratories, 4th edition has been adopted as the campus standard for the use of biological agents.

3. The U.S. Public Health Service publication, Primary Containment for Biohazards, Selection and Use of Biological Safety Cabinets, 2nd edition, has been adopted as the campus standard for the acquisition, installation and use of biological safety cabinets.

4. Activities involving the use of identified agents classified Biosafety Level 2 or 3 must be approved by the Biological Safety Committee (BSC). No research involving Biosafety Level 4 is permitted at Humboldt State University. A Biological Use Authorization (BUA) is required for identified Biosafety Level 2 or 3 agents. Application forms are available from Environmental Health & Safety (EH&S) and/or the College of Natural Resources and Sciences Hazardous Materials Technician.

5. Newly isolated or recognized infectious agents of unknown pathogenicity shall be treated as Biosafety Level 2. If the principal investigator believes that increased safety is warranted, biosafety level three practices shall be instituted until such time, if any, that BSL 2 practices are deemed adequate. Infectious agents that demonstrate evidence of oncogenicity shall be treated as prescribed by the guidelines of the National Cancer Institute:
    a. Low-risk, oncogenic viruses will be treated as BSL 2.
    b. Moderate-risk, oncogenic viruses will be treated as BSL 3.
    c. High-risk, oncogenic viruses will be treated as BSL 4. (Currently BSL-4 work is prohibited on the HSU campus.)

6. Select agents and toxins require special registration. The Public Health Security and Bioterrorism Preparedness and Response Act of 2002 (the Act) required institutions to notify the US Department of Health and Human Services (DHHS) or the US Department of Agriculture (USDA) of the possession of specific pathogens or toxins (i.e., select agents), as defined by DHHS, or certain animal and plant pathogens or toxins (i.e., high-consequence pathogens), as defined by USDA. The Act provides for expanded regulatory oversight of these agents and a process for limiting

access to them to persons who have a legitimate need to handle or use such agents. In addition, the Uniting and Strengthening America by Providing Appropriate Tools Required To Intercept and Obstruct Terrorism (USA PATRIOT) Act of 2001 prohibits restricted persons from shipping, possessing, or receiving select agents. Violation of either of these statutes carries criminal penalties. Contact EH&S for registration information.

7. All research involving recombinant DNA shall be treated as prescribed by the April 2002 edition of NIH's Guidelines for Research Involving Recombinant DNA Molecules (copies are available from NIH at: http://www4.od.nih.gov/oba/rac/guidelines/guidelines.html) and as prescribed by law.
   a. Projects involving recombinant DNA molecules that are listed as "Exempt" by the NIH Guidelines do not require registration.
   b. Projects that are not exempt must be submitted to the Bisosafety Officer for review and subsequent submission to the Biosafety Committee for approval.

8. Activities involving the release of plants or organisms into the environment require a completed USDA permit application. Before submitting the application to USDA, the BSC must review and approve it.

9. The Campus Biosafety Manual shall be the basis for general safety guidelines in the laboratory. Laboratory personnel will be expected to follow practices outlined in this manual as well as the prudent practices specific to the project(s) in which they are involved.

B. Responsibilities

1. Laboratory faculty, staff and students who work in the laboratory are responsible for the following:
   a. Being familiar with all protocols and organisms used in the laboratory.
   b. Knowing all relevant emergency procedures established by the Principal Investigator (PI). Emergency procedures are included as addenda to the Chemical Hygiene Plan located in each laboratory.
   c. Completing training and verifying documentation of appropriate training.
   d. Following all appropriate laboratory practices as outlined in this manual and all additional practices outlined in the laboratory safety protocol. Laboratory safety protocols are included as addenda to the Chemical Hygiene Plan located in each laboratory.

2. The Principal Investigator of a research project or laboratory manager of a teaching laboratory is responsible for the following:
   a. Developing specific protocols to ensure the safe use of infectious agents.
   b. Developing specific protocols that outline proper emergency procedures in

the case of an accidental exposure of personnel or the environment to the biological agents.

c. Completing and submitting a Biological Use Authorization request and specific safety protocol information to EH&S for all work involving biosafety level 3 organisms and/or agents.
d. Obtaining approval from other committees or administrators relevant to the project. For example, obtaining approval from the campus veterinarian if the project involves animals.
e. Obtaining the required approvals from the department chairperson.
f. Complying with the protocols, this manual, campus policy and any applicable federal and state laws and regulations.
g. Training all personnel involved in the project so that they have a complete understanding of the hazards involved, safety procedures required and the emergency protocols in place. This includes animal care personnel not directly supervised by the PI, who provide care for infected animals. Documentation of training must be kept on file.
h. Complying with the Medical Waste Management Act by maintaining a designated medical waste autoclave or an approved medical waste accumulation area as well as handling medical waste in compliance with the Campus Medical Waste Management Plan. (For a copy of this plan, contact EH&S).
i. Notifying EH&S of any changes in personnel, procedures or protocols.
j. Monitoring the access of laboratory visitors and assuring their safety.

3. The department chair or director is responsible for the following:
   a. Assuring the health and safety of employees, visitors, and students in HSU facilities under departmental control.
   b. Approving biological agent research and safety protocols prior to the start of work on the project within the department.
   c. Signing copies of safety protocols certifying your approval prior to submittal to EH&S.
   d. Ensuring departmental compliance with applicable laws, regulations and guidelines covering the use of biological agents in research.

4. Office of Environmental Health & Safety is responsible for the following:
   a. Providing consultation in the development of safety protocols as requested by the PI or department chair.
   b. Advising generators on proper waste treatment and disposal methods in accordance with federal, state and campus standards.
   c. Reviewing all applications for the use of biological agents.
   d. Assuring department and user compliance with EH&S recommendations.
   e. Scheduling and performing annual inspections of facilities.
   f. Monitoring completion of projects through annual updates of protocols.
   g. Keeping records and copies of applicable laws and regulations.
   h. Providing training materials and classes upon request.

5. The Student Health Center's Chief of Medical Staff shall review all safety protocols and advise the PI and EH&S regarding the necessity of medical surveillance and/or immunizations of personnel exposed, or potentially exposed, to biological agents.

6. The campus veterinarian advises investigators and managers of animal facilities as to the recommended procedures for containment of biohazards in experimental animals.

II. GENERAL INFORMATION

A. Requirements for Approval of Projects Using Biohazardous Agents

The following are the application requirements for biohazardous agents according to the biosafety level required for its use at HSU. Biological agents classified according to risk are listed in Appendix A. If the agent is not listed, contact EH&S. A letter of Biological Agent Use Authorization (BUA) is required for anyone possessing and or using biosafety level 3 organisms/agents.

1. Biosafety Level 1 is suitable for work involving well-characterized agents not known to consistently cause disease in healthy adult humans, and of minimal potential hazard to laboratory personnel and the environment. The laboratory is not necessarily separated from the general traffic patterns in the building. Work is generally conducted on open bench tops using standard microbiological practices. Special containment equipment or facility design is neither required nor generally used. Laboratory personnel have specific training in the procedures conducted in the laboratory and are supervised by a scientist with general training in microbiology or a related science. Approval of BSL 1 work is not required.

2. Biosafety Level 2 is similar to Biosafety Level 1 and is suitable for work involving agents of moderate potential hazard to personnel and the environment. It differs from BSL-1 in that (1) laboratory personnel have specific training in handling pathogenic agents and are directed by competent scientists; (2) access to the laboratory is limited when work is being conducted; (3) extreme precautions are taken with contaminated sharp items; and (4) certain procedures in which infectious aerosols or splashes may be created are conducted in biological safety cabinets or other physical containment equipment. Approval of BSL 2 work is not required.

3. Biosafety Level 3 is applicable to clinical, diagnostic, teaching, research, or production facilities in which work is done with indigenous or exotic agents which may cause serious or potentially lethal disease as a result of exposure by the inhalation route. Laboratory personnel have specific training in handling pathogenic and potentially lethal agents, and are supervised by competent scientists who are experienced in working with these agents.

   All projects involving biohazardous agents classified as BSL 3 must be reviewed and approved by EH&S and must follow the general guidelines specified for that level in the BMBL 4th ed.

4. Select agents require special registration with the Centers for Disease Control and Prevention (CDC) (see Appendix B). Contact EH&S for further information and registration forms

5. Projects involving BSL 4 organisms are prohibited at HSU.

B. Requirements for Approval of Recombinant DNA Projects

Classification and containment requirements for use of recombinant DNA molecules can be found in the latest edition of NIH's Guidelines for Research Involving Recombinant DNA Molecules. Copies can be obtained from CDC/NIH at http://www4.od.nih.gov/oba/rac/guidelines/guidelines.html.

1. Biosafety Level 1&2 and NIH-exempt projects - Projects involving recombinant DNA molecules that are classified NIH-exempt or Biosafety Level 1, do not require EH&S approval. BSL 3 - All projects involving recombinant DNA molecules classified as Biosafety Level 3 must be reviewed and approved by the EH&S and must follow the general guidelines outlined in NIH's most recent Guidelines for Research Involving Recombinant DNA Molecules.
2. Biosafety Level 4 - Projects involving BSL-4 organisms are prohibited at HSU.

C. Inspections

Laboratory inspections will be performed periodically by EH&S when BSL 3 work is being done. These inspections are designed to verify that all laws and regulations outlined in this manual and by state and federal organizations are followed. This includes the use of adequate facilities and proper maintenance of these facilities. Additionally, interviews of laboratory personnel may be conducted to ensure that they are aware of proper safety and emergency protocols and that they are informed about the properties of the organisms with which they are working. Training records, waste disposal records and other documentation will be reviewed at this time

D. Annual Updates

After approval, written authorizations for BSL 3 work are good for three years. However, PIs are required to submit an annual update in the form of a verification letter. Verification letters will be sent to EH&S. The annual update will allow the PI to discontinue the protocol, verify that it is is still active or to submit amendments. Significant changes must be approved by EH&S. The annual update will allow PI's to make minor changes to projects or add or delete personnel from their protocols. The update may also be necessary or helpful for approval of new or ongoing grants.

E. Training

1. Training is required for all employees, including students and volunteers, working in labs or animal rooms where biological agents are used. The PI, laboratory director or animal facility director (whoever has supervisory authority over personnel) is responsible for ensuring that adequate instruction

is provided to all personnel who will have contact, or will be involved with, biological agents. This includes training for specific tasks that employees will perform. All training must be documented and the signed documents must be kept in the lab or with departmental records. Documentation shall include:
   a. A description of the training
   b. Date and time of the training
   c. Name and title of the trainer
   d. Signatures of the trainer and trainee

2. Personnel shall not begin working with BSL 3 agents before the authorization has been granted by EH&S. Documentation of their training must be submitted to EH&S. Personnel must always receive training when new agents, procedures, processes and equipment are introduced. They will be prohibited from performing new duties until they are properly trained. Records of this training must also be kept on file with the PI on department office and be available for review.

F. Medical Surveillance

1. Immunizations - Using certain biohazardous agents may require immunizations for personnel. The Student Health Center, Medical Chief of Staff may recommend immunization for personnel exposed, or potentially exposed, to certain biohazardous agents as a result of their participation in a project.

2. Medical Examinations - The Student Health Center, Medical Chief of Staff in consultation with the PI and the department chair may require medical examinations including collection of blood specimens for future analysis of personnel exposed, or potentially exposed, to certain biological agents. When appropriate, baseline serum samples from animal care and other at-risk personnel are collected and stored. Additional serum samples may be collected periodically depending on the agents handled or the function of the facility.

3. Cost for Medical Surveillance - The costs for medical surveillance will be borne by the appropriate departmental, research or instructional budget. Medical surveillance costs for employees and students should be planned before conducting the research project.

G. Health Service of Individuals Having Animal Contact

1. Definition - The phrase "individuals having animal contact" refers to employees and students who, in the course of their employment, research or education, have substantial contact with research animals used for biohazardous agent studies (e.g., animal caretakers, animal technicians,

veterinarians) and where such contact may pose a threat to humans or animals.

2. Responsibility - It is the responsibility of the immediate supervisor to establish whether the animal contact is substantial or poses a possible health threat, based on guidelines in the BMBL 4th ed.

3. Notification - The supervisors of individuals having animal contact will notify the campus veterinarian and submit a letter explaining the how and to what extent animal contact will occur. The campus veterinarian will review and forward the letter to EH&S.

H. Laws, Regulations and Guidelines

1. Bloodborne Pathogens Regulation - The presence of bloodborne pathogens in the workplace is regulated by Title 8 of the California Code of Regulations (CCR) Section 5193, Bloodborne Pathogens.
   - Working with biohazardous agents may include working with human blood or OPIM. If you are doing such work, the Bloodborne Pathogen (BBP) regulation may apply to your project. The BBP regulations and Biological Agent Use Authorizations are different programs, but requirements and information may overlap and can be utilized in both programs.
   - Cal-OSHA developed its BBP regulations (CCR, Title 8, Section 5193) in response to the federal government's published rule (29 CFR Part 1910.1030) governing occupational exposure to bloodborne pathogens. This standard provides guidelines to eliminate or minimize employee exposure to human bloodborne pathogens. The targeted pathogens specifically include, but are not limited to, the Human Immunodeficiency Virus (HIV), hepatitis B virus (HBV) and hepatitis C virus (HCV).
   - The state standard requires the employer to have a written Exposure Control Plan (ECP) which identifies potential worker exposures and outlines measures to eliminate or minimize exposures, including training, Personal Protective Equipment (PPE), a hepatitis B vaccination program and engineering and work practice controls. A schedule and method of implementation must be included in the plan.
   - The standard applies to all campus employees in those job classifications that have potential for occupational exposure. The job classes affected include, but are not limited to, faculty, researchers, teaching assistants, laboratory technicians, medical personnel, first-aid providers, university police, custodial staff, health and safety representatives and others with potential occupational exposure.
   - Contact EH&S for information on the campus Exposure Control Plan for compliance with the Cal-OSHA Bloodborne Pathogen Standard (CCR Title 8, Section 5193). Copies of the Campus Exposure Control Plan are available from EH&S.

2. Medical Waste Management Act - The state Medical Waste Management Act (MWMA), California Health & Safety Code Division 20, Chapter 6.1 regulates the handling, storage, treatment and disposal of medical waste. Most activities involving biohazardous agents will involve medical waste generation. Generators must register their facility as a medical waste generator with EH&S. The state Department of Health Services (DHS) must permit medical waste treatment facilities, including autoclaves.

3. The Medical Waste Management Plan is on file in the EH&S office.

4. Biological Safety Cabinets - The certification, use and maintenance of Class II biological safety cabinets is described in the NSF International Standard 49 (NSF Standard 49). The use and maintenance of biological safety cabinets is regulated by Cal-OSHA in Title 8, CCR, Section 5154.2, Ventilation Requirements for Biosafety Cabinets.

5. Biosafety Practices - This biosafety manual is primarily based on the CDC/NIH guideline entitled Biosafety in Microbiological and Biomedical Laboratories.

6. Biosafety Training - Biosafety training is mandated by Title 8, CCR, Section 3203, Injury and Illness Prevention Program (IIPP) and Title 8, CCR, Section 5193, Bloodborne Pathogens.

7. Recombinant DNA - Use of recombinant DNA molecules is governed by NIH's Guidelines for Research Involving Recombinant DNA Molecules.

III. PRINCIPLES OF BIOSAFETY

A. Containment

The term containment is used in describing safe methods for managing infectious agents in the laboratory environment where they are being handled or maintained. The purpose of containment is to reduce or eliminate exposure of laboratory workers, other people and the outside environment to potentially hazardous agents. The three elements of containment include laboratory safety practices and techniques, safety equipment and facility design.

Containment includes primary containment, the protection of personnel and the laboratory environment from exposure to biohazardous agents, and secondary containment, the protection of the environment outside of the laboratory from exposure to biohazardous agents. Primary containment is possible through good microbiological techniques and the proper use of appropriate safety equipment. Secondary containment is provided by a combination of facility design and operational practices.

1. Laboratory Safety Practices and Techniques

    - The most important element of containment is strict adherence to standard microbiological safety practices and techniques. Persons working with infectious agents or infected materials must be aware of potential hazards and must be trained and proficient in the practices and techniques required for handling such material safely. The PI or laboratory supervisor is responsible for providing or arranging for appropriate training of personnel.
    - Each laboratory should develop Standard Operating Procedures (SOP) that identify specific hazards that will or may be encountered as well as specific practices and procedures designed to minimize or eliminate risks. Personnel should be advised of special hazards and should be required to read and to follow the required practices and procedures. A scientist trained and knowledgeable in appropriate laboratory techniques, safety procedures and hazards associated with the handling of infectious agents must direct laboratory activities.
    - When standard laboratory practices are not sufficient to control the hazard associated with a particular agent or laboratory procedure, additional measures may be needed. The PI is responsible for selecting additional safety practices, which must be in keeping with the hazard associated with the biological agent or procedure.
    - Laboratory personnel safety practices and techniques must be supplemented by appropriate facility design and engineering features, safety equipment and management practices.

2. Safety Equipment (Primary Barriers)

    - Safety equipment includes biological safety cabinets, enclosed containers and other engineering controls designed to remove or minimize exposures to hazardous biological materials. The Biological Safety Cabinet (BSC) is the principal engineering control used to provide containment of infectious splashes or aerosols generated by many microbiological procedures.
    - Safety equipment also may include items for personal protection such as personal protective clothing, respirators, face shields, safety glasses or goggles. Personal Protective Equipment (PPE) is often used in combination with other safety equipment when working with biohazardous agents. In some situations, personal protective clothing may form the primary barrier between personnel and the biohazardous agents.

3. Facility Design (Secondary Barriers).

    - The design of a facility is important in providing a barrier to protect people working inside and outside the laboratory and to protect people or animals in the community from infectious agents that may be accidentally released

in the laboratory. Facilities must be commensurate with the laboratory's function and the recommended biosafety level for the agent being manipulated.

- The recommended secondary barrier(s) will depend on the risk of transmission of specific agents. For example, the exposure risks for most laboratory work in Biosafety Level 2 and 3 facilities will be direct contact with the agents or inadvertent contact exposures through contaminated work environments. Secondary barriers in these laboratories may include separation of the laboratory work area from public access, availability of a decontamination facility (e.g., autoclave) and handwashing facilities.
- As the risk for aerosol transmission increases, higher levels of primary containment and multiple secondary barriers may become necessary to prevent infectious agents from escaping into the environment. Such design features could include specialized ventilation systems to assure directional airflow, air treatment systems to decontaminate or remove agents from exhaust air, controlled access zones, airlocks at laboratory entrances, or separate buildings or modules for isolation of the laboratory.

B. Biosafety Levels

There are four biosafety levels that consist of combinations of laboratory safety practices and techniques, safety equipment and laboratory facilities. Each combination is specifically appropriate for the operations performed, for the documented or suspected routes of transmission of the infectious agents, and for the laboratory function or activity. The recommended biosafety level for an organism represents the conditions under which the agent can be ordinarily handled safely.

1. Biosafety Level 1

Biosafety Level 1 is appropriate for work done with defined and characterized strains of viable microorganisms not known to cause disease in healthy adult humans. It represents a basic level of containment that relies on standard microbiological practices with no special primary or secondary barriers recommended, other than a sink for handwashing.

2. Biosafety Level 2

Biosafety Level 2 is applicable to work done with a broad spectrum of indigenous, moderate-risk agents present in the community and associated with human disease of varying severity. Agents can be used safely on the open bench, provided the potential for producing splashes or aerosols is low. Primary hazards to personnel working with these agents relate to accidental percutaneous or mucous membrane exposures or ingestion of infectious materials. Procedures with high aerosol or splash potential must be conducted in primary containment equipment such as biosafety cabinets. Primary barriers such as splash shields, face protection, gowns and gloves should be used as appropriate. Secondary barriers such as handwashing and waste decontamination facilities must be available.

3. Biosafety Level 3

Biosafety Level 3 is applicable to work done with indigenous or exotic agents with a potential for respiratory transmission and which may cause serious and potentially lethal infection. Primary hazards to personnel working with these agents (i.e., Mycobacterium tuberculosis, St. Louis encephalitis virus and Coxiella burnetii) include autoinoculation, ingestion and exposure to infectious aerosols. Greater emphasis is placed on primary and secondary barriers to protect personnel in adjoining areas, the community and the environment from exposure to infectious aerosols. For example, all laboratory manipulations should be performed in a biological safety cabinet or other enclosed equipment. Secondary barriers include controlled access to the laboratory and a specialized ventilation system (e.g., HEPA filters, incinerators, etc.) that minimizes the release of infectious aerosols from the laboratory.

4. Biosafety Level 4

Biosafety Level 4 is applicable for work with dangerous and exotic agents that pose a high individual risk of life-threatening disease that may be transmitted via the aerosol route and for which there is no available vaccine or therapy. All manipulations of potentially infected materials and isolates pose a high risk of exposure and infection to personnel, the community and the environment. The facility is a specially designed building with specialized ventilation and waste management systems to prevent release of viable agents to the environment. A Biosafety Level 4 laboratory or facility is prohibited at HSU.

C. Vertebrate Animal Biosafety Levels

There are four animal biosafety levels, designated Animal Biosafety Level 1 through 4, for work with infectious agents in animals. The levels are combinations of practices, safety equipment and facilities for experiments on animals infected with agents that produce or may produce human infection. In general, the biosafety level recommended for working with an infectious agent in vivo and in vitro is comparable.

D. Biosafety Level and Animal Biosafety Level Criteria

1. For a copy of each laboratory and/or animal biosafety level, contact EH&S.
2. For a summary of recommended biosafety levels for infectious agents, see Table 1.
3. For a summary of recommended biosafety levels in which vertebrate animals are used, see Table 2

TABLE 1 - Summary of Recommended Biosafety Levels for Infectious Agents

Bio-Safety Level	Agents	Practices	Safety Equipment (Primary Barriers)	Facilities (Secondary Barriers)
1	Not known to cause disease in healthy adults.	Standard Microbiological Practices	None Required	Open bench-top sink required.
2	Associated with human disease, hazard = autoinoculation, 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 as well as PPE such as laboratory coats, gloves, face protection as needed.	BSL-1 plus ensure that an autoclave is 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 clothes before laundering -Baseline serum	Primary barriers = Class I or II BSCs or other physical containment devices used for all manipulations of agents as well as PPE such as protective lab clothing, gloves and respiratory protection, as needed.	BSL-2 plus: -Physical separation from access corridors -Self-closing, double door access -Exhaust air not recirculated -Negative airflow into laboratory.

This table was taken from the 4th Edition of the "Biosafety in Microbiological and Biomedical Laboratories" Handbook.

TABLE 2 - Summary of Recommended Biosafety Levels in Which Vertebrate Animals Are Used

Bio-Safety Level	Agents	Practices	Safety Equipment (Primary Barriers)	Facilities (Secondary Barriers)
1	Not known to cause disease in healthy adults.	Standard animal care and management practices, including appropriate medical surveillance programs.	As required for normal care of each species.	Standard animal facility -nonrecirculation of exhaust air -directional air flow recommended
2	Associated with human disease. Hazard: percutaneous exposure, ingestion, mucous membrane exposure.	ABSL-1 practices plus: -Limited access -Biohazard warning signs -Sharps precautions -Biosafety manual -Decontamination of all infectious wastes and animal cages prior to washing.	ABSL-1 equipment plus: -Primary barriers -Containment equipment appropriate for animal species -PPE such as laboratory coats, gloves, and face and respiratory protection as needed.	ABSL-1 facility plus: -Autoclave available -Handwashing sink available in the animal room
3	Indigenous or exotic agents with potential for aerosol transmission; disease may have serious health effects.	ABSL-2 practices plus: -Controlled access -Decontamination of clothing before laundering -Cages decontaminated before bedding removed -Disinfectant foot bath as needed	ABSL-2 equipment plus: -Containment equipment for housing animals and cage dumping activities -Class I or II BSCs available for manipulative procedures (inoculation, necropsy) that may create infectious aerosols -Respiratory protection	ABSL-2, facility plus: -Physical separation from access corridors -Self-closing, double door access -Sealed penetrations -Sealed windows -Autoclave available in facility

This table was taken from the 4th Edition of the "Biosafety in Microbiological and Biomedical Laboratories" Handbook.

IV. BIOLOGICAL SAFETY GUIDELINES

A. Biosafety Cabinets

Biosafety cabinets (BSCs) are used to provide primary containment in the laboratory when using potentially infectious materials and can be used for manipulation of sterile cultures.

BSCs must be used in Biosafety Level 2 or 3 projects if aerosol-generating procedures are conducted, a high concentration of infectious agents are used or if large volumes of infectious agents are used. There are three types of BSCs as defined by CDC/NIH's Biosafety in Microbiological and Biomedical Laboratories. EH&S should be consulted for selection, purchase, installation and use of BSCs on campus.

1. Testing and Certification of BSCs

BSCs must be tested and certified annually or after installation, alterations or maintenance. Testing and certification of BSCs will be performed by an outside contractor. (Contact EH&S for more information.) Records of tests performed on BSCs must be retained by the PI for a minimum of five years. Tests are conducted in accordance with the most recent edition NSF International's Standard No. 49, Class II (Laminar Flow) Biohazard Cabinetry.

2. Types of Biological Safety Cabinets

- Class I BSC - The Class I BSC provides personnel and environmental protection but no product protection. It is similar in function to a chemical fume hood but has a HEPA filter in the exhaust system to protect the environment. The Class I BSC is not commonly used on campus.
- Class II BSC (Types A, B1, B2 and B3) - Class II cabinets are designed for work involving microorganisms assigned to Biosafety Levels 1, 2 and 3. These cabinets provide the microbe-free work environment necessary for cell culture propagation and may be used for nonvolatile chemotherapeutic drug preparation.
- Class III BSC - The Class III biological safety cabinet is designed for work with biosafety level IV microbiological agents and provides maximum protection to the operator and the environment.
- Horizontal and Vertical Laminar Flow "Clean Bench" - Horizontal and vertical laminar-flow clean-air benches are not BSCs. They discharge HEPA-filtered air across the work surface and toward the user. These devices provide only product protection.

3. Procedures for Use of BSCs

- Start-up Procedure
  - i. Turn off ultraviolet sterilizer if so equipped.
  - ii. Turn on all blowers and cabinet illumination lights.

iii. Allow five minutes of operation to purge system and check flow alarm system audio and visual alarm function if so equipped.
iv. Decontaminate readily accessible interior surfaces with a disinfectant appropriate for the agents or suspected agents present.

- Working in the BSC
  i. Check the magnehelic gauge regularly for an indication of a problem.
  ii. Do not disrupt the protective airflow pattern of the BSC. Such things as rapidly moving your arms in and out of the cabinet, people walking rapidly behind you and open lab doors may disrupt the airflow pattern and reduce the effectiveness of the BSC.
  iii. Plan your work prior to starting.
  iv. Minimize the storage of materials in and around the BSC.
  v. Always leave the BSC running.
- Operational Directions
  i. Before using, wipe work surface with 70 percent alcohol. Wipe off each item you need for your procedures and place them in cabinet.
  ii. Do not place objects over the front air intake grille. Do not block the rear exhaust grille.
  iii. Segregate contaminated and clean items. Work from "clean to dirty."
  iv. Place a pan with disinfectant and/or a sharps container inside the BSC for pipette discard. Do not use vertical pipette discard canisters on the floor outside cabinet.
  v. It is not necessary to flame items. This creates turbulence in airflow and will compromise sterility; heat buildup may damage the filters.
  vi. Move arms slowly when removing or introducing new items into the BSC.
  vii. If you use a piece of equipment that creates air turbulence in the BSC (such as a centrifuge or blender), place equipment in the back one-third of the cabinet; stop other work while equipment is operating.
  viii. Protect the building vacuum system from biohazards by placing a cartridge filter between the vacuum trap and the source valve in the cabinet.
  ix. Clean up all spills in the cabinet immediately. Wait 10 minutes before resuming work.
  x. When work is finished, remove all materials and wipe all interior surfaces with 70 percent alcohol or other appropriate disinfectants.
  xi. Remove lab coats and wash hands thoroughly before leaving the laboratory.
- Shutdown Procedures
  i. Decontaminate and remove all items from the interior work area.
  ii. Decontaminate readily accessible interior surfaces with a disinfectant appropriate for the agents or suspected agents present.

iii. Turn on the ultraviolet sterilizer if so equipped.
iv. Allow five minutes of operation to purge the system.
v. Turn off the cabinet blower.

B. Waste Management

1. Medical/Biohazardous Waste

All waste defined as medical waste by the Medical Waste Management Act (California Health and Safety Code §117600 et seq.) must be properly treated before disposal or before being collected, treated and disposed of by an approved medical waste company. Most medical waste generated on campus is removed by a permited medical waste hauler (Med Tec)

2. Medical waste is defined as biohazardous waste and sharps waste.

- Biohazardous wastes include:
  i. All liquid and solid waste generated while collecting, producing, processing, testing, immunizing, treating and/or storing specimens from humans or animals (vertebrate, invertebrate, wild or laboratory) that are known or reasonably suspected of containing agents infectious to humans. Biohazardous wastes also include cultures of infectious agents (i.e., bacteria, fungi, rickettsia, helminths, insects, prions, protozoa and viruses) classified as Biosafety Level 3 or greater with evidence of human pathogenicity (Biosafety in Microbiological and Biomedical Laboratories, U.S. Public Health Service - CDC/NIH).
  ii. All human anatomical remains (except teeth) and any fluid human blood and blood products.
  iii. Excluded from the MWMA are items such as microbiological cultures used in food processing and biotechnology, except for genetically altered organisms or recombinant DNA molecules that are medical waste by definition or that are infectious to humans.
- Sharps waste includes any device having acute rigid corners, edges or protuberances capable of cutting or piercing, including:
  i. Hypodermic needles, hypodermic needles with syringes, blades, needles with attached tubing, syringes contaminated with biohazardous waste, acupuncture needles and root canal files.
  ii. Broken glass items, such as Pasteur pipettes and blood vials contaminated with biohazardous waste.

3. The main provisions of the MWMA for the HSU campus include the following:

- Generators must notify EH&S that their facility is a medical waste

generator.

- Medical waste must be contained separately from other waste in the lab. Medical sharps waste must be contained in approved medical waste sharps container.
- Medical waste must be placed in approved RED biohazard bags labeled with the words "Biohazardous Waste" or with the biohazard symbol and the word "Biohazard." Nonbiohazardous waste should not be placed in labeled red biohazard bags.
- Medical waste and sharps waste can not be stored for more than seven days at room temperature. (Extended storage is allowed under certain conditions. Contact EH&S for details.)
- Medical waste bags must be stored, handled and transported in properly labeled, leakproof secondary containers with tight-fitting covers.
- Bagged medical waste that has been treated according to MWMA requirements is considered solid waste and may be disposed of at the municipal landfill through the routine campus refuse collection and disposal system. Medical waste sharps containers must be collected by EH&S for transport by a licensed medical waste hauler.
- Medical waste animal carcasses, which meet the definition of biohazardous waste, must be collected by the licensed medical waste hauler. Arrangements may be made by contacting EH&S.
- Autoclaves and incinerators used to treat medical waste must be included in the medical waste management plan and must be permitted. This is coordinated on campus through EH&S.
- Non-medical waste animal carcasses must be disposed of through an approved disposal company.

4. Autoclaving Medical Waste

- Each autoclave must be operated in accordance with the medical waste management plan. A Standard Operating Procedure (SOP) should be posted at the autoclave.
- Medical/biohazardous waste must be autoclaved at 121 degrees Centigrade (250 degrees Fahrenheit) for a minimum of 30 minutes dependent on the load structure and materials.
- Red autoclave bags and sharps containers must be placed in an autoclavable container and loaded into the autoclave. Autoclaves must not be loaded beyond approved capacity.
- Autoclave tape or other indicators must be placed on each bag or sharps container prior to treatment. The autoclave tape or other indicator on each container must be checked to verify color change before disposal.
- The autoclave log must be completed by each user for each autoclave cycle. All parameters must be noted as listed on the log for each autoclave load.
- If the autoclave does not attain the minimum time and/or temperature or

the autoclave tape does not change color, a notation must be made in the comment section of the autoclave log. The load must then be re-autoclaved after placing new tape on the red bags or sharps containers. If minimum time and temperature is not attained on the second cycle, users must contact the person responsible for maintaining the unit to initiate repairs. Waste should then be treated at an alternate autoclave facility.

- After autoclave bags have sufficiently cooled to handle, dispose of them in a solid-waste container. All sharps containers must be collected for disposal. Call EH&S for pickup of the containers.
- Thermometers on the autoclave must be calibrated annually, and a written record must be maintained. This should be done by an authorized autoclave service company during routine servicing.
- Monthly *Bacillus stearothermophilus* tests must be performed in conjunction with a biological control as described in the department's medical waste management plan. Written results of tests and controls must be maintained for each autoclave.
- All records including logs, calibration results and *Bacillus stearothermophilus* tests must be kept for a minimum of three years. Logs and records storage locations must be designated in the medical waste management plan and be available upon request during inspections.
- After autoclaving, bags of medical waste can be disposed of in regular, solid-waste containers. Autoclaved liquids can be discharged to the campus sewage system.
- Sharps waste handling and disposal is as follows:
  i. Sharps must not be placed directly in red bags. Sharps must be placed into rigid, puncture- and leak-resistant sharps containers that can not be opened without great difficulty. Needles and syringes should be placed directly in these containers after use without modification. Needles should not be clipped, bent, recapped or removed from disposable syringes before disposal. In addition, do not fill above the level indicated on the container.
  ii. Sharps containers may be autoclaved as medical waste.
  iii. Sharps containers must be collected by EH&S. Sharps containers must not be placed in regular solid waste containers.

C. Emergency Procedures

1. Accidents

All biohazard laboratories must establish written emergency procedures based on the biohazardous agents used as well as other hazards that may be present. Emergency procedures must take into consideration the use of radioactive materials and chemicals. The following items should be noted for the type of biohazardous agent used in the laboratory:

- First, attend to any injured personnel. Call 911 for emergency assistance, and inform departmental responders of biohazards that may be a threat. (UPD will notify EH&S.)
- For spills in BL-2 laboratories, evacuate the room close the doors.
- For spills in BL-3 laboratories, ensure that the room is evacuated and doors are closed. Wait 30 minutes before re-entering to allow droplets and aerosols to settle.
- After evacuating the area, wait to assist emergency responders.

2. Exposures

- Report exposures verbally to the UPD responders on site and in writing to the BSC. Suspected exposures should also be reported.
- Report the exposure to the EH&S biosafety officer at 826-5711 for a review of laboratory protocols and procedures.

3. Biohazard Spill

The following procedures are provided as a guideline to biohazardous spill cleanup. Appropriate lab coats, gloves and other PPE should be worn in the laboratory at all times.

- Inside the Biosafety Cabinet (BSC)
  - i. Apply appropriate disinfectant and allow a minimum of 20 minutes contact time while allowing the cabinet to run.
  - ii. Wipe up spillage with disposable, disinfectant-soaked paper towels.
  - iii. Wipe the walls, work surface and any equipment in the cabinet with a disinfectant-soaked paper towels.
  - iv. Discard contaminated disposable materials in appropriate biohazardous waste container(s) and autoclave before discarding as biohazardous waste.
  - v. Place contaminated reusable items in separate biohazard bags and autoclavable pans with lids before autoclaving and cleanup.
  - vi. Expose non-autoclavable materials to disinfectant for a minimum of 20 minutes before removing them from the BSC.
  - vii. Remove protective clothing used during cleanup and place in a biohazard bag for autoclaving. viii. Run the cabinet for a minimum of 10 minutes after cleanup before resuming work or turning off the cabinet.
- In the lab and outside the BSC
  - i. If the organisms are transmitted through aerosols, HOLD YOUR BREATH AND LEAVE THE ROOM IMMEDIATELY. Wait a minimum of 30 minutes for droplets and aerosols to settle before re-entering spill area.
  - ii. Remove any contaminated clothing and place in biohazard bag to

be autoclaved.

iii. Wear a disposable gown, safety glasses and gloves.

iv. Initiate cleanup with disinfectant as follows:

- Soak paper towels in disinfectant and place over the spill.
- Encircle the spill with additional disinfectant being careful to minimize aerosolization while assuring adequate contact.
- Decontaminate all items within spill the area.
- Allow a minimum of 20 minutes contact time to ensure germicidal action of disinfectant, and wipe up the spill with more paper towels.
- Clean the spill area with fresh towels and disinfectant
- Place disposable contaminated spill materials in red biohazardous waste bags for autoclaving.
- Place contaminated reusable items in biohazard bags or autoclavable pans with lids before autoclaving and cleanup

- Outside lab, during transport

i. Transport biohazardous material in an unbreakable, well-sealed primary container placed inside of a second unbreakable lidded container labeled with the biohazard symbol The container can be a cooler, plastic pan or pail.

ii. Should a spill occur in a public area, do not attempt to clean it up without appropriate PPE.

iii. As an interim measure, wear gloves and place paper towels, preferable soaked in disinfectant, directly on spilled materials to prevent spread of contamination. To assure adequate contact, surround the spill with disinfectant, if available, taking care to minimize aerosols.

iv. Notify EH&S.

D. Chemical Disinfectants

1. Chemical disinfectants are used to decontaminate surfaces used for biological experiments. Some of the factors influencing selection of a disinfectant are:
   - The nature of the biological agent.
   - The type of surface to be disinfected.
   - The amount of contact time required to inactivate the biological agent when using the selected disinfectant.
   - The volume of disinfectant that will be required to inactivate the biological agent.
   - The toxicity of the chemical disinfectant.
   - Whether the disinfectant will chemically react with the samples to be disinfected.

2. When using a chemical disinfectant, remember that you are using a

potentially toxic chemical that could be a corrosive, flammable solvent and/or a carcinogen. Wear PPE as indicated on the product container and Material Safety Data Sheets (MSDS). If you must prepare a dilution of the disinfectant, do so whenever possible in a chemical fume hood or in a well ventilated area. If you are working with mixed solutions, check the MSDS to insure that any incompatible chemical reaction will not result.

3. Allow sufficient contact time after applying the disinfectant. Do not apply a disinfectant and immediately remove it from the contaminated surface, as the contact time will be too brief to ensure that the surface has been thoroughly disinfected. When cleaning a spill of concentrated material or if the disinfectant must act on an uneven surface, allow extra time for the disinfectant to act.

4. Avoid using concentrated or undiluted solutions of your disinfectant to speed up the inactivation process. Undiluted chemicals may adversely affect the surface being cleaned. This is especially significant when working with bleach, which is a very strong corrosive. Some disinfectants will leave a residue. Rinse the cleaned area with distilled water to avoid adverse effects on the experiment after allowing sufficient contact time. This is especially important in tissue culture rooms where a cell line can be destroyed by disinfectant residue left on equipment.

5. The following are approved disinfectants:

    - Chlorine compounds
    - Ethyl alcohol
    - Quaternary ammonium compounds
    - Phenolics
    - Iodophors
    - Paraformaldehyde
    - Formaldehyde
    - Glutaraldehyde

6. Disinfectants are Pesticides

    - The U.S. Environmental Protection Agency (EPA) and California Environmental Protection Agency define antimicrobials such as disinfectants, sanitizers and bacteriostats as pesticides. Worker safety requirements for pesticides are similar to those for other hazardous materials administered by Cal-OSHA.
    - The lead agencies in California are Cal-OSHA and the Department of Pesticide Regulation (DPR). Local enforcement is under the jurisdiction of the County Agricultural Commissioner (CAC).

- Requirements pertaining to material use, labeling, hazard communication, exposure records, training, respiratory protection, safety equipment, lighting and equipment maintenance must be followed. All requirements on the label must be followed when using the product.

E. Biohazard Labels and Signs

1. Posting of Rooms

The California Code of Regulations, Title 8, Section 5193, the CDC/NIH document Biosafety in Microbiological and Biomedical Laboratories and NIH's Guidelines for Research Involving Recombinant DNA Molecules require that signs indicating that biohazardous agents are used within the room be posted at or on access doors. The sign must include the universal biohazard symbol, specific entry requirements and the name and telephone number of the PI and/or other responsible persons. Areas that require posting are:

- Entrances to laboratories and animal rooms that use biohazards classified as Biosafety Level 2 (BL-2) or Biosafety Level 3 (BL-3); and
- Cages or animal rooms used for housing animals experimentally infected with BL-2 or BL-3 biohazardous agents. Rooms that house infected animals must also have a sign posted that reads "Animal Handler Precautions." Information on how to obtain signs can be obtained from EH&S.

2. Labeling

- Bloodborne pathogen regulations and biological agent use require labels to be placed on equipment such as refrigerators, freezers, incubators, shipping containers, primary and secondary agent containers, and any surface that may be reasonably anticipated to have surface contamination from biohazardous agents. The label must include the universal biohazard symbol and the word "Biohazard."
- All medical waste (including animal carcasses, waste and bedding) except sharps must be placed in red bags that are labeled with the international biohazard symbol and the words "Biohazard" or "Biohazardous Waste."
- The department name, building name and room number also must be attached to the bags
- Medical waste sharps containers must also be labeled as above with the biohazard symbol and wording as well as the location information.
- Secondary containers for medical waste must be labeled on two sides and on the lid with the biohazard symbol and wording.

F. Transporting and Shipping

1. Transportation outside of the laboratory

    - Biohazardous agents must be properly handled, contained and labeled to transport between locations to prevent accidental exposure to unsuspecting persons outside of the laboratory.
    - Biohazardous agents must be placed in securely closed primary containers. The exterior of the primary container should be decontaminated prior to transportation.
    - The primary container should be placed in a covered, leakproof, shatterproof secondary container. The secondary container should be labeled with the biohazard symbol, the biohazardous agents present and the lab of origin. If it is transported by vehicle, the name and telephone number of the PI or other responsible person(s) must be included on the outside of the secondary container.

2. Shipment off Campus (domestic shipment)

    - Three federal regulatory agencies specify requirements for packaging and shipping of biological materials. The United Nations publishes recommendations for packing and shipping biological materials, and both the International Civil Aeronautics Organization and International Air Transport Association (IATA) publish regulations based on the UN's recommendations. The requirements for all these regulations are similar; therefore, most carriers elect to follow the IATA regulations set forth in their Dangerous Goods Regulations (DGR). Information regarding requirements, lists and authorized shipping labels can be obtained from EH&S.
    - When transporting infectious agents, the shipper is responsible for the proper packing of dangerous goods and must pack biological agents as infectious substances (Packing Instruction 602, IATA-DGR) or diagnostic specimens (Packing Instruction 650, IATA-DGR). The following are packing instructions for infectious substances:
        i. Primary Container
            - The specimen will be placed in a securely closed, watertight primary container. Stoppers and screw-capped tubes will be secured with waterproof tape.
            - The contents of the primary container will not exceed 50 ml.
            - The exterior of the primary container will be decontaminated prior to transportation.
            - A biohazard label will be placed on the exterior of the primary container. (See Figure 1)

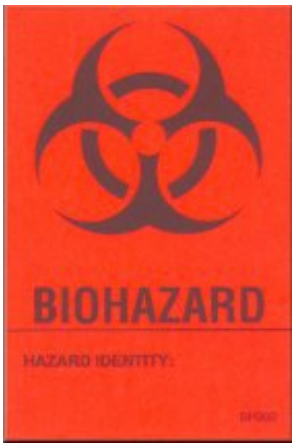

Figure 1. Biohazard Label

ii Secondary Container

- One (or more) primary container(s) may be placed within the secondary container as long as the total volume of the specimen does not exceed 50 ml.
- The absorbent material used within the secondary container must be sufficient to absorb the contents of the primary container(s), if it should leak.
- The secondary container must be free of contamination and labeled with the same symbol as the primary container.

iii. Outer Container

- This container will be made of corrugated fiberboard, cardboard, wood or other material of equivalent strength.
- The interior of the outer container may be filled with coolant material such as ice or dry ice. If ice or dry ice is used, additional shock absorbent material will be added and positioned in a manner that allows protection of the specimen should the ice or dry ice melt or sublimate. The dry ice should be placed outside of the secondary container in the outer container
- The exterior will be labeled with the special sticker depicted in Figure 2.

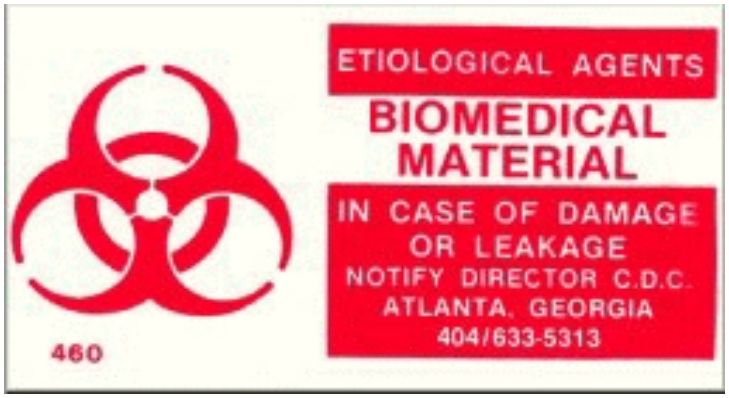

Figure 2. Etiologic Agents

iv. Prior to transport, the outer container should be sealed or secured in a manner so as to make it leak-proof should the container be placed on its side.
v. The package will be decontaminated before shipment.

3. International Shipments

All domestic and international shipments of infectious substances require the use of packaging that has been tested and certified to carry such material.

- The certified packaging will have United Nations performance markings on the outside indicating that it has met performance tests.
- A statement should be included in the additional handling information that states, "Prior arrangements as required by the IATA Dangerous Goods Regulations 1.3.3.1 have been made."
- The shipper should include the name and telephone number of the person responsible for the shipment.
- Diagnostic specimens being shipped for the purpose of initial diagnosis are excluded from the regulations. However, diagnostic specimens known, or thought likely, to contain infectious substances are included.

4. Receipt

- Upon receipt of any packaged specimens, immediately check for leakage or damage.
- If leaking:
  i. Isolate the package either in a Class II biological safety cabinet or in a leak-proof, sealed container. Add disinfectant and dispose of as medical waste.

ii. Call EH&S at 826-5711 if BL-3 agents are involved. Submerge contents in 10 percent bleach.
iii. Keep unauthorized personnel away from the package.

- The package should be opened in the laboratory on an easily cleaned, water-resistant surface.

APPENDIX A - Biosafety Levels for Infectious Agents and Infected Animals

Bacterial Agent	BSL	ABSL	Comments
Actinetobacter calceticus	2	2	
Actinobacillus sp.	2	2	
Actinomyces sp.	2	2	
Aeromaonas sp.	2	2	
Arachnida propionica	2	2	
Bacillus alvei	2	2	
Bacillus anthracis*	2	2/3	BMBL, vaccination recommended
Bacteroides sp.	2	2	
Bartonella sp.	2	3	
Bordetella sp.	2	2	
Bordetella pertussis	2	2/3	BMBL
Borrelia sp.	2	2	
Brucella sp.*	2/3	3	BMBL
Campylobacter fetus var. jejuni	2	2	BMBL
Camplobacter sp.	2	2	
Chlamydia psittaci	2	3	BMBL
Chlamydia pneumoniae	2/3	2	BMBL
Chlamydia trachomatis	3	3	
Clostridium botulinum*	2/3	2	BMBL
Clostridium tetani	2		BMBL
Corynebacterium diphtheriae	2	2	BMBL
Corynebacterium equi	2	2	
Corynebacterium haemolyticum	2	2	

Corynebacterium pseudotuberculosis	2	2	
Corynebacterium pysogenes	2	2	
Corynebacterium renale	2	2	
Enterobacteriaceae all other	2	2	
Erysipelothrix rhusiopathiae	2	2	
Escherichia coli	2	2	
Escherichia coli K12 derivative	1	1	
Francisella tularensis*	2/3	3	BMBL
Fusobacterium sp.	2	2	
Haemophilus sp.	2	2	
Klebsiella sp.	2	2	
Legionella pneumophilia	2/3	2	BMBL
Leptospira interrogans all servars	2	2	BMBL
Listeria sp.	2	2	
Moraxella sp.	2	2	
Mycobacterium avium	2	2	
Mycobacterium bovis	2	3	BMBL
Mycobacterium leprae	2	2	BMBL
Mycobacterium sp.	2	2	BMBL
Mycobacterium tuberculosis	2/3	2/3	BMBL
Mycoplasma sp.	2	2	
Neisseria gonorrhoreae	2/3	2	BMBL
Neisseria menegitidis	2/3	2	BMBL
Nocardia sp.	2	2	
Pasteurella sp.	2	2	
Pseudomonas mallei	2/3	3	BMBL

Pseudomonas testoserone	2	2	
Rotococcus (Coryne.) equi	2	2	
Salmonella sp.	2	2	BMBL
Salmonella typhi	2/3	2	BMBL
Shigella sp.	2	2	BMBL
Staphylococcus sp.	2	2	
Streptococcus sp.	2	2	
Streptocacillus moniliformis	2	2	
Streptomyces somaliensis	2	2	
Treponema pallidum	2	2	BMBL
Vibrio sp.	2	2	BMBL
Yersinia pestis*	2/3	3	BMBL, immunization recommended
BMBL - Agent summary and biosafety levels according to type of activities are listed in the CDC/NIH's Biosafety in Microbiological and Biomedical Laboratories 4th Edition			
V - Vaccination is recommended for personnel			
***** - Select agents			

Fungal Agent	BSL	ABSL	Comments
Blastomyces dermatitides	2	2	BMBL
Coccidioides immitis*	2/3	2	BMBL
Cryptococcus neoformans	2	2	BMBL
Epidermophyton - pathogenic sp.	2	2	BMBL
Histoplasma capsulatum	2/3	2	BMBL
Microsporum - pathogenic sp.	2	2	BMBL
Paracoccidioides brasilienisis	2	2	
Sporothrix schenckii	2	2	BMBL
Trichophyton - pathogenic sp.	2	2	BMBL
Candida albicans	2	2	
Miscellaneous Molds	2		BMBL
BMBL - Agent summary and biosafety levels according to type of activities are listed in the CDC/NIH's Biosafety in Microbiological and Biomedical Laboratories 4th Edition			
V - Vaccination is recommended for personnel			
***** - Select agents			

Parasitic Agents	BSL	ABSL	Comments
Anaplasma sp.	2	2	
Ascaris sp.	2	2	BMBL
Coccidia sp.	2	2	BMBL
Cryptosporidia sp.	2	2	BMBL
Echinococcus Granulosus	2	2	BMBL
Ehrlichia sp.	2	2	
Entamoeba sp.	2	2	BMBL
Enterobius sp.	2	2	BMBL
Fasciola sp.	2	2	BMBL

Giardia sp.	2	2	BMBL
Haemobartonella sp.	2	2	
Hymenolepsis nana	2	2	BMBL
Leishmania sp.	2	2	BMBL
Leukocytozoon sp.	2	2	
Naegleria sp.	2	2	
Plasmodium sp.	2	2	BMBL
Sarcocystis sp.	2	2	BMBL
Schistosoma sp.	2	2	BMBL
Strongyloides sp.	2	2	BMBL
Taenia solium	2	2	
Toxocara canis	2	2	
Toxoplasma sp.	2	2	BMBL
Trichinella spiralis	2	2	BMBL
Trypanosoma sp.	2	2	BMBL
BMBL - Agent summary and biosafety levels according to type of activities are listed in the CDC/NIH's Biosafety in Microbiological and Biomedical Laboratories 4th Edition			
V - Vaccination is recommended for personnel			
* - Select agents			

Rickettsial Agents	**BSL**	**ABSL**	**Comments**
Coxiella burnetii*	2/3	3	BMBL
Rickettsia akari	2/3	2/3	
Rickettsia australis	2/3	2/3	BMBL
Rickettsia canada	2/3	2/3	BMBL
Rickettsia conorii	2/3	2/3	BMBL
Rickettsia prowazekii*	2/3	2/3	BMBL
Rickettsia rickettsii*	2/3	2/3	BMBL

Rickettsia siberica	2/3	2/3	BMBL
Rickettsia tsutsugamushi	2/3	2/3	BMBL
Rickettsia typhi (R. mooseri)	2/3	2/3	BMBL
Rochalimaea quintana	2	2	
Rochalimaea vinsonii	2	2	
Spotted Fever Group - other	2/3	2/3	
BMBL - Agent summary and biosafety levels according to type of activities are listed in the CDC/NIH's Biosafety in Microbiological and Biomedical Laboratories 4th Edition			
V - Vaccination is recommended for personnel			
* - Select agents			

Viral Agents	BSL	ABSL	Comments
Adenoviruses	2	2	
Adenoviruses - animal - all	2	2	
Aleutian Disease Virus	2	2	
Arboviruses - certain	2	2	BMBL
Arboviruses - certain	3	3	BMBL
Arboviruses - certain	4	4	BMBL
Arenaviruses - certain	3	3	BMBL
Arenaviruses - certain	4	4	BMBL
Avian Erthyroblastosis Virus	2	2	
Avian Leucosis Virus	2	2	
Avian Lymphomatosis Virus	2	2	
Avian Myeloblasotosos Virus	2	2	
Bovine Encephalomyelitis Virus	2	2	
Bovine Leukemia Virus	2	2	
Bovine Resp. Syncytial Virus	2	2	

Bovine Rhinotracheitis (IBR)	2	2	
Cache Valley Virus	2	2	BMBL
Canine Hepatitis Virus	2	2	
Canine Distemper Virus	2	2	
Caprine Arthritis	2	2	
Coxsackie A & B Viruses	2	2	
Cytomegaloviruses	2	2	
Encephalomyelitis Virus*	2	2	
Echovirus	2	2	
Dengue Virus	2	3	BMBL
Encephalomyocarditis Virus	2	2	
Epidemic Diarrhea Infant Mice	2	2	
Epstein-Barr Virus	2	2	
Feline Leukemia Virus	2	2	
Feline Sarcoma Virus	2	2	
Filoviruses	2	2	
Flanders Virus	2	2	BMBL
Gibbon Ape Lymphosarcoma	2	2	
Hart Park Virus	2	2	BMBL
Hemorrhagic Fever Agents*	2	2	
Hep A Virus, Hep E Virus	2	2	BMBL
Hep B Virus, Hep C Virus	2	2	BMBL
Virus, Hepatitis D Virus	2	2	BMBL
Herpesvirus - other	2	2	
Herpesvirus ateles	2	2	
Herpesvirus saimir	2	2	
Herpesvirus Simiae (B-virus)	3	3	BSL-2, -3 or -4 depending on activity, BMBL

Human Herpesviruses	2	2	BMBL
Hog Cholera Virus	2	2	
Human T-Cell Leukemia VirusI & II	2	2	
Infectious Bronchitis Virus	2	2	
Influenza Virus	2	2	BMBL
Influenza Virus Virulent Avian	3	3	
K (Rate) Virus	2	2	
Lactic Dehydrogenase Elevating	2	2	
Langat Virus	2	2	BMBL
Laryngotracheitis Virus	2	2	
Lassa Virus*	4	4	BMBL
Low Risk Oncogenic Viruses	2	2	
Lymphocytic Choriomeningitis Virus	2/3	2/3	BMBL
Marburg Virus*	4	4	BMBL
Measles Virus	2	2	
Memingopneumonitis Virus	2	2	
Mouse Encephalomyelitis Virus	2	2	
Mouse Hepatitis Virus	2	2	
Mouse Leukemia Virus	2	2	
Mouse Pneumonia Virus	2	2	
Mumps Virus	2	2	
Myxomatosis Virus	2	2	
Newcastle Disease Virus	2	2	
Newcastle Disease Virus (VVND)	2	2	
Non-Defective Adenovirus 2SV40 HYB	2	2	

Papilloma Virus Shope	2	2	
Parainfluenza Virus	2	2	
Poliovirus - all types	2	2	BMBL
Polyoma Virus	2	2	
Poxvirus alastrim	2	2	
Poxvirus monkey pox	3	3	
Poxvirus - Smallpox*			restricted use by WHO
Poxvirus sp.	2	2	BMBL
Pseudorabies Virus	2	2	
Rabies Virus	2/3	2/3	BMBL
Reovirus sp.	2	2	
Respiratory Syncytial Virus	2	2	
Retroviruses, including HIV & SIV	2/3	2/3	BMBL
Rhinovirus sp.	2	2	
Rous Sarcoma Virus	2	2	
Rubella Virus	2	2	
Simian Virus - other	2	2	
Simian T-Cell Leukemia Virus	2	2	
Sindbis Virus	2	2	
Slow Viruses	2	2	
Tensaw Virus	2	2	
Tick-Borne Encephalitis Complex	4	4	
Transmissible Spongiform Encephalopathies (Creutzfeldt-Jakob, kuru, and related agents	2	2	BMBL
Turlock Virus	2	2	
Vaccinia Virus	2	2	

Venezuelan Equine Encephalitis*	3	3	
Vesicular Stomatitis - lab adapted	2	2	BMBL
Vesicular Somatitis Virus	3	3	BMBL
Woolly Monkey Fibrosarcoma	3	3	
Yaba Virus	2	2	
Yellow Fever Virus 17D Strain*	2	2	BMBL
Yellow Fever Virus Except 17D*	3	3	BMBL
BMBL - Agent summary and biosafety levels according to type of activities are listed in the CDC/NIH's Biosafety in Microbiological and Biomedical Laboratories 4th Edition			
V - Vaccination is recommended for personnel			
***** - Select agents			

APPENDIX B - Select Agents/Toxins

Select agents require special registration with the Centers for Disease Control and Prevention (CDC); contact EH&S for further information.

Viruses

- Crimean-Congo haemorrhagic fever virus
- Eastern Equine Encephalitis virus
- Ebola viruses
- Equine Morbillivirus (Hendra virus)
- Lassa fever virus
- Marburg virus
- Rift Valley fever virus
- South American haemorrhagic fever viruses
- Junin
- Machupo
- Sabia
- Flexal
- Guanarito
- Tick-borne encephalitis complex viruses
- Variola major virus (Smallpox virus)
- Venezuelan Equine Encephalitis virus
- Viruses causing hantavirus pulmonary syndrome
- Yellow fever virus

Rickettsiae

- Coxiella burnetii
- Rickettsia prowazekii
- Rickettsia rickettsii

Fungi

- Coccidioides immitis

Toxins

- Abrin
- Aflatoxins
- Botulinum toxins
- Clostridium perfringens epsilon toxin
- Conotoxins
- Diacetoxyscirpenol
- Ricin
- Saxitoxin
- Shigatoxin
- Staphylococcal enterotoxins
- Tetrodotoxin
- T-2 toxin

Bacteria
- Bacillus anthracis
- Brucella abortus, B. melitensis, B. suis
- Burkholderia (Pseudomonas) mallei
- Burkholderia (Pseudomonas) pseudomallei
- Clostridium botulinum
- Francisella tularensis
- Yersinia pestis

APPENDIX C - Types of Biological Safety Cabinets

The similarities and differences in protection offered by the various classes of biosafety cabinets are reflected in Table 3. Use this table in selection and risk assessment of BSCs.

Class I BSC

The Class I BSC provides personnel and environmental protection but no product protection. It is similar in air movement to a chemical fume hood but has a HEPA filter in the exhaust system to protect the environment. In the Class I BSC, unfiltered room air is drawn across the work surface. Personnel protection is provided by this inward airflow. Class I BSCs can be used specifically to enclose equipment (e.g., centrifuges and harvesting equipment) or procedures (e.g. cage dumping or homogenizing tissues) with a potential to generate aerosols. The Class I BSC is HEPA filtered and hard-ducted to the building exhaust system, and the building exhaust fan provides the negative pressure necessary to draw room air into the cabinet.

Class II BSC

The Class II (Types A, Bl, B2, and B3) BSCs provide personnel, environmental and product protection. Air flow is drawn into the front grille of the cabinet, which provides personnel protection. In addition, downward laminar flow of HEPA-filtered air provides product protection by minimizing the chance of cross-contamination along the work surface of the cabinet. Because cabinet air has passed through the exhaust HEPA filter, it is contaminant-free (an environmental protection) and may be recirculated back into the laboratory (Type A) or ducted out of the building (Type B).

HEPA filters are effective at trapping particulates and infectious agents but not at capturing volatile chemicals or gases. Only BSCs that are ducted to the outside should be used when working with volatile toxic chemicals.

All Class II cabinets are designed for work involving microorganisms assigned to Biosafety Levels 1, 2 and 3. Class II cabinets provide the microbe-free work environment necessary for cell culture propagation and also may be used for the formulation of nonvolatile chemotherapeutic drugs.

Class II, Type A

An internal blower draws sufficient room air through the front grille to maintain a minimum average inflow velocity of at least 75 lfpm at the face opening of the cabinet. The supply air flows through a HEPA filter and provides particulate-free air to the work surface. Laminar airflow reduces turbulence in the work zone and minimizes the potential for cross-contamination. The downward moving air "splits" as it approaches the work surface; part of the air is drawn to the front grille and the remainder to the rear grille. This split generally occurs about half-way between the front and rear grilles and two to six inches above the work surface.

The air is then discharged through the rear plenum into the space between the supply and exhaust filters located at the top of the cabinet. Due to the relative size of

these two filters, about 30 percent of the air passes through the exhaust HEPA filter and 70 percent recirculates through the supply HEPA filter back into the work zone. Most Class II, Type A cabinets have dampers to modulate this 30/70 division of airflow.

An unducted Class II Type A cabinet can not to be used for work involving volatile or toxic chemicals. The buildup of chemical vapors in the cabinet by recirculated air and in the laboratory from exhaust air can create health and safety hazards.

Type A cabinet exhaust can be ducted out of the building through an indirect "thimble" connection to an exhaust system or through a canopy hood. It must be done in a manner that does not alter the balance of the cabinet exhaust system. The volume of the exhaust must be sufficient to maintain the flow of room air into the space between the thimble unit and the filter housing. The thimble must be removable or be designed to allow for operational testing of the cabinet. The performance of a cabinet with this exhaust configuration is unaffected by fluctuations in the building exhaust system.

Class II, Type B1

Some biomedical research requires the use of small quantities of certain hazardous chemicals, such as carcinogens. The powdered form of these carcinogens should be weighed or manipulated in a chemical fume hood. Carcinogens used in cell culture or microbial systems require both biological and chemical containment.

The Class II, Type B cabinet originated with the National Cancer Institute (NCI)-designed Type 2 (later called Type B) biological safety cabinet, which was designed for manipulations of minute quantities of these hazardous chemicals with in vitro biological systems. The National Sanitation Foundation (NSF) Standard 49 definition of Type BI cabinets includes this classic NCI design Type B, as well as cabinets without supply HEPA filters located immediately below the work surface and/or those with exhaust/recirculation downflow splits other than 70/30 percent.

Room air is drawn through the face opening of the cabinet at a minimum inflow velocity of 100 lfpm. As with the Type A cabinet, there is a split in the downflowing air stream just above the work surface. In the Type B cabinet, about 70 percent of the downflow air exits through the rear grille, passes through the exhaust HEPA filter and is discharged from the building. The remaining 30 percent of the downflow air is drawn through the front grille. Since the air which flows to the rear grille is discharged into the exhaust system, activities that may generate hazardous chemical vapors or particulates should be conducted towards the rear of the cabinet. Type BI cabinets must be hard-ducted to their own dedicated exhaust system. A failure in the building exhaust system may not be apparent to the user, as the supply blowers in the cabinet will continue to operate. A pressure-independent monitor should be installed to sound an alarm and shut off the BSC supply fan, should failure in exhaust air flow occur. Since this feature is not supplied by all cabinet manufacturers, it is prudent to install a sensor in the exhaust system as necessary.

Class II, Type B2
This BSC is a total-exhaust cabinet; no air is recirculated within it. This cabinet provides primary biological and chemical containment. The supply blower draws in room air at the top of the cabinet, passing it through a HEPA filter and down into the work area of the cabinet. The cabinet exhaust system draws air through both the rear and front grilles, capturing the supply air plus the additional amount of room air needed to produce a minimum calculated or measured inflow face velocity of 100 lfpm. All air entering this cabinet is exhausted and passes through a HEPA filter (and other air-cleaning devices such as a carbon filter if needed) prior to being discharged to the outside. Exhausting as much as 1200 cubic feet per minute of conditioned room air makes this cabinet expensive to operate. Should the building or cabinet exhaust fail, the cabinet will be pressurized, resulting in a flow of air from the work area back into the laboratory. Cabinets built since the early 1980s usually have an interlock system installed by the manufacturer to prevent the supply blower from operating whenever the exhaust flow is insufficient. Presence of such an interlock system should be verified; systems can be retrofitted if necessary. Exhaust air movement should be monitored by a pressure-independent device.

Class II, Type B3
This biological safety cabinet is a ducted Type A cabinet having a minimum inward airflow of 100 lfpm. All positive-pressure, contaminated plenums within the cabinet are surrounded by a negative air pressure plenum. Thus, leakage in a contaminated plenum will be into the cabinet and not into the environment. As in the Type A cabinet, exhaust can be ducted out of the building through an indirect "thimble" connection to an exhaust system or through a canopy hood with the same requirements for air flow and design.

Special Applications
Class II BSCs can be modified to accommodate special tasks. For example, the front sash can be modified by the manufacturer to accommodate the eye pieces of a microscope, or the work surface can be designed to accept a carboy, a centrifuge or other equipment that requires containment. A rigid plate with arm holes can be added if needed. Good cabinet design, microbiological aerosol tracer testing of the modification and appropriate certification are required to ensure that the basic systems operate properly after modification. Maximum containment potential is achieved only through strict adherence to proper practices and procedures. Note: EH&S will consult with the manufacturer for design, testing and certification of special application BSCs.

Class III BSC
The Class III biological safety cabinet is designed for work with biosafety level 4 microbiological agents and provides maximum protection to the environment and the worker. It is a gas-tight enclosure with a nonopening view window. Access for passage of materials into the cabinet is through a dunk tank or double-door pass-through box (such as an autoclave) that can be decontaminated between uses. Reversing that process allows for safe removal of materials from the Class III biosafety cabinet. Both

supply and exhaust air are HEPA filtered. Exhaust air must pass through two HEPA filters before being discharged to the outdoors. Airflow is maintained by a dedicated independent exhaust system exterior to the cabinet, which keeps the cabinet under negative pressure. Long, heavy-duty rubber gloves are attached in a gas-tight manner to ports in the cabinet and allow for manipulation of the materials isolated inside.

Horizontal and Vertical Laminar-flow "Clean Benches"

Horizontal and vertical laminar-flow clean-air benches are not BSCs. They discharge HEPA-filtered air across the work surface and toward the user. These devices provide only product protection. They can be used for certain clean activities, such as the dust-free assembly of sterile equipment or electronic devices. These benches should not be used when handling cell culture materials or drug formulations or when manipulating potentially infectious materials. The worker can be exposed to materials being manipulated on the clean bench, which may cause hypersensitivity. Horizontal and vertical clean air benches should never be used as a substitute for a biological safety cabinet in research, biomedical or veterinary laboratories and/or applications.

Table 3: Comparison of Biological Safety Cabinet Characteristics and Applications

Class Type	Work Opening	Inflow Velocity (fpm)	Percentage of recirculated air	Percentage of exhausted air	Approximate exhaust volume (cfm)	Exhaust Requirement	Application
Class I	Fixed	75	0%	100%	4 ft-200 6 ft-300	Exhausted to the outside (remote fan) or to the room through a HEPA filter (integral fan)	BL-1 through BL-3; small amounts of toxic chemicals or radionuclides (if exhausted to outside)
Class II Type A	Fixed, sliding or hinged	75-100	70%	30%	4 ft-300 6 ft-400	Exhausted to room through HEPA filter	BL-1 through BL-3
Class II Type B1	Sliding	100	30%	70%	4 ft-250 6 ft-400	Exhausted to outside with remote fan; duct is hard-connected.	BL-1 through BL-3; small amounts of toxic chemicals or radionuclides
Class II Type B2	Sliding, hinged	100	0%	100%	4 ft-600 6 ft-1000	Exhausted to outside with remote fan; duct is hard-connected.	BL-1 through BL-3; small amounts of toxic chemicals or radionuclides
Class II Type B3	Sliding, hinged	100	70%	30%	4 ft-300 6 ft-400	Exhausted to outside with remote fan utilizing thimble or hard-connected duct.	BL-1 through BL-3; small amounts of toxic chemicals or radionuclides
Class III	Glove ports	n/a	0%	100%	_*	Exhausted to outside through two HEPA filters with remote fan; duct is hard-connected.	BL-1 through BL-4; small amounts of toxic chemical or radionuclides

*Class III cabinets should have about 20 air changes per hour or enough ventilation to accommodate the heat load. A negative pressure of 0.5 in water gauge (w.g.) must be maintained, and 100 fpm should be maintained through a glove port, if a glove is accidentally removed.

Appendix D - Biosafety Web Links

American Biological Safety Association - http://www.absa.org

Biosafety in Microbiological and Biomedical Laboratories (BMBL) 4th Edition - http://www.cdc.gov/od/ohs/biosfty/bmbl4/bmbl4toc.htm

Cal Dept. Of Health Services, Medical Waste Branch - http://www.dhs.ca.gov/ps/ddwem/environmental/emb/medwasteindex.htm

Cal OSHA Regulations - http://www.dir.ca.gov/Samples/search/query.htm

California Codes - http://www.leginfo.ca.gov/calaw.html

Centers for Disease Control and Prevention - http://www.cdc.gov/page.do

International Agency for Research on Cancer - http://www.iarc.fr/

National Institutes of Health - http://www.nih.gov/

National Toxicology Program - http://ntp-server.niehs.nih.gov/

Packaging Critical Biological Agents - http://www.bt.cdc.gov/labissues/PackagingInfo.pdf

U.S. Dept of Health and Human Services - http://www.os.dhhs.gov/

World Health Organization - http://www.who.int/

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