UNIVERSITY OF ARKANSAS
BIOLOGICAL SAFETY MANUAL

OFFICE OF ENVIRONMENTAL HEALTH AND SAFETY
DEPARTMENT OF FACILITIES MANAGEMENT
UNIVERSITY OF ARKANSAS

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Purpose and Scope:

This document applies to all University of Arkansas and Division of Agriculture activities, funded and unfunded, performed on the campus and at the farms, extension stations, and other off-campus facilities, and to activities performed by University personnel at other, non-University facilities. Both teaching and research activities are covered, as well as field operations. Personnel covered by the program include graduate and undergraduate students, part and full-time faculty and staff, and visitors.

This manual specifies controls and handling practices required for microbiological agents, (bacterial, viral, and fungal, as well as certain multicellular parasites), biological toxins, recombinant and/or synthetic DNA and/or RNA molecules, human or non-human primate blood or tissues, and animal cell cultures and tissues.

Use of radioactive materials and chemicals are covered in the Radiation Safety Manual and Chemical Hygiene Plan, respectively, found on the University of Arkansas EH&S webpage.

Protocols involving animals must be reviewed and approved by the University's Institutional Animal Care and Use Committee (IACUC). Contact the IACUC at iacuc@uark.edu. In addition, the reader is referred to the CDC/NIH Publication No. (CDC) 93-8395, *Biosafety in Microbiological and Biomedical Laboratories* (5th edition) for a complete discussion of appropriate precautions for working with infected animals.

Roles and Responsibilities:

Institutional Biosafety Committee (IBC):

1. Advise the Chancellor and the Provost on issues relating to biological safety.

2. Meet for review of:

   Protocols involving RG-2 agents propagated in production quantities or used in procedures in which the agent is likely to become aerosolized; Research protocols involving recombinant and/or synthetic DNA and/or RNA molecules (rDNA) in accordance with The National Institutes of Health (NIH) guidelines;

   Protocols involving biological toxins, human or non-human primate blood, tissues or cell lines derived thereof.
   Protocols involving Risk Group (RG) 3 or Biosafety Level (BSL) 3 agents

   Protocols involving RG-4 organisms or Select Agents and Toxins are excluded from use at the University of Arkansas. For a discussion of the Risk Groups and their corresponding Biosafety Levels, see Appendix VI of this document "Classification of Hazards and Levels of Containment".

3. Determine the necessity for health surveillance and prophylaxis for personnel conducting biological research projects.

4. Review any proposed additions or changes to the University of Arkansas Biological Safety Manual.

5. Periodically review departmental inventories of rDNA, cell culture lines, and biological agents and toxins.

6. Respond to reports of significant violations or accidents and report any such occurrence involving rDNA to the NIH Office of Biotechnology Activities.

7. Review and approve any protocol changes that are required for IBC approval of the protocol.

Institutional Biological Safety Officer:

1. Provide consultation and technical guidance for the safe handling of biological agents and toxins, assisting in the development of safety and exposure control plans and training programs.

2. Provide advice regarding the disinfection of facilities and equipment, and assist in the disposal of infectious waste.

3. Periodically review and recommend updates to the University of Arkansas Biological Safety Manual to the IBC.

4. Review needs and make recommendations regarding selection, purchase, and certification of biological safety cabinets (BSCs) and other related safety equipment.

5. Maintain a record of agents used, their classification, location and the names of the principal investigators.

6. Conducts audits of rDNA biological labs on a yearly basis. The BSO or designate will audit any lab working with biological materials on a yearly basis to ensure compliance with approved standards and policies of the University.

7. Enforce the policies of the University to ensure the safety of the University community and area citizens.

8. Review and forward with recommendation all rDNA, Risk Group-2 and Risk Group-3 protocols to the IBC for final consideration.

Principal Investigators and Laboratory Supervisors:

1. Submit applications (including all required forms and complete protocols), and solicit and receive approval from the IBC prior to initiating any project or curriculum involving the use of agents or materials covered in the scope of this document. Graduate students may not present protocols to the IBC. Each protocol shall include a safety/exposure control plan and procedures for containment and decontamination of spills.
   Those agents or materials include:
   - rDNA
   - Risk Group 2 and 3 organisms (human, animal and/or plant)
   - biotoxins
   - human materials/nonhuman primate materials (This may also trigger IRB review)

- animals or animal tissues and any of the above categories; transgenic animals or tissues; wild vertebrates or tissues
- plants, plant tissues, or seed and any of the above categories; transgenic plants, plant tissues or seeds
- CDC and/or USDA regulated select agents (The University is NOT presently registered to possess, use, or transfer select agents and toxins.)

2. Register all potentially infectious agents, recombinant materials, and toxic materials with Environmental Health & Safety (EH&S). See the University of Arkansas Chemical Hygiene Plan (CHP). Use of recombinant materials and Risk Group 2 or higher organisms requires approval of the IBC.

3. Advise the IBC, in writing, of any significant changes in approved protocol involving use of biological agents and/or toxins. Changes must be approved by the IBC.

4. Maintain and annually review laboratory-specific IBC protocols.

5. Ensure that laboratory staff and students are trained in the procedures in the protocols and comply with their requirements.

6. Encourage employees and students to report any changes in health status.

7. Survey laboratories for compliance with standards and policies regarding safe handling and use of biological agents and toxins.

8. Enforce compliance with the approved standards and policies of the University.

9. Comply with the U. S. Department of Transportation (DOT) shipping requirements for biohazardous substances and toxins.

10. Post all signs and procedures, both outside and inside laboratories, as required by the BSO and IBC.

11. Inform the University Health Center, in writing, of:
    A. RG-2 agents and their toxins being used;
    B. a list of personnel who may be exposed to those agents;
    C. any available requested information regarding agents or other relevant hazardous materials.

12. Post a succinct, written spill procedure in the laboratory where all can see.

13. Keep children and guests out of lab as stated by the U of A policy found in the Faculty Handbook: Academic Responsibilities of Faculty (from Fayetteville Policies and Procedures 732.0, February 15, 2003).

14. Report incidents and accidents to EH&S and the IBC (e.g., needle sticks, burns and exposures).

All Project Participants:

1. Comply with the established policies, procedures, and guidelines for biological safety as trained.

2. Promptly inform immediate supervisor of any unsafe practice or conditions in the work area.

3. Report any change in health status to the supervisor if there is a possibility it may be work-related.

4. Immediately report all biological spills and incidents to the supervisor.

5. Become familiar with written emergency procedures for handling exposure to infectious or potentially infectious biological agents and other hazardous materials.

6. Become trained in the procedures, both archived and wall posted, to safely handle appropriate biological agents.

General Policies and Procedures for Biological Laboratories:

Compliance:

Good laboratory procedure will be rigorously enforced in both research and teaching laboratories. Eating, drinking, smoking, application of cosmetics, putting in/ taking out contact lenses, or storage of food is not permitted in any University biological laboratory.

Personnel must wash hands after handling infectious material, after removal of gloves, and before leaving the laboratory.

Work with biological agents and materials will be conducted at the appropriate biological containment level.

Appropriate disinfection and waste disposal procedures will be stringently observed.

Biological safety cabinets must be certified yearly.

Autoclaves must be tested once per month using the biological indicator *Bacillus stearothermophilus*.

Keep the laboratory doors and windows closed at all times.

Biohazard areas must be posted (by initiative of the PI) with a warning sign with the universal biohazard symbol, identifying the infectious agent present and indicating requirements for entry.

Access to the laboratory or classroom is limited at the discretion of the PI when experiments are in progress. All laboratories are locked after normal University working hours.

The PI's name and telephone number must be posted along with the telephone number of EH&S (575-5448) and the BSO (575-3533) on the door of biological research laboratories.

The use of Particularly Hazardous Substances requires a laboratory/research specific Standard Operating Procedure (SOP) approved by Toxic Substances Committee. For more information, refer to the section Particularly Hazardous Substances found in the UA Chemical Hygiene Plan.

The use of DEA Controlled Substances must be registered through the Office of Research Compliance. For more information, refer to the UA Chemical Hygiene Plan or contact EH&S for assistance.

Containment:

Working in a BSC:

Never work with the UV light illuminated. Skin and eye damage can occur from the direct and reflected light.

Wipe down the work surface with an appropriate disinfectant. Do not depend on the UV germicidal lamp to provide a sterile surface.

Needed items should be placed inside the BSC prior to beginning work, arranged in a manner to segregate clean and contaminated materials. Work left to right from the clean side to the dirty side of the cabinet to try to minimize cross contamination to the greatest extent possible

Keep the glass sash lowered and conduct work at least four inches inside the sash. To minimize the escape of aerosols, keep necessary arm movements slow and smooth and avoid moving arms in and out of cabinet.

Do not using an open flame inside the cabinet.

Upon completion of work in the BSC, disinfect all surfaces and leave the blower on for five minutes to purge the air from the cabinet.

A BSC is not to be used with infectious materials until it has been certified as meeting minimal safety specifications (e.g., NIH-03- 112 or National Sanitation Foundation Standard 49) on site. Cabinets are to be certified in situ by a trained technician when installed and annually thereafter, and in addition, whenever they are moved.

For additional information regarding the use of the BSC, the reader is referred to the CDC/NIH publication on the use of the BSC: *Primary Containment for Biohazards: Selection, Installation, and Use of Biological Safety Cabinets.*"(5th edition). (This document is currently printed as Appendix A in this hyperlink *Biosafety in Microbiological and Medical Laboratories (BMBL).*

General Guidelines:

Pipetting:

Mouth pipetting is strictly forbidden. No infectious mixture is to be prepared by bubbling air through the liquid with the pipette. No infectious materials are to be forcibly discharged from pipettes.

Insert aerosol containment =

Syringes and needles:

Avoid the use of syringes and needles wherever possible.
Use the needle-locking type or a disposable syringe needle unit.

Needles should not be re-sheathed, bent, broken, or removed from disposable syringes.

Needles and syringes should be discarded into biohazard-labeled, approved sharps containers for later disposal.

Do not discard needles into disinfectant pans containing disposable pipettes or other glassware. These items must be disposed of separately.

Disinfection and Sterilization:

Frequently disinfect floors, cabinet tops, and equipment where biohazard material is stored.

Sterilize all infectious materials and contaminated equipment prior to being washed, stored, or discarded.

All infectious waste is to be autoclaved.

Autoclaves:

An autoclave is a device used to sterilize all infectious or dangerous medical and biological waste prior to disposal including blood or blood products, pathological waste, cultures and stocks of infectious agents, biotechnological byproduct effluents, and contaminated animal bedding.

Before operating an autoclave, training on safe and proper use is required.

To ensure biological materials are autoclaved appropriately, autoclaves must be tested once per month. Use the biological indicator *Bacillus stearothermophilus* for the monthly testing by placing it at the center of a load processed under standard operating conditions to confirm the adequate sterilization conditions were reached. Maintain records of *B. stearothermophilus* testing and maximum autoclave temperature recordings. Indicators shall be found at this hyperlink: https://us.vwr.com/store/catalog/product.jsp?catalog_number=19872-006

- Monthly Spore Testing Procedure

  Place ampoule of *B. stearothermophilus* spores and holding thermometer in the center of an autoclave load.

  Process the load under normal operating procedures.

  The highest temperature indicated on the holding thermometer is entered on the Autoclave QC Log. If this temperature is less than 121ºC, then autoclave is not to be used to treat infectious materials until it is checked by authorized personnel (someone from warranty granting company, if applicable, or Someone from a company certified to maintain autoclaves).

Use disposable materials wherever possible, keeping reusable items and disposable materials separated.

DO NOT AUTOCLAVE items containing corrosives (e.g., acids, bases, phenols, etc.), solvents, volatiles, flammable or radioactive materials. Contact EH&S for assistance.

Clearly mark all holding containers as “NON-INFECTIOUS – TO BE CLEANED” or “BIOHAZARDOUS – TO BE AUTOCLAVED”.

Waste Disposal:

Infectious waste must be decontaminated on site, preferably by autoclaving. Transport of waste for off-site decontamination and disposal must have the approval of the BSO (575-3533).

After autoclaving, disposable, non-glass, materials may be placed in ordinary trash bags for disposal. **Do not** dispose of biohazard bags without first placing them in an unmarked black bag. Do not use Red Medical Waste Services bags for autoclaved waste.

Sharps should be placed in an approved container and disposed of by EH&S as medical waste.

Do not put disposable glass in sharps containers. Instead, dispose of contents in the broken glass approved container.

Broken glass containers and sharps containers shall be ordered by the PI at:
https://us.vwr.com/store/catalog/product.jsp?product_id=4601699
https://us.vwr.com/store/product/4601692/vwr-broken-glass-disposal-cartons
https://us.vwr.com/store/product/4618302/vwr-sharps-container-systems-red

Liquid waste can be disposed of down the sink, provided it contains no infectious agents, hazardous chemicals, or radioactive materials.

Do not pour sterile melted agar down the drain. It will solidify and clog the pipe. Let it harden and dispose in regular waste.

Animal carcasses must be incinerated or disposed of by a contractor

For disposing a mix of hazardous chemical and biological materials refer to the Chemical Hygiene Plan and contact the Chemical Hygiene Officer.

Medical Surveillance and Examinations:

Each area with potentially exposed employees or students must have a written Exposure Control Plan. The plan describes specific practices and procedures designed to minimize or eliminate exposure to these hazards. It must be reviewed annually by the PI and updated as necessary with written records kept.

Appropriate immunization may be required for some personnel. Hepatitis B vaccine must be provided for all employees who have the potential for an occupational exposure to human or non-human primate blood or other potentially infectious human or non-human primate materials within 10 days of assignment.

Other prophylaxis or surveillance may be necessary for personnel working with feral or non-domesticated animals.

Note: Acute medical care will normally be provided by the Pat Walker Health Center in accordance with University policies and procedures. Requests for special surveillance and examinations should be arranged through EH&S. All medical surveillance and examinations must be performed by or under the 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.

Consult the Pat Walker Health Center and EH&S for assistance.

Accidents:

Accidents that result in injury or overt exposure to infectious materials are immediately reported to the PI. Medical evaluation, surveillance and treatment are provided as appropriate and written records are maintained.

See the section on Exposure Assessment and Medical Services found in the University of Arkansas Chemical Hygiene Plan available from EH&S for more information. All IBC protocols require research related accidents, exposure incidents or release of rDNA materials to the environment to also be reported to IBC committee.

Spills:

Laboratories are required to develop procedures for dealing with spills and should have available appropriate equipment and materials. A basic spill kit should include a concentrated disinfectant (chlorine bleach or Wescodyne), a package of paper towels, sponges, household "rubber" gloves, forceps for broken glass, and an autoclavable container.

Procedures for handling spills must be posted in the laboratory.

A site-specific spill plan must be developed by the PI that is appropriate to the biosafety level of the project.

Consult EH&S for assistance.

See the section on Spills and Accidents found in the University of Arkansas Chemical Hygiene Plan available from EH&S for more information.

Training:

Training of technical personnel, teaching assistants and students must be accomplished prior to beginning the project and repeated at least annually. At a minimum it will consist of methods to minimize exposure, proper shipping procedures, and if working with human or non-human primate blood or blood containing products, access to a copy of the OSHA Bloodborne Pathogen Standard, explanation of its contents, and a general explanation of the Exposure Control Plan. All EH&S Training is through the University of Arkansas BioRAFT site. Other training requirements are laid out in the University of Arkansas Chemical Hygiene Plan.

Training records must be kept on file by the PI. Training assistance is available from EH&S.

Labeling Biohazards:

Specimens of all human tissue, body fluids or other potentially infectious material shall be stored in a container marked with an orange label that clearly includes the word "Biohazard" and the international symbol for biohazard waste.

Items contaminated with bloodborne pathogens require special labeling.

Any building, container or freezer containing blood is required be marked with the orange label that clearly includes the word "Biohazard" and the international symbol for biohazard waste.

Refrigerators, microwaves or any piece of equipment shall be labeled with a biohazard symbol and "No food or drink".

Any food product used for research shall be labeled "Not for human consumption".

Other laboratory signage requirements are laid out in the Sign section of the University of Arkansas Chemical Hygiene Plan regarding hazard communication.

Personal Protective Equipment (PPE):

Protective clothing designed to keep street clothes and forearms free of contamination shall be worn when working with microorganisms in the laboratory. Long sleeve lab coats are recommended at minimum.

Different levels and types of PPE guarantee the integrity of the individual exposed to chemical, physical, or biological hazards.

PPE offers a high degree of protection if used properly; therefore, training must be provided in order to instill awareness and motivation for the proper use and maintenance of protective equipment.

Training must be oriented to emphasize the capabilities and limitations of PPE as well as its useful life and disposal.

Training should be completed prior to actual PPE use in a hazardous environment and should be repeated at least annually.

Appropriate selection of protective equipment is based upon several considerations including type and physical state of containments and risk assessment.

Protective clothing is never to be worn outside the laboratory. Contaminated clothing must be stored in an area separate from street clothing and well ventilated with good air flow as a coat rack.

Laboratory clothing

A laboratory coat or other suitable protective clothing is recommended for general biological (BSL 1)work.

Handling potentially infectious materials or biohazardous RG 2 agents Requires a Lab coat or other suitable protective clothing. (Biological Safety Level 2 safety equipment), BMBL 5th edition page 36.

In situations where splashing is possible, wear a laboratory garment that resists to liquid penetration.

All protective clothing should be discarded in the laboratory. Reusable laboratory coats must be laundered by the facility or a commercial contractor and are never to be taken home. Consult EH&S for assistance.

Eye and face protection

Primary eye protection (e.g., safety glasses or goggles) is worn when an individual is potentially exposed to eye or face hazards including harmful gases or vapors and flying particles.

In circumstances when splashes, sprays or aerosols of infectious or hazardous materials from microorganisms manipulated outside the BSC may be anticipated, face shields must be worn in combination with primary eye protection to create an extra layer of protection.

Respirators

When inhalation hazards are present, respiratory protective devices are required. In fact, where personnel cannot be adequately protected via procedural or ventilation controls, it is important

that *appropriate* respiratory protection be used with respect to the hazards associated with the agent or procedure used.

The selection of the best respirator will depend on hazards on which worker is exposed, different types of respiratory equipment available, protection factors, and fit testing.

For example, surgical masks may be worn for product protection, but offer no personal protection against infectious materials. All questions concerning the selection or use of respiratory protection or other PPE should be referred to EH&S.

Use of disposable respirators for personnel protection must follow procedures outlined in the EH&S respiratory protection program. EH&S offers fit testing and training for respiratory protection. Call 575-5448 for assistance.

Hand Protection

Appropriate hand protection is required when there is a change of exposures to toxic and harmful substances to protect the skin.

Protective gloves (e.g., latex or nitrile) must be worn when hands may contact infectious material. In some instances, double gloves may be appropriate when working directly with biohazardous agents.

Gloves should be changed if damaged and removed before contact with clean surfaces such as the telephone, computer or doorknob. Hands must be washed as soon as gloves are removed.

Foot protection

Closed-toe/closed-heel shoes are required for general biological work to avoid danger of foot injuries due to sharp objects or exposure to biohazardous materials. Boots may be required when working in animal facilities.

Transportation of Biological Materials:

The transportation of biological materials involves handling, packing, storing, moving, loading and unloading regulated and unregulated laboratory substances as well as responding to emergency situations while such materials are in transportation.

The Office of Environmental Health and Safety (EH&S) has the responsibility of ensuring that biological materials are transported safely and responsibly by individuals affiliated with the University of Arkansas.

Personnel in charge of packing, handling and shipping biological material are subjected to all applicable training. In addition, all personnel must complete training to be certified for transporting biological material. Contact EH&S for assistance regarding training on transportation of biological material.

Principal investigators shall maintain training records for audits and review upon the request of regulatory authorities.

For regulated biological materials, each principal investigator must notify EH&S prior the transport of biohazards to obtain the required permits. Shipments of hazardous materials must be in compliance with all applicable local, federal, and international transportation and shipping regulations.

For unregulated biological materials, each principal investigator has the responsibility to follow the Department of Transportation SOPs for transferring, packing and shipping from the laboratory. Contact EH&S for assistance.

All biological materials must be properly packaged and labeled in order to be safely transported between buildings on campus. Biological material should be transported in a manner that minimizes the potential for environmental releases and maintains the integrity of the material transported preventing exposure to the personnel and public. Avoid hand carrying.

Biological Safety Cabinets:

There are three classes of BSCs defined on the basis of the different types of biosafety levels. For a complete discussion on biological safety cabinets, the reader is referred to the CDC/NIH manual *Biosafety in Microbiological and Biomedical Laboratories* available from the U. S. Government Printing Office. (HHS Publication No (CDC) 93-8395).

Installation of BSCs shall be done by certified professionals. Certifications shall be done annually.

BSCs need to be clean before being moved and safety certified to move by BSO. Certifications are also done whenever a biosafety cabinet has been moved.

Unlike Biological Safety Cabinets, Clean Benches and Laminar flow hoods are not required to be inspected and certified every year. They can be however. To setup an inspection with an approved Contractor, contact the EH&S office.

Biological Safety Cabinet Decommissioning

1) Contact BSO
2) BSO will work with PI to schedule decontamination with a BSC contractor to set up a Decontamination of the BSC.
3) BSO will alert colleagues in EH&S if this is part of a lab decommissioning. If that is the case other triggers will engage, and EH&S personnel will contact PI and PI should contact EH&S about Chemical, and if necessary, Radiological Decommissioning of the Lab can take place.
4) Since this is also Department and U of Arkansas Fiscal Property, PI needs to work with their Department Chair to ensure University Finance is notified. (BSO cannot help there)
5) Once BSC is decontaminated and proper inventory concerns are notified, BSC can be disposed of as Scrap Metal

Animal Use, Hazards and Exposures:

Prior to initiating any project or curriculum involving the use of animals in research, teaching and outreach activities regardless the source of funding for the project, approval must be requested and received by the Institutional Animal Care and Use Committee (IACUC).

The principal investigator has the ultimate responsibility for reducing or eliminating the exposure to or transmission of the biohazards associated with laboratory animals.

The activities of animals themselves can present unique hazards not found in the standard microbiological laboratories.

General policies and procedures, equipment and facilities must be selected to minimize or reduce such risks in conjunction with a conceived animal care program.

Definitive protocols that encompass standard microbiological practices, safety equipment, laboratory facilities, decontamination and disposal procedures, biohazard control and risk assessment are beyond the scope of this document.

For additional information contact the IACUC at iacuc@uark.edu.

Working with rDNA:

Federal Guidelines and Registering Experimental Protocols

All research conducted at the University of Arkansas involving rDNA must meet current NIH guidelines.

Experimental protocols must be approved by the IBC and, in special instances, by a committee at the NIH or USDA as well.

The principal investigator is responsible for determining the status of his/her experiments and filing the proper documents if review is required.

The NIH Guidelines instruct the PI to prepare a set of emergency plans covering accidental spills and resulting personnel contamination for work involving rDNA.

Research that is carried out at physical containment level BSL-2 or higher requires the PI prepare or adopt a lab specific biosafety manual. The University Biosafety Manual may serve as the basis for preparing a more specific document.

Investigators who create transgenic animals must IBC Form 2 and submit it to the IBC for approval. In addition, the protocol must receive approval from the IACUC.

Experiments to genetically engineer plants by rDNA methods require approval from the IBC.

The NIH guidelines provide specific plant biosafety containment recommendations to prevent release of transgenic plant materials to the environment. Protocols must be registered with the IBC.

Working with Toxins of Biological Origin:

The laboratory facilities, equipment, and procedures appropriate for work with toxins of biological origin must reflect the intrinsic level of hazard posed by a particular toxin as well as the potential risks inherent in the operations performed.

If both toxins and infectious agents are used, both must be considered when containment equipment is selected and policies and procedures are written.

If animals are used, animal safety practices must also be considered.

When vacuum lines are used with systems containing toxins, they shall be protected with HEPA filters to prevent entry of toxins into the lines.

Sink drains shall be similarly protected when water aspirators are used. Do not dispose of toxic or hazardous materials down the sink.

Practices:

Special practices listed under BSL-2 and BSL-3 should be reviewed and incorporated as appropriate into protocols for work with toxins.

Additional requirements for working with biological toxins are as follows:

1. Each laboratory shall develop an SOP specific to the toxin(s) used in that laboratory. Standard Operating Procedure must: (a) identify the hazards that will be encountered in normal use of the toxin, and those that could be encountered in case of a spill or other accident, and (b) specify the policies and practices to be used to minimize risks (e.g., containment and personal protective equipment, management of spills, management of accidental exposures, medical surveillance). (See the University of Arkansas Chemical Hygiene Plan available from EH&S.)

2. Training specific to the toxin(s) used is required and shall be documented for all laboratory personnel working with toxins, before starting work with the toxin and at intervals thereafter.

3. An inventory control system shall be in place. Toxins shall be stored in locked storage rooms, cabinets, or freezers when not in use.

4. Access to areas containing toxins shall be restricted to those whose work assignments require access.

5. The user shall verify inward airflow of the hood or BSC before initiating work. All work should be done within the operationally effective zone of the hood or biological safety cabinet.

6. The laboratories shall be posted with signs indicating the toxin and listing the phone numbers of the PI and other emergency contacts.

7. Any special entry requirements shall be posted on the entrance(s) to the room. Only personnel whose presence is required should be permitted in the room while toxins are in use.

8. All high-risk operations shall be conducted with two knowledgeable individuals present. Each must be familiar with the applicable procedures, maintain visual contact with the other, and be ready to assist in the event of an accident.

9. Before containers are removed from the hood, cabinet, or glove box, the exterior of the closed primary container must be decontaminated and placed in a clean secondary container. Toxins shall be transported only in leak/spill-proof secondary containers.

10. Contaminated and potentially contaminated protective clothing and equipment shall be decontaminated using methods known to be effective against the toxin before removal from the laboratory for disposal, cleaning or repair.

11. If decontamination is not possible- practical materials (e.g., used gloves) shall be disposed of as toxic waste. (Call EH&S for assistance.)

12. Materials contaminated with infectious agents as well as toxins shall also be autoclaved or otherwise rendered non-infectious before leaving the laboratory.

13. The interior of the hood, glove box, or cabinet shall be decontaminated periodically (e.g., at the end of a series of related experiments).

14. Until decontaminated, the hood, box, or cabinet should be posted to indicate that toxins are in use, and access to the equipment and apparatus restricted to necessary, authorized personnel.

15. Preparation of primary containers of toxin stock solutions and manipulations of primary containers of dry forms of toxins shall be conducted in a chemical fume hood (***NOTE: A chemical fume hood is not acceptable for handling biological agents***), a glove box, or a BSC or equivalent containment system approved by EH&S. HEPA and/or charcoal filtration of the exhaust air may be required, depending on the toxin.

Personal Protective Equipment:

When using an open-fronted fume hood or BSC, protective clothing, including gloves and a disposable long-sleeved body covering (gown, laboratory coat, smock, coverall, or similar garment) should be worn so that hands and arms are completely covered.

Eye protection shall be worn if an open-fronted containment system is used.

Other protective equipment may be required, depending on the characteristics of the toxin and the containment system. For example, it may be necessary to use additional respiratory protection if aerosols may be generated and it is not possible to use containment equipment or other engineering controls.

Gloves shall be a type that does not generate static electricity. When handling toxins that are percutaneous hazards (irritants, necrotic to tissue, or extremely toxic from dermal exposure), select gloves that are known to be impervious to the toxin. For assistance in choosing a glove or for additional information, call EH&S at 575-5448.

Appendix I
Biological Waste Management and Disposal at University of Arkansas

A. INTRODUCTION

The purpose of this document is to provide information, requirements, guidelines and procedures for the handling and disposal of hazardous and non-hazardous biological waste for all departments and units on the University of Arkansas campus. The conclusion of this section will briefly focus on the term biomedical waste and its definition.

"BIOLOGICAL WASTE" means discarded biological material from teaching, clinical, and research laboratories and operations; examples include cell culturing media, culture flasks, Petri dishes, gloves, and absorbent pads. This does not include household or office trash, waste from Food Services, Facilities Management, bedding and manure from normal agricultural operations or bedding and litter from noninfectious animals. **"BIOHAZARDOUS WASTE"** means any solid or liquid biological laboratory waste that may be infectious due to its physical and/or biological nature. All waste that contains infectious material or which, because of its biological nature, may be harmful to humans, animals, plants or the environment is biohazardous waste. This includes: waste from infectious animals; bulk human blood or blood products; microbiological waste; pathological waste; viruses; sharps; and hazardous products of recombinant DNA biotechnology and genetic manipulation.

Treatment of all laboratory biological waste prior to disposal is good laboratory practice, and is highly recommended, but biohazardous waste must be treated prior to disposal. Acceptable treatment methods include thermal or chemical disinfection, encapsulation (solidification), or incineration. However, if those treatment methods are not available, then the Office of Environmental Health and Safety must be contacted for biohazardous waste disposal.

The key requirements for disposal of biohazardous waste are that it must be (1) segregated from other waste; (2) securely packaged; (3) specifically labeled to indicate the method of treatment; (4) transported to the point of treatment or disposal by appropriately trained personnel; (5) treated to eliminate the biological hazard; and (6) documented by maintenance of appropriate records.

Biohazardous waste that is mixed with hazardous chemical waste, radioactive waste, or both must be treated to eliminate the biohazard prior to disposal. After treatment, the waste must be managed as hazardous chemical waste through the Office of Environmental Health and Safety (EH&S) or as radioactive waste through the Office of Environmental Health and Safety (EH&S).

"BIOMEDICAL WASTE" means biological waste that is contaminated by human blood or fluids. Such examples of this type of waste include sharps and gauze. Biomedical waste is always picked up by the Office of Environmental Health and Safety (EH&S).

B. RESPONSIBILITY

The Principal Investigator, faculty member or other person with operational responsibility shall assure compliance with these requirements within his/her laboratory or area of responsibility.

C. SEGREGATION

1. Any waste that could produce laceration or puncture injuries must be disposed of as "sharps". Sharps must be segregated from other waste. Metal sharps and broken glass may be commingled with each other, but not with non-sharp waste. Metal sharps such as carpet blades must be put into a metal sharps container and put in a dumpster. For information about an appropriate metal sharps container, contact EH&S at 575-5448. Broken glass must be put into a broken glass container lined with at least one garbage bag. Once the box is filled, then tape it shut and label it broken glass. The box can then be put in a dumpster. For information about a broken glass container, contact EH&S at 575-5448.
2. Waste that is to be incinerated should not be commingled with glass or plastics.
3. Biological waste must not be commingled with chemical waste or other laboratory trash.
4. Biohazardous waste should be segregated from nonhazardous biological waste.

D. CONTAINERS

Containers must be appropriate for the contents; not leak; be properly labeled; and maintain their integrity if chemical or thermal treatment is used. Containers of biohazardous material should be kept closed.

1. LIQUIDS – Use leak-proof containers able to withstand thermal or chemical treatment.
2. METAL SHARPS – Use a rigid, puncture-resistant container (heavy-walled plastic is recommended) suitable for encapsulation and disposal. Container and encapsulated contents must withstand an applied pressure of 40 psi without rupture.
3. NON-HAZARDOUS SOLID BIOLOGICAL WASTE – Use heavy-duty plastic bags or other appropriate containers without a Biohazard Symbol. Red or orange containers should not be used for non-hazardous material.
4. PASTEUR PIPETS and BROKEN GLASSWARE – Use the appropriate rigid, puncture-resistant container (e.g., plastic, heavy cardboard or metal) that can be sealed.
   SOLID BIOHAZARDOUS WASTE – Use CLEAR heavy-duty plastic "BIOHAZARD BAGS" (autoclave bags) or containers for solid biohazardous waste. Hyperlink for VWR Clear autoclaveable Biohazard bags

E. STORAGE

Biological waste may be held temporarily under refrigeration, prior to disposal, in a safe manner that does not create aesthetic (visual or odor) problems. Biohazardous waste should be treated and disposed of promptly and not allowed to accumulate. Containers holding biohazardous material must be clearly labeled, including the Biohazard Symbol. Temporary holding areas for biohazardous waste must be clean and orderly with no access to unauthorized persons (warning signs should be posted).

F. LABELING BIOHAZARDOUS WASTE CONTAINERS

1. Each container of untreated biohazardous waste must be clearly identified as such and must be labeled with the Biohazard Symbol.
2. Each container of treated biohazardous waste to be placed in a UA trash dumpster must be labeled to indicate the method of treatment and to cover biohazard markings. The contents must be placed inside a garbage bag before placing in a UA trash dumpster.
3. Label autoclave bags with commercially available autoclave tape that produces the word **"AUTOCLAVED"** upon adequate thermal treatment. Apply this tape across the Biohazard Symbol on the bag before autoclaving.
4. All containers of encapsulated sharps must be labeled as **"ENCAPSULATED SHARPS"**.

Note: It is not a requirement to label containers of non-hazardous biological waste, but it is recommended to label such containers as "NON-HAZARDOUS BIOLOGICAL WASTE".

G. HANDLING AND TRANSPORT

1. Only properly trained technical personnel can handle or transport untreated biohazardous waste.
2. Treated waste must also be transported by properly trained technical personnel (not custodial).
3. Avoid transporting untreated biohazardous materials or foul or visually offensive material through non-lab or populated areas.

H. TREATMENT AND DISPOSAL METHODS

NOTE: Waste should be treated as near the point of origination as possible.

1. ANIMAL CARCASSES AND BODY PARTS may be incinerated, biodigested, landfilled, or rendered.
2. ANIMAL WASTE, SOLID (bedding, manure, etc.):
    1) Incinerate; or
    2) Disinfect by thermal or chemical treatment; place in a UA trash dumpster; or
    3) Alternative method, with approval of the Campus Biosafety Officer.
3. CHEMICAL WASTE: Biohazardous waste that also contains hazardous chemicals must be managed as hazardous chemical waste trough the Office of Environmental Health and Safety.
4. GENETIC MATERIAL: Disposal of materials containing recombinant DNA or genetically altered organisms must be consistent with applicable NIH Guidelines, in addition to complying with the requirements contained in this document.
5. HUMAN PATHOLOGICAL WASTE:
    a. Human cadavers, recognizable body parts: dispose by cremation or interment.
6. METAL SHARPS: Discarded metal sharps **MUST** be contained, encapsulated and disposed of in a manner that prevents injury to laboratory, custodial and landfill workers. Needles, blades, etc., are considered HAZARDOUS even if they are sterile, capped and in the original container.
   Never place sharps in a trash container or plastic bag that might be handled by custodial staff.
    a. Place sealed containers of encapsulated sharps and blades in a UA trash dumpster.

b. Gas chromatography needles should be thoroughly rinsed to remove hazardous chemicals, then disposed with non-contaminated broken glassware.
c. Do not attempt to recap, bend, break or cut discarded needles.

7. MICROBIOLOGICAL WASTE:
   a. Solid – Disinfect by thermal or chemical treatment; place in a black garbage bag and into UA trash dumpster.
   b. Liquid – Disinfect by thermal or chemical treatment; discharge into the sewer system.
8. NON-HAZARDOUS BIOLOGICAL WASTE:
   a. It is good laboratory practice to autoclave or chemically treat all microbial products prior to disposal, even if the material is not hazardous.
   b. Solid – Place in a UA trash dumpster.
   c. Liquid – Discharge into the sewer system.
   Note: Never pour hot/warm agar down the sink because it will solidify after cooling and clog the drain.
9. PASTEUR PIPETS and BROKEN GLASSWARE:
   a. CONTAMINATED WITH BIOHAZARDOUS MATERIAL:
      1) Disinfect by thermal or chemical treatment; place in a UA trash dumpster; or
      2) Encapsulate and place in a UA trash dumpster. **NOTE: Encapsulation is required if metal sharps are commingled with glass sharps.**
   b. NOT CONTAMINATED: Place in a UA trash dumpster.
   c. **DO NOT INCINERATE GLASSWARE.**
10. PLASTIC WASTE:
   a. CONTAMINATED WITH BIOHAZARDOUS MATERIAL: Disinfect by thermal or chemical treatment; place in a UA trash dumpster.
   b. NOT CONTAMINATED: Place in a UA trash dumpster.
   c. **DO NOT INCINERATE PLASTICS.**
11. RADIOACTIVE WASTE: Biological waste that contains radioactive material must be disposed according to the procedures of the Radiation Safety Officer in EH&S.

I. TRAINING AND HAZARD COMMUNICATION

The Principal Investigator or individual with primary supervisory responsibility must assure that all personnel who work with, or who may contact potentially biohazardous material are informed of the hazards and are trained in the proper procedures and equipment needed to avoid exposure, proper treatment and disposal of biohazardous wastes, and recognition of symptoms of infection or exposure.

J. REFERENCES:

1. *Management and Disposal of Biological Waste at Texas A&M University* http://ehsd.tamu.edu/documents/AgriculturalSafety/biowaste03.pdf
2. Centers for Disease Control/ National Institutes of Health, *Biosafety in Microbiological and Biomedical Laboratories*, 5th Edition, 2009.
3. *University of Arkansas Biological Safety Manual*, 2011.
4. *Arkansas Department of Health, Rules and Regulations Pertaining to the Management of Medical Waste from Generators and Health Care Related Facilities*, 2013.

Appendix II
Transportation of Biological Materials

Researchers at the University of Arkansas often collaborate with researchers from institutions throughout the state and surrounding states as well. The Office of Environmental Health and Safety (EH&S) has the responsibility of ensuring that biological materials are transported safely and responsibly by individuals affiliated with the university. This document outlines unregulated and regulated biological materials as well as proper packaging and handling procedures for biological materials. Once a researcher determines whether the biological material to be transported is unregulated or regulated, then he/she must follow the correct procedures and/or notify EH&S if warranted. If the biological material for transport falls under the category of unregulated biological materials, then proceed to the packing and transport sections. However, if the biological material for transport falls under the category of regulated biological materials, contact EH&S at 575-5448 for proper shipping instructions. If there is a question or concern about the proper category for a particular biological material, contact EH&S for clarification.

Unregulated and Regulated Materials
This section provides information on which biological materials are or are not subject to DOT HMR (U.S. Department of Transportation's 49 CFR "Hazardous Materials Regulations") and IATA DGR (International Air Transport Association's "Dangerous Goods Regulations") infectious substance and genetically modified organism shipping regulations.

Unregulated Biological Materials
The following materials are not subject to DOT and IATA infectious substance shipping regulations:

- Substances that do not contain infectious substances or that are unlikely to cause disease in humans or animals.
- Noninfectious biological materials from humans, animals, or plants. Examples include noninfectious cells, tissue culture, blood, or plasma from individuals not suspected of having an infectious disease, DNA, RNA, or other genetic elements.
- Substances containing microorganisms that are nonpathogenic to humans or animals.
- Substances that have been neutralized or inactivated so that they no longer pose a health risk.
- Environmental samples that are not considered to pose a significant risk of infection (e.g., food and water samples).
- Dried blood spots.
- Fecal occult blood screening tests.
- An infectious substance (other than a Category A infectious substance) contained in a patient sample being transported for research, diagnosis, investigational activities, or disease treatment and prevention; or a biological product when such materials are being transported by a private carrier in a motor vehicle used exclusively to transport such materials.
- Blood or blood components that have been collected for the purpose of transfusion or the preparation of blood products to be used for transfusion or transplantation.
- Tissues or organs intended for use in transplantation.
- A material with a low probability of containing an infectious disease, or where the concentration of the infectious substance is at a level that naturally occurs in the environment and cannot cause disease when exposure to it occurs. Examples of these

materials include foodstuffs and environmental samples (e.g., samples of water, dust, or mold).

- A biological product, including an experimental or investigational product or component of a product, subject to federal approval, permit, review, or licensing requirements such as those required by the Food and Drug Administration (FDA) or U.S. Department of Agriculture (USDA).

Regulated Biological Materials

The materials presented below are subject to DOT and IATA shipping regulations for infectious substances and genetically modified organisms:

- **Infectious substances** are materials regulated for shipping. These materials are known to be, or are reasonably suspected to contain, an animal or human pathogen. A pathogen is a virus, microorganism (including bacteria, plasmids, or other genetic elements), proteinaceous infectious particle (prion), or a recombinant microorganism (hybrid or mutant) that is known or reasonably expected to cause disease in humans or animals. Microorganisms that are unlikely to cause human or animal diseases are not subject to biological shipping regulations.

    - **Category A infectious substances** are materials capable of causing permanent disability, or a life threatening or fatal disease in humans or animals when exposure to them occurs. Category A infectious substances are shipped as infectious substances affecting humans (UN2814) or infectious substances affecting animals (UN2900). Examples of Category A infectious substances are listed in a table in the infectious substances section of the IATA Dangerous Goods Regulations.
    - **Category B infectious substances** are materials that do not meet Category A criteria. Category B infectious substances are shipped as UN3373.

- **Patient specimens** or **diagnostic specimens** are any human or animal materials including but not limited to excreta, secreta, blood, blood components, tissue, and tissue fluids being shipped for the purpose of diagnosis. Patient specimens that have a minimal likelihood of containing pathogens are regulated materials, but they are also exempt from many shipping requirements. Professional judgment is used to determine if a specimen contains pathogens and should be based on the patient's medical history, symptoms, local conditions, and individual circumstances. The outer package must be marked "Exempt human specimen" or "Exempt animal specimen." If there is more than a "minimal likelihood" that a patient specimen contains pathogens, it must be shipped as a Category A or Category B infectious substance.

- **Biological products** are materials that are derived from living organisms and manufactured for use in the prevention, diagnosis, treatment, or cure of disease in humans or animals and are certified by the USDA, FDA, or other national authority. Examples of biological products include certain viruses, therapeutic serums, toxins, antitoxins, vaccines, blood, and blood products. Biological products transported for final packaging, distribution, or use by medical professionals are not subject to biological shipping regulations. Biological products that do not meet these criteria must be shipped as UN2814, UN2900, or UN3373 when appropriate.

- **Genetically Modified Organisms (GMO) or microorganisms (GMMO)** are organisms whose genetic material has been purposely altered through genetic engineering in a way that does not occur naturally. GMOs and GMMOs that are not infectious but that can alter animals, plants, or microorganisms in a way that is not normally the result of natural reproduction are considered a miscellaneous hazard (Class 9) and are shipped as UN3245. GMOs and GMMOs that are infectious must be shipped as UN2814, UN2900, or UN3373.

Source: Lawrence Berkeley National Laboratory (Berkeley Lab), a Department of Energy (DOE) Office of Science lab.

Packaging Unregulated Biological Material

- Guidelines for Packaging and Transporting Biological Materials
  Packages must be clearly labeled as to the contents and constructed of materials to protect the specimen and prevent leakage. Additionally, the OSHA Bloodborne Pathogens Standard requires all packages containing blood/blood products be labeled with the biohazard label.

- Recommended Packaging for Biological Materials
  Primary container (innermost container):
  - Use a vial, tube, or plate made of glass, metal, plastic or other medium suitable for transportation of the material being transported.
  - Clearly identify the contents and avoid abbreviations (e.g. write out *E. coli* K-12 – DH1 rather than just DH1).
  - Wrap the primary container tightly e.g. using Parafilm to ensure that there will be no leakage.

  Secondary container:
  - Use a watertight/leak proof container (e.g. Ziploc bag) and reinforce with an adhesive tape as necessary to contain the contents.
  - Affix a label with a complete list of the contents including the scientific name and the amount in ml for liquids.
  - Surround each primary container with sufficient absorbent packing material to completely absorb the contents should the primary container break.

Transport of Unregulated Biological Material

- Transporting container (if necessary):
  - Use a container made of sufficient strength to protect the specimen.
  - Affix a proper label to identify the contents.
  - Affix an accurate address label with the complete address and phone number for both the shipper and the recipient.

- Transport of Biological Materials in Personal or University Vehicle
  Note: University vehicles are preferred.
  Personnel transporting biological materials must:
  1) have a valid driver's license;
  2) be authorized to use a University of Arkansas vehicle;
  3) should use a University of Arkansas vehicle when available;
  4) use the proper containment and packaging materials en route;

5) notify the Office of Environmental Health and Safety at 575-5448 before transporting material.

A spill kit containing absorbent material, a chlorine disinfectant, a leak-proof waste container, and personal protective equipment (gloves and eye protection) should be available in the transport vehicle.
The transport boxes need to be secured in the transport vehicle, and traveling should be directly from the location of origin to the drop-off location. During transportation the vehicle should only be used for that purpose and there is to be no passenger or food transport. EH&S encourages the use of university-owned vehicles rather than personal vehicles when transporting materials off campus to/from another facility or collaborator.
In the event of a motor vehicle accident, the transporter should follow the steps below:

- Call for emergency assistance, if needed.
- Let all emergency responders know that you are transporting potential biohazards.
- Notify recipient of sample(s) status.
- Arrange for alternate transportation if you are unable to reach your destination.

If a personal vehicle is used for transport, the transporter must have the following:

1) Liability insurance and
2) Proof of insurance inside the vehicle

Under no circumstances may public transportation (taxis, buses, etc.) be used for transport of work-related biological materials.
**When transporting dry ice in a vehicle, the box should not be placed inside the passenger compartment to prevent carbon dioxide accumulation within the vehicle.
Sources: University of Texas Arlington and Georgia Regents University.

Appendix III
Acronyms

BBP	Bloodborne Pathogens
BMBL	Biosafety in Microbiological and Biomedical Laboratories
BSC	Biological Safety Cabinet
BSL	BioSafety Level
BSO	Biological Safety Officer
CDC	Centers for Disease Control and Prevention
DNA	Deoxyribonucleic Acid
DOT	Department of Transportation
EH&S	Environmental Health & Safety
HEPA	High Efficiency Particulate Air
IACUC	Institutional Animal Care and Use Committee
IBC	Institutional Biosafety Committee
LSAT	Laboratory Registration and Select Agent Transfer
NIH	National Institutes of Health
OSHA	Occupational Safety and Health Administration
PHMSA	Pipeline and Hazardous Materials Safety Administration
PI	Principal Investigator
PPE	Personal Protective Equipment
rDNA	Recombinant and/or Synthetic Nucleic Acid Molecules that fall under the scope of NIH guidelines
RG	Risk Group
RSO	Radiation Safety Officer
SOP	Standard Operating Procedure
TS	Tracking System
UAPD	University of Arkansas Police Department
USDA	United States Department of Agriculture
UV	Ultraviolet

Appendix IV
Definition of Terms

Aerosols: Microscopic particles of respirable size (<10 μm) in liquid or solid form suspended in a gas.

Animal Waste: Carcasses, body parts, bulk whole blood and blood products, serum, plasma and other blood components, and bedding of animals.

Bacterial Spores: A stage of bacteria resistant to hash environments and external agents including radiation and acids that require special methods of disinfection.

Biohazard: A biological substance or condition capable of causing death, disease or biological malfunctions in living organisms.

Biodigestion: Heated alkaline hydrolysis tissue digestion system.

Biohazardous Waste: Any kind of laboratory waste that may be infectious or, because of its physical and/or biological nature, may be harmful.

a. Animal waste known or suspected of being contaminated with a pathogen.
b. Bulk human blood or blood products.
c. Microbiological waste.
d. Pathological waste.
e. Infectious waste.
f. Waste products of rDNA biotechnology and genetic manipulation.
g. Sharps.

Biological Agents: Biological agents include bacteria, viruses, fungi, other microorganisms and their associated toxins. They have the ability to adversely affect human health in a variety of ways, ranging from relatively mild, allergic reactions to serious medical conditions, even death. These organisms are widespread in the natural environment; they are found in water, soil, plants, and animals. Because many microbes reproduce rapidly and require minimal resources for survival, they are a potential danger in a wide variety of occupational settings. (U.S. Department of Labor, Occupational Safety & Health Administration).

Biological Indicators: Commercially available microorganisms (e.g., spore strips or vials of *Bacillus* species) which can be used to verify the performance of waste treatment equipment and/or processes.

Biological Product: A virus, therapeutic serum, toxin, antitoxin, vaccine, blood, blood component or derivative, allergenic product, or analogous product, or arsphenamine or derivative of arsphenamine (or any other trivalent arsenic compound) applicable to the prevention, treatment, or cure of a disease or condition of human beings or animals. (*Transporting Infectious Substances Safely, Guide To Changes*, U. S. Department of Transportation, 2006).

Biomedical Waste: Waste contaminated by human blood or fluids, such as sharps or gauze.

Biotoxin: A toxic substance of biological origin.

Bloodborne Pathogens: 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). (Center for Disease Control and Prevention)

Bulk Blood and Blood Products: Discarded bulk (>100 ml.) blood and blood products in a free draining, liquid state; body fluids contaminated with visible blood; and materials saturated or dripping with blood.

Cell Culture: The result of growing cells in vitro derived from multicellular organisms in a favorable artificial environment.

Chemical Disinfection: The use of a chemical agent such as 10% bleach or EPA-approved chemical disinfectant/sterilant (used according to manufacturer's direction) to significantly reduce biological activity of biohazardous material.

Containment: Use to describe safe methods for managing infectious agents in the laboratory environment where they are being handled and maintained. The purpose of containment is to reduce or eliminate exposure of laboratory workers, other persons, and the outside environment to potentially hazardous agents.

Culture: An infectious substance containing a pathogen that is intentionally propagated. Culture does not include a human or animal patient specimen. (*Transporting Infectious Substances Safely, Guide To Changes*, U. S. Department of Transportation, 2006).

Discharge into the Sewer System: Flushing treated liquid biological waste into the UA sanitary sewer system followed by copious quantities of water.

Disinfection: Physical or chemical process that kills or inactivates pathogens such as bacteria, viruses and protozoa preventing the growth of pathogenic microorganisms in the vegetative phase.

Encapsulation: The treatment of sharps waste using a material such as Plaster of Paris (or a commercial product such as Isolyser) which when fully reacted, will encase the waste in a solid protective matrix. The encapsulating agent must completely fill the container. The container and solidified contents must withstand an applied pressure of 40 psi without disintegration.

Incineration: Burning biological waste in an incinerator

Infectious Material: Any substance that is known or reasonably expected to contain a biohazard.

Infectious Waste: Waste containing pathogens or biologically active material which because of its type, concentration, and quantity is capable of transmitting disease.

Lipoviruses: Viruses surrounded by a lipid layer, this affects the virus's ability to be killed by some disinfectants.

Microbiological Waste:

a. Discarded cultures and stocks of infectious agents and associated biological material.
b. Discarded cultures of specimens from medical, pathological, pharmaceutical, research, and clinical laboratories.
c. Discarded live and attenuated vaccines.
d. Discarded used disposable culture dishes.
e. Discarded used disposable devices used to transfer, inoculate, and mix cultures.

NOTE: in vitro tissue cultures that have not been intentionally exposed to pathogens are exempt from the definition of microbiological waste.

Microorganism: Any microbiological or cellular structure capable of reproducing or transferring genetic material.

Mycobacteria: Aerobic acid-fast bacteria that contains a wide range of nutritional types including saprophytic species present in the soil as well as parasitic organisms responsible of tuberculosis and leprosy.

Non-lipid Viruses: Viruses not surrounded by a lipid layer, this makes them more susceptible to some disinfectants.

Parasite: An organism living at the expense of another organism without providing any kind of benefit, but significant damage or injury.

Pathogens: External element capable of causing a disease to a host including humans, animals or plants.

Pathological Waste: pertains to human materials and includes, but is not limited to:

a. Human materials removed during surgery, labor, delivery, spontaneous abortion, autopsy or biopsy including: body parts; tissues and fetuses; organs; bulk blood and body fluids.
b. Laboratory specimens of blood, tissue or body fluids after completion of laboratory examination.
c. Anatomical remains.

Patient Specimen: Human or animal materials collected directly from humans or animals and transported for research, diagnosis, investigational activities, or disease treatment or prevention. Patient specimen includes excreta, secreta, blood and its components, tissue and tissue swabs, body parts, and specimens in transport media (e.g., culture media, blood culture bottles). (*Transporting Infectious Substances Safely, Guide To Changes*, U. S. Department of Transportation, 2006).

Recombinant DNA: Molecules that result from the artificial combination of two DNA segments. The technology of recombinant DNA enables the isolation of a gene from an organism for further manipulation and insertion into a different one.

Select Agents/Select Toxins: Biological agents or Toxins deemed as a threat to the public, animal or plant health, or to animal or plant products.

Serum: Transparent liquid and lightly dense part of the blood that remains after coagulation.

Sharps: Any device having acute rigid corners or edges, or projections capable of cutting or piercing, including:

a. Hypodermic needles, syringes, and blades.
b. Glass pipets, microscope slides, and broken glass items.

Sterilization: The use of a physical or chemical procedure to destroy all microorganisms including large numbers of resistant bacterial spores.

Thermal Treatment:

a. Autoclaving at a temperature of not less than 121°C and a minimum pressure of 15psi for at least 30 minutes (longer times may be required depending on the amount of waste, water content and the type of container used); or
b. Subjecting biological material to dry heat of not less than 160°C under atmospheric pressure for at least two hours. (Exposure begins after the material reaches the specific temperature and does not include lag time).

Toxin: The toxic material or product of plants, animals, microorganisms (including, but not limited to, bacteria, viruses, fungi, rickettsia, or protozoa), or infectious substances, or a recombinant or synthesized molecule, whatever their origin and method of production, and includes:

a. Any poisonous substance or biological product that may be engineered as a result of biotechnology produced by a living organism; or
b. Any poisonous isomer or biological product, homolog or derivative of such a substance.

Treatment: Any chemical, thermal or mechanical process that significantly reduces or eliminates the hazardous characteristics, or that reduces the amount of waste.

Vegetative Bacteria: Bacteria not in the spore stage of their life cycle, these bacteria are easier to sterilize than those in the spore form.

Virus: A microscopic agent carrying an infection that can only replicate within the cells of other organisms.

Appendix V
Resources

- Biological Safety Forms can be found on University of Arkansas EH&S webpage.
- Chemical Hygiene Plan can be found at University of Arkansas EH&S webpage.
- EH&S Safety Training can be found on University of Arkansas BioRAFT site.

APPENDIX VI
Classification of Hazards and Levels of Containment:

Agents listed by the National Institutes of Health (NIH) are those biological agents known to infect humans as well as selected animal agents that may pose theoretical risks if inoculated into humans. Included are lists of representative genera and species known to be pathogenic; mutated, recombined, and non-pathogenic species and strains are not considered. Non-infectious life cycle stages of parasites are excluded. The NIH list can be found as Appendix VII of the BMBL. These lists are the more commonly encountered agents and are not meant to be all-inclusive. The agents are divided into risk groups, which correspond to the equivalent biosafety level. For a complete discussion of the levels of containment, the reader is referred to the CDC/NIH manual *Biosafety in Microbiological and Biomedical Laboratories* available from the U. S. Government Printing Office. (HHS Publication No (CDC) 93-8395)

(Note: There are certain non-indigenous animal pathogens that the importation, possession or use of is restricted by law,. Contact the Office of Research Compliance for more information.)

Biosafety Level 1:

Work is done with defined and characterized strains of viable microorganisms not known to consistently cause disease in healthy adult humans. BSL-1 is suitable for work involving agents of known or of minimal potential hazard to laboratory personnel and the environment.

RG-I agents are not associated with disease in healthy adult humans.

Examples of microorganisms: *Bacillus subtilis*, *Lactobacillus acidophilus, non-pathogenic strains of E. Coli.*

A. Laboratory Practice and Technique

The following Standard Microbiological Practices apply to agents assigned to BSL-1:

1. Access to the laboratory is limited or restricted at the discretion of the Principal Investigator/Supervisor when experiments are in progress.
2. Work surfaces are decontaminated once a day and after any spill of viable material.
3. All contaminated liquid or solid wastes are decontaminated before disposal. Contaminated materials that are to be decontaminated at a site away from the laboratory are placed in a durable leak-proof container, which is closed before removal from the laboratory.
4. Technical pipetting devices are used; mouth pipetting is prohibited.
5. Eating, drinking, smoking, and applying cosmetics (including lip balm) are not permitted in the work area. Food stored in cabinets or refrigerators should be located outside of the work area.
6. Persons must wash their hands after handling viable materials and animals and before leaving the laboratory.

7. All procedures are performed carefully to minimize the creation of aerosols.

8. Laboratory coats or gowns are worn to prevent contamination or soiling of street clothes.

9. A sign incorporating the universal biohazard symbol must be posted at the entrance to the laboratory when infectious agents are present. The sign may include the name of the agent(s) in use, and the name and phone number of the laboratory supervisor or other responsible personnel. Other posted information must include: the laboratory's biosafety level and required procedures for entering and exiting the laboratory. Agent information should be posted in accordance with institutional policy.

B. Safety Equipment

There are no special considerations for primary barriers.

Special containment equipment is not required or generally used.

PPE includes lab coat, gloves, eye protection (safety googles), and additional protective equipment when needed.

C. Facility Design

Basic level of containment. The laboratory is not separated from the general traffic patterns in the building.

There are no special considerations for secondary barriers other than a sink for hand washing.

Work is conducted on open bench tops.

D. Training and Supervision

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.

Biosafety Level 2:

Persons who are at increased risk of acquiring infection or for whom infection may be unusually hazardous are not allowed in the laboratory or animal rooms.

Examples: *Salmonella*, Hepatitis B virus, bloodborne pathogens (BBP), human body fluids.

A. Laboratory Practice and Technique

It builds upon BSL-1.

BSL-2 requires the same Standard Microbiological Practices as BSL-1. *In addition*,

1. Laboratory personnel must have specific training in handling pathogenic agents and must be directed by competent scientists.
2. Access to the laboratory is limited or restricted at the discretion of the PI/Supervisor when experiments are in progress.
3. Procedures that may create infectious aerosols must be conducted in a BSC or other suitable containment or with the use of personal protective equipment.

When appropriate, considering the agent(s) handled, baseline serum samples for laboratory and other at-risk personnel are to be collected and stored. Additional serum specimens may be collected periodically, depending on the agents handled or the function of the facility.

Laboratory personnel working with human derived materials should refer to the OSHA Bloodborne Pathogen Standard Regulation 29CFR via this link:
https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10051&p_table=STANDARDS

B. Safety Equipment

Procedures with aerosol or high splash potential may increase the risk of personnel exposure must be conducted in primary containment equipment, or in devices such as BSCs or safety centrifuge cups.

PPE includes gloves, gowns, face protection, splash shields. Laboratory coats, gowns, or smocks are to be worn while in the laboratory. Before leaving the laboratory for non-laboratory area (e.g., library, administrative offices), this protective clothing is to be removed and left in the laboratory or covered with a clean coat not used in the laboratory. Special care is taken to avoid skin contamination with infectious materials; gloves are to be worn when handling infected animals and when the skin contact with infectious materials is unavoidable.

A BSC (Class 1 or 2) or other appropriate personal protective or physical containment devices is to be used whenever:

1. Procedures with a high potential for creating infectious aerosols are conducted. These may include centrifuging, grinding, blending, vigorous shaking or mixing, sonic disruption, by sparging a gas through a liquid, by boiling a liquid or by the opening of a pressure or vacuum containers, inoculating animals intranasally, and harvesting infected.

2. High concentrations or large volumes of infectious agents are used. Such materials may be centrifuged in the open laboratory if sealed heads or centrifuge safety cups are used and if they are only in a biological biosafety cabinet.

C. Facility Design

Lab must have hand washing sinks and waste decontamination.

D. Training and Supervision

The PI/Supervisor shall establish policies and procedures whereby only persons who have been advised of the potential hazard and meet any specific entry requirements (e.g., immunization) enter the laboratory or animal rooms. Special training is required for handling Bloodborne Pathogens (BBP).

Biosafety Level 3:

RG-3 agents are associated with serious or lethal human disease for which preventive or therapeutic interventions may be available.

The BSL-3 laboratory must have special engineering and design features to be applicable to clinical, diagnostic, teaching, research, or production facilities in which work is done with indigenous or exotic agents that may cause serious or potentially lethal disease as a result of exposure by the inhalation route.

Examples of microorganisms: H5N1 influenza virus, *Yersinia pestis*, West Nile virus.

For a detailed description of BSL-3 requirements, please see the BMBL. *Currently there are no facilities on the University of Arkansas campus that are approved for BSL-3 work involving human pathogens*. Any proposals involving RG-3 agents must come to the attention of the IBC.

The University of Arkansas does not currently have containment facilities that support BSL-3 research and RG-3 agents are not to be used

Biosafety Level 4:

RG-4 agents are likely to cause serious or lethal human disease for which preventive or therapeutic interventions are not usually available.

The University of Arkansas does not have containment facilities that support BSL-4 research and RG-4 agents are not to be used.

Appendix VII
Emergency Contacts

- **In case of emergency: Dial 911**
- **For assistance involving occupational, environmental, biological, chemical and/or radiation safety**

Monday – Friday 7:30am-5:00pm
Environmental Health & Safety (EH&S)
(479) 575 5448

After hours and weekends
University of Arkansas Police Department (UAPD)
(479) 575 2222

- Biological or Blood Spill

Name	Office	Cell	Email
Jim Hogan	(479) 575-3533	(479) 879-2168	jrhogan@uark.edu
Tim Webb	(479) 575-7916	(479) 841-5856	txw019@uark.edu
Wayne Brashear	(479) 575-4419	(479) 263-1622	wbrashe@uark.edu
**Richard Ashworth	(479) 575-3597	(479) 263-2840	ashworth@uark.edu
**Keith Roberts	(479) 575-6185	((479) 305-4066	kwr001@uark.edu
**Mike Johnson	(479) 575-6601	(479) 263-4157	mrj03@uark.edu
*Kyle McKaughan	(479) 575-6475	(479) 644-0587	kmckaugh@uark.edu

- Chemical Spill

Name	Office	Cell	Email
Rick Williams	(479) 575-4079	(479) 879-2161	raw002@uark.edu
Justice Williams	(479) 575-8473	(479)841-0873	jlw067@uark.edu
Wayne Brashear	(479) 575-4419	(479) 263-1622	wbrashe@uark.edu
**Richard Ashworth	(479) 575-3597	(479) 263-2840	ashworth@uark.edu
**Keith Roberts	(479) 575-6185	(479) 305-4066	kwr001@uark.edu
**Mike Johnson	(479) 575-6601	(479) 263-4157	mrj03@uark.edu
*Kyle McKaughan	(479) 575-6475	(479) 841-3042	kmckaugh@uark.edu

- Radiological Incident

Name	Office	Cell	Email
Peter Chowdhury	(479) 575-3379	(479) 263-2572	pradyotc@uark.edu
Tim Webb	(479) 575-7916	(479) 841-5856	txw019@uark.edu
Rick Williams	(479) 575-4079	(479) 879-2161	raw002@uark.edu
Wayne Brashear	(479) 575-4419	(479) 263-1622	wbrashe@uark.edu
**Richard Ashworth	(479) 575-3597	(479) 263-2840	ashworth@uark.edu
**Keith Roberts	(479) 575-6185	(479) 305-4066	kwr001@uark.edu
**Mike Johnson	(479) 575-6601	(479) 263-4157	mrj03@uark.edu
*Kyle McKaughan	(479) 575-6475	(479) 644-0587	kmckaugh@uark.edu

*Call if the incident involves the Agricultural Farm.
**Administrative Personnel.