Biosafety Manual

Institutional Biosafety Committee (IBC)
University of Wisconsin-La Crosse

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Adapted with permission from *UW-Madison Researchers' Biosafety Manual*

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Links Verified 5/2025, but if broken please refer to IBC website to see PDF version of file

Introduction

The University of Wisconsin-La Crosse (UWL) Biosafety Manual is intended as a resource to provide personnel with the best practices for working with biological materials that entail a potential risk to humans, animals, or the environment. Complying with best practices helps ensure research is conducted in a safe and secure manner in accordance with all applicable regulations and guidelines. This manual is based on the *National Institutes of Health (NIH) Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules* (NIH Guidelines) and the Centers for Disease Control & Prevention (CDC) *Biosafety in Microbiological and Biomedical Laboratories* (BMBL).

For applicable classroom projects and research involving biological materials that entail a potential risk to humans, animals, plants, or the environment, a UWL faculty or staff member must complete a Biosafety Protocol Application to be reviewed by the Institutional Biosafety Committee (IBC). Failure to comply with these requirements may result in intervention by the IBC, which could result in enforced cessation of the activity. Activities involving human-derived materials must additionally comply with UWL Environmental Health & Safety requirements (e.g., training, exposure control/BBP plan). Activities involving vertebrate animals must additionally comply with UWL Institutional Animal Care & Use Committee (IACUC) policies and procedures. Activities involving the deliberate transfer of recombinant or synthetic nucleic acids, recombinant microbes, or cells into human research participants (human gene transfer studies) must additionally comply with UWL Institutional Review Board (IRB) for the Protection of Human Subjects requirements.

A copy of this guide, along with other IBC resources, is available at the UWL IBC website.

Contacts

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Institutional Biosafety Committee (IBC) Statement of Purpose

The IBC is charged with responsibility for oversight of classroom projects and research using biological materials that entail a potential risk to humans, animals, or the environment. This includes activities involving recombinant or synthetic nucleic acid molecules; infectious agents or pathogens; biological toxins; human-derived tissues, fluids, and cells; non-human animal-derived tissues, fluids, and cells that are infectious, potentially infectious, or recombinant; or other biological materials that may be toxic to living organisms. The IBC is authorized to approve, require modifications to secure approval, or disapprove proposed activities. The IBC is further authorized to suspend or revoke authorization for

previously approved activities that are not being conducted in accordance with the approved protocol, the IBC's requirements, federal or state laws or regulations, or institutional policies applicable to biological research. The IBC may also suspend or revoke authorization for previously approved research when the research or its conduct creates an unexpected serious potential threat to safety, health, or the environment. In addition, the IBC is authorized to draft and implement policy and to set other requirements related to the use of biological materials in research or teaching, and to serve as the institutional review entity for potential Dual Use Research of Concern (DURC) and research involving Pathogens with Enhanced Pandemic Potential and Select Agents or Toxins.

The Chancellor has designated the Associate Vice Chancellor for Academic Affairs/Research Integrity Officer (RIO) to monitor the operation of the IBC and to appoint its membership. The Office of Research & Sponsored Programs (ORSP) serves the IBC in an administrative role. The IBC is mandated by the US Department of Health and Human Services (HHS), *National Institutes of Health (NIH) Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules* (NIH Guidelines). The responsibilities of this committee extend beyond activities involving recombinant or synthetic nucleic acid molecules to all biological materials that entail a potential risk to humans, animals, or the environment. In addition to the NIH Guidelines, the recommendations of the Centers for Disease Control & Prevention (CDC) *Biosafety in Microbiological and Biomedical Laboratories* (BMBL) are adopted as standards of conduct.

IBC Responsibilities

IBC supports and critically evaluates applicable UWL biological classroom projects and research to protect the health and safety of the university community, visitors, and neighbors, and ensure compliance with applicable regulations and guidelines. As part of fulfilling its charge, the IBC will:

- Review protocols that involve biological materials for safety, regulatory compliance, and protection of human and animal health and the environment. Collaborate with other committees and offices such as the Institutional Animal Care and Use Committee (IACUC), Environmental Health & Safety, and Institutional Review Board (IRB) to assure that biological safety issues are properly addressed. Periodically review criteria for mutual referral of protocols.
- Give advice and counsel to institutional officials concerning safe use and management of biological materials and compliance with regulations to support and achieve excellence in biological safety.
- Adopt policies that guide, support, and promote high standards of safety, regulatory compliance, and protection of human and animal health and the environment in activities involving biological materials.
- Perform reviews of campus biological safety programs and biological safety aspects of regulatory compliance documents that require review.
- Review biological safety training programs, records, plans, and priorities as needed to help ensure optimum availability of needed and required training.
- Provide a forum for the campus community to raise concerns regarding the safe use and handling of biological materials and advise the Research Integrity Officer (RIO) in the resolution of disputes regarding biological safety issues.
- Suspend research and/or revoke a protocol in instances where necessary according to the IBC charge and responsibilities.

Administrative support for the functions of the IBC is provided by the Office of Research & Sponsored Programs (ORSP). Approval and registration of the protocols are transmitted to investigators and to ORSP to comply with federal regulations, funding agency requirements, institutional policies, and all other applicable regulations and requirements.

Appointment Process & Length of Service

The IBC members are appointed by the Associate Vice Chancellor for Academic Affairs/Research Integrity Officer (RIO) with the concurrence of the Provost under the authority of the Chancellor. Each voting member of the IBC will serve for a three-year term. The Associate Vice Chancellor for Academic Affairs/Research Integrity Officer (RIO) may reappoint any member for additional term(s). *Ex officio* members serve as long as they are in their respective positions.

IBC Membership

The IBC is composed of faculty/staff; at least two community members; *ex officio* members; subject matter experts; and ad hoc consultants per NIH Guidelines, Section IV. Regular members are selected for their expertise in subjects for which the committee will review protocols. The RIO and ORSP administrative support serve as a permanent, non-voting, *ex officio* members. The IBC Coordinator is appointed by the RIO and serves as a voting, *ex officio* member. Subject matter experts may be appointed as non-voting, ad hoc consultants to advise the committee in areas such as vertebrate animals, human subjects, Select Agents and Toxins, occupational health, and legal affairs.

Research Requiring IBC Protocol Approval

If classroom projects and/or research involves any biological materials that entail a potential risk to humans, animals, or the environment, a Biosafety Protocol Application must be completed. This includes work with materials that are not subject to the NIH Guidelines or that are exempt under the NIH Guidelines, Section III-F (see Appendix A). Protocol Processing

The Biosafety Protocol Application serves as a tool to gather relevant information about activities that involve the criteria for which a protocol must be submitted. The protocol is submitted as an email attachment to the Office of Research & Sponsored Programs at grants@uwlax.edu. There are several types of submissions:

- **New** protocols are the first submission to obtain IBC approval for a 3-year period.
- **Renewals** of existing protocols are required every 3 years to extend IBC approval of ongoing work for another 3-year period.
- **Revisions** must be submitted for changes in research elements, biological materials used, and/or locations.
- **Personnel & Award Modifications** serve to add or remove personnel, add external awards, or change the PI associated with an approved protocol.
- **Protocol Progress Reviews** for projects subject to DURC and/or PEPP standards must be submitted annually or semi-annually.

New Biosafety Protocols must be accompanied by copies of related CITI training completion certificates for all personnel listed in the protocol (faculty, staff, and students) (see the IBC webpage for information on how to access and complete training). Personnel modifications to add faculty, staff, or students to a protocol must also be accompanied by copies of CITI training completion certificates for all individuals added in the modification form. Personnel modifications must also be submitted to remove faculty or staff from a protocol; students do not need to be formally removed from a protocol. Students enrolling in laboratory courses do not need to be added to protocols and are not required to complete CITI training modules unless directed by the instructor.

Biosafety Protocols may be subject to the NIH Guidelines. Protocols that are not subject to the NIH Guidelines may not require review by the full IBC and may be eligible for administrative review by ORSP and/or primary review by the IBC Coordinator or a designee with relevant expertise. For protocols subject to the NIH Guidelines, expedited reviews by an individual or subcommittee to approve such protocols on behalf of the entire IBC are not permitted by the NIH Guidelines. All protocols subject

to the NIH Guidelines, with the exception of those exempt under Section III-F of the Guidelines, will be reviewed and approved when a quorum of the IBC is present at a convened meeting.

Complete protocols must be submitted to the IBC at least two weeks prior to an IBC meeting to ensure the protocol will be reviewed at the upcoming meeting.

Exempt Activities

All activities involving biological materials that entail a potential risk to humans, animals, or the environment must have a corresponding Biosafety Protocol Application registered with the IBC. However, activities that are not subject to the NIH Guidelines (e.g., do not involve recombinant or synthetic nucleic acid molecules) *or* activities involving recombinant or synthetic nucleic acid molecules that are exempt from the NIH Guidelines under Section III-F may have the protocol reviewed only by the IBC Coordinator or designee rather than the full IBC. The Coordinator or designee will verify the activity has been correctly categorized. **Researchers/instructors are not permitted to deem their own research as being exempt from any review.** At the discretion of the Coordinator or designee, a protocol that is not subject to the NIH Guidelines may be required to undergo review by the full IBC (e.g., projects involving higher risk materials).

Meeting Procedures & Protocol Review

Reviews of Biosafety Protocols focus on the risks of the materials and the mitigating measures. The IBC does not judge the merits of the scientific inquiry, traditional ethical considerations (unless it pertains to elements of public safety under the IBC review purview per NIH Guidelines), or review the scientific approach of the research itself, but the committee reviews for the purpose of risk assessment in accordance with the NIH Guidelines, the CDC Biosafety in Microbiological and Biomedical Laboratories (BMBL), and applicable federal, state, and institutional regulations and policies.

Protocol Administrative Pre-Review

Protocols, renewals, revisions, and semi-annual reviews are submitted by the PI to the Office of Research & Sponsored Programs (ORSP) at grants@uwlax.edu. Complete protocols must be submitted at least two weeks prior to an IBC meeting to ensure the protocol will be reviewed at the upcoming meeting. After submission, ORSP conducts an administrative pre-review to ensure the submission includes all the required components and then forwards the protocol to the IBC Coordinator. Semi-annual reviews also follow this process.

Personnel and award modifications can be processed and approved by ORSP without the need for further review or approval.

Protocol Primary Review

Once ORSP forwards the protocol, renewal, or revision to the IBC Coordinator, the Coordinator conducts a primary review. The Coordinator reviews for compliance with the NIH Guidelines, IBC policies and requirements, and standard biosafety practices outlined in the UWL Biosafety Manual and the CDC Biosafety in Microbiological and Biomedical Laboratories (BMBL). The Coordinator determines whether review by the full IBC is required and then communicates that information to ORSP.

Protocols that require full IBC review are selected according to the following criteria:

- Projects involving organisms that could have a significant impact on the environment if accidentally released from the laboratory (e.g., exotic plants, nonindigenous plant pathogens, regulated insects)
- Projects involving activities that are subject to the NIH Guidelines, Sections III-A through III-E
- Projects involving gene drive modified organisms (GDMOs) subject to the NIH Guidelines, Section III-D-8

- Projects that require BSL3 containment or involve large scale production under BSL1-LS or BSL2-LS
- Human gene therapy trials, subject to NIH Guidelines, Section III-C
- Dual Use Research of Concern
- Pathogens with Enhanced Pandemic Potential
- Select Agents and Toxins
- Protocols selected at the discretion of the IBC Coordinator or designee

Protocols that do not require full IBC review and that may be approved by the IBC Coordinator or a designee with subject matter expertise on behalf of the IBC include the following:

- Those that are categorized under NIH Guidelines, Section III-F
- Protocols not subject to the NIH Guidelines that do not otherwise meet the criteria requiring full IBC review
- Certain revisions deemed similar enough to previously approved work

If alternate or additional expertise is needed to evaluate protocols that do not require full IBC review, the IBC Coordinator may designate another individual with relevant expertise to conduct the primary review. Approvals for protocols not requiring full IBC review will be provided in writing to the PI by ORSP following IBC Coordinator approval. If information is missing, unclear, incongruent, or deviates from established standards, the protocol will be returned to the PI for revision.

Protocol IBC Review

For protocols requiring review by the full IBC, protocols will be sent by ORSP to IBC members at least one week prior to a scheduled IBC meeting. If needed, non-voting, ad hoc consultants may additionally be invited to review and weigh in on specific aspects of a protocol.

When a protocol is reviewed by the full IBC, one of the following decisions will be made:

- **Approve**. The protocol is accepted as provided to the committee and registered by ORSP.
- **Approve with contingency/ies**. The protocol is returned to the PI, who is required to take additional steps before the protocol will be approved. The protocol must be revised to the satisfaction of the IBC Coordinator.
- **Approve with contingency/ies** – **must go back to designated reviewer(s)**. The protocol is returned to the PI, who is required to take additional steps before the protocol will be approved. The protocol must be revised to the satisfaction of the designated IBC reviewer(s) with the expertise to evaluate if the revision requirements have been met.
- **Table**. The protocol has significant deficiencies and/or insufficient information to conduct the risk assessment that must be addressed before the committee will reconsider it.
- **Reject**. This action is indicative of significant problems with the protocol. The IBC Coordinator and/or designated reviewer(s) with expertise in the related areas sends a memo to the investigator explaining the action taken by the IBC.

Previously approved protocols will be submitted for complete review at least every three years. In addition, any changes to the experiment to which the NIH Guidelines apply must be reviewed by the IBC. Finally, protocol changes that require significant changes in safety precautions (e.g., changes in PPE, administrative controls, engineering controls) must be reviewed by the IBC.

The IBC has the discretion to withhold protocols from the agenda if the protocol is deemed not ready for review.

The IBC may ask the PI or representative to attend the meeting in order to help clarify points and answer questions when their protocol is being reviewed. A PI or representative may attend any open session IBC meeting or when their protocol is being discussed during a closed session IBC meeting.

The results of the IBC's review of a protocol will be communicated to the PI in writing, facilitated by ORSP. In the event a protocol is approved with contingency/ies, the notification will include the additional steps the investigator is required to take before the protocol will be approved.

IBC Protocol Appeals Process

If a PI disagrees with the determination of their submitted protocol to the IBC, they may appeal the decision initially to grants@uwlax.edu. To appeal, the PI must address why they disagree with the IBC's decision using support from the applicable NIH statues and guidelines. The IBC will reevaluate the submitted protocol. If the matter is not resolved through this initial re-review, it can be escalated to the Research Integrity Officer (RIO) for an external IBC for review and consultation at the PI's request. The PI is responsible for identifying funding to cover the review costs for an externally administered IBC (e.g., extramural funding, start-up costs).

Activities Requiring Oversight by Multiple Compliance Committees

Activities requiring oversight by IBC and Environmental Health & Safety (EHS): If human-derived materials are included in the protocol, researchers must contact UWL Environmental Health & Safety to ensure compliance with OSHA bloodborne pathogens standards (e.g., annual training, exposure control/BBP plan).

Activities requiring review by IBC and IACUC: Activities involving vertebrate animals that have been administered recombinant or synthetic nucleic acids, administered cells or microbes that have been recombinantly modified, administered pathogens or biological toxins, or genetically modified using recombinant techniques must be reviewed by IBC and IACUC. IBC protocol approval is required before an IACUC protocol can be approved.

Activities requiring review by IBC and IRB: Activities involving the deliberate transfer of recombinant or synthetic nucleic acids, recombinant microbes or cells into human research participants (human gene transfer studies) must be reviewed by IBC and IRB. IBC protocol approval is required before an IRB protocol can be approved.

Open Meetings Law

The committee is subject to Wisconsin Open Meetings Law. Actions may be taken only at meetings that are announced and open to the public. A notice of the meeting is publicly posted. Specific statutory exceptions from the requirement to meet in open session allow the conduct of certain business in closed session.

Closed Session & Confidentiality

Protocols may contain information that must be protected due to confidentiality agreements and/or impact of disclosure on competitive positioning or the ability to obtain a patent and/or to ensure the safety and security of research facilities, such as in the case of work involving Select Agents and Toxins or research subject to Dual Use Research of Concern (DURC). Such protocols will be discussed in closed session.

Every protocol is assumed to contain confidential information, and release of copies to an individual outside of the committee may be done only with the permission of the PI. If an external person or entity requests a copy of the protocol, UWL's records custodian should be contacted so that the request can be handled pursuant to the university's standard processes. Copies of protocols may not be retained by committee members and consultants and must be destroyed (e.g., shredded) prior to disposal.

Reporting of Incidents, Violations, Accidents & Illnesses

In accordance with the NIH Guidelines, significant problems with or violations of the NIH Guidelines and any significant research-related accidents or illnesses will be reported to the NIH Office of Science Policy (OSP) within thirty days or immediately depending on the nature of the incident. PIs are responsible for reporting incidents within 24 hours by submitting an IBC Incident Report Form to grants@uwlax.edu. Reports will be submitted to the NIH OSP by the Associate Vice Chancellor for Academic Affairs/Research Integrity Officer (RIO). Additional information about incident reporting requirements can be found in the NIH incident reporting FAQs.

The following types of incidents must be reported to OSP immediately:

1. Any spills or accidents in BSL-2 laboratories resulting in an overt exposure *or*
2. Spills or accidents occurring in high containment (BSL-3 or BSL-4) laboratories resulting in overt or potential exposure

Any spill or accident involving recombinant DNA or synthetic nucleic acid molecules research of the nature described above or that otherwise leads to personal injury or illness or to a breach of containment must be reported to OSP. These kinds of events might include skin punctures with needles containing recombinant DNA or synthetic nucleic acid molecules, the escape or improper disposition of a transgenic animal, or spills of high-risk recombinant materials occurring outside of a biosafety cabinet. Failure to adhere to the containment and biosafety practices articulated in the NIH Guidelines must also be reported to OSP.

Minor spills of low-risk agents not involving a breach of containment that were properly cleaned and decontaminated generally do not need to be reported. OSP should be consulted if the IBC is uncertain whether the nature or severity of the incident warrants reporting; OSP can assist in making this determination.

Meeting Schedule

IBC meetings are posted publicly on the university website in accordance with Wisconsin Open Meetings Law. Unless otherwise noted, IBC meetings usually are held on campus and typically last one hour. Meetings may be cancelled if it is unlikely that a quorum will be present or if there is not enough business to be conducted. Committee members will be notified when this is the case.

Noncompliance Policy

UWL defines noncompliance as any failure to follow (1) federal regulations, state laws, or institutional policies relevant to biosafety, or (2) the requirements and determinations of the reviewing IBC. Relevant regulations and policies include, but are not limited to, the NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules, CDC Biosafety in Microbiological and Biomedical Laboratories (BMBL), UWL Biosafety Manual, and UWL Environmental Health & Safety policies. Failure to follow any portion of UWL's IBC policy may result in an investigation, report, and/or finding of noncompliance. Findings of noncompliance will result in corrective actions. See UWL's IBC Noncompliance Policy for additional information. Individuals concerned that they or another UWL researcher may be out of compliance must contact the IBC, ORSP, or Research Integrity Officer (RIO) immediately. Noncompliance concerns can be submitted via an anonymous Qualtrics survey posted on the IBC website, or individuals can reach out directly to ORSP, the IACUC & IBC Coordinator, IBC Chair, or RIO.

Principal Investigator (PI) Responsibilities

For the purposes of activities requiring IBC review and approval, only a UWL faculty or staff member with a continuing appointment may be listed as the principal investigator (PI) on a Biosafety Protocol. Students are not eligible to be listed as PIs on Biosafety Protocols.

Biosafety Protocol

IBC monitors and reviews research through the use of a Biosafety Protocol Application. The PI is responsible for maintaining an up-to-date protocol if their research at UWL involves any of the following:

- Recombinant (transgenic) or synthetic DNA/RNA organisms or materials, including human gene therapy
- Microbes and disease-causing agents including bacteria, viruses, fungi, prions, protozoa, and parasites
- Large scale propagation consisting of a volume greater than 10L or more in one vessel
- Human cells and cell culture, organs or tissues, or biological samples; however, this does not apply to preserved biological samples
- Non-human cells and cell culture, organ or tissues, or biological samples that are infectious, potentially infectious, or recombinant; however, this does not apply to preserved biological samples
- Animals (vertebrate and/or invertebrate) that are recombinant (transgenic), exotic, and/or grown in association with pathogens, biological toxins, and/or recombinant materials
- Plants that are recombinant (transgenic), exotic, and/or grown in association with biological toxins, pathogenic or recombinant microbes and/or pathogenic or recombinant small animals (insects, etc.)
- Soils, seeds, plants, plant pathogens, or other materials that may be at an increased risk for contamination with pathogens
- Biological toxins (this does not include toxic chemicals or antibiotics)
- Select agents or toxins (see Research with Select Agents and DURC & PEPP)
- Dual use research of concern (DURC) agents (see DURC & PEPP)
- Pathogens with enhanced pandemic potential (PEPP) (see DURC & PEPP)

If experiments performed in teaching labs are subject to the NIH Guidelines, a biosafety protocol is required. In the absence of recombinant work, a biosafety protocol is recommended for lab courses and can be reviewed by the IBC to ensure proper biosafety precautions are taken.

If research involves any of the above, the PI must do the following:

1. Conduct an initial risk assessment (see Risk Assessment).
2. Complete and submit a Biosafety Protocol Application for IBC review to the Office of Research & Sponsored Programs (ORSP) at grants@uwlax.edu.

Complete protocols must be submitted to the Office of Research & Sponsored Programs at least two weeks prior to an IBC meeting to ensure the protocol will be reviewed at the upcoming meeting.

New protocols are the first submission of a Biosafety Protocol Application to obtain IBC approval for a 3-year period. This form must be accompanied by CITI training completion certificates for the PI and any other personnel listed in the form. CITI training completion certificates are valid for 3 years; training expiration is automatically tracked by CITI.

Renewals of existing protocols are required to be submitted every 3 years to extend IBC approval of ongoing work for another 3-year period. A PI should submit a Biosafety Protocol Application marked “renewal” for such projects.

Revisions must be submitted for changes in research elements, microbes utilized, and/or locations. A PI should submit a Biosafety Protocol Application marked “revision” for projects requiring such changes.

Personnel & Award Modifications serve to change personnel or external awards associated with the protocol. A PI should submit a Personnel & Award Modification Form for such changes. CITI training completion certificates must be submitted with the form for any personnel being added to a protocol.

Once a project with an approved protocol has been completed, a PI should complete an **IBC Protocol Closure Form**.

All Biosafety Protocols, modifications, and closure forms should be submitted to the Office of Research & Sponsored Programs at grants@uwlax.edu.

Training

The PI is responsible for ensuring that all personnel, including but not limited to faculty, staff, and students, working with biological or recombinant materials in their laboratory or related to their research are listed in the related Biosafety Protocol Application and complete the required biosafety training. In addition, the PI should ensure laboratory specific training is provided for all faculty, staff, students, and visitors. Personnel are responsible for updating their training certification in the event of expiration or when procedural or policy changes occur.

Teaching laboratory courses: Students enrolling in laboratory courses do not need to be listed in a PI’s Biosafety Protocol Application as personnel and are not required to complete CITI training modules unless directed by the instructor. This includes students enrolled in independent research courses (e.g., BIO/CHM 499). As part of the Biosafety Protocol Application submission for laboratory courses, a PI must summarize the training provided to students who will be involved in the course (e.g., hands-on training, instructor-based training, online learning) and include the summary as an attachment with the protocol submission.

UWL provides biological safety training to inform and prepare faculty, staff, and students for work in campus biological research laboratories in compliance with standards set forth by the NIH and CDC. Training is provided online through CITI (https://www.citiprogram.org/), and **basic IBC training is valid for three years**. All faculty, staff, and students listed in a Biosafety Protocol Application must complete the training modules designated below. The minimum passing aggregate score for quizzes is 80%, which is automatically tracked by CITI. CITI training completion certificates must be attached to the Biosafety Protocol Application for all personnel listed in the protocol. Basic training requirements are outlined in the table below.

Basic IBC Training Requirements

Course	Faculty & Staff	Students
Biosafety Course Overview (13314)	Required	Required
Laboratory-Acquired Infections (13454)	Required	Required
Biohazard Risk Assessment (13455)	Required	Optional
Medical Surveillance (13456)	Required	Optional
Risk Management: Work Practices (13898)	Required	Required
Risk Management: Personal Protective Equipment (13458)	Required	Required
Risk Management: Emergency and Spill Response (13459)	Required	Required
Risk Management: Engineering Controls (13929)	Required	Optional
Work Safely with Sharp Instruments (13899)	Required	Required
Disinfection and Sterilization (13900)	Required	Required
Centrifuge Precautions (13945)	Required	Optional

Additional training requirements are listed below based on the type of research being conducted. Training must be completed by all personnel (faculty, staff, students) engaged in the activities. **Most training below is valid for three years**, with the exception of OSHA Bloodborne Pathogens training, which must be renewed annually and is overseen by UWL Environmental Health & Safety. See the EHS Laboratory Safety & Chemical Disposal Guide, Appendix G: Training for Laboratory Personnel and Bloodborne Pathogens Exposure Control Program.

Additional Training Requirements by Research Type

Research	Additional Course(s) Required
Research involving recombinant DNA, recombinant RNA, or synthetic nucleic acids	NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules (13493)
Research involving human-derived materials, cell lines, and/or bloodborne pathogens	Contact UWL Environmental Health & Safety for initial and annual training requirements.
Research involving vertebrate or invertebrate animals	Animal Biosafety (13654) *Additional IACUC training requirements apply for vertebrate animals. See IACUC guidelines.*
Research involving nanotechnology	Understanding Nanotechnology and Its Implications (14044)
Research involving select agents	• Select Agents (13951) • Biosecurity (13857) • Bioterrorism (13524)
Research involving Dual Use Research of Concern (DURC)	Dual Use Research of Concern (DURC) (16263)
Research involving plants and/or soils	USDA Permits: • Plant Pest (17256) • Soils (17257) • Veterinary Services (17258)
Research involving human gene transfer	Human Gene Transfer Research (13494)

Principal Investigator (PI) Assurance Statement

The PI is responsible for the scientific research within a laboratory, personnel training, and must abide by and adhere to all UWL IBC policies, NIH Guidelines, Biosafety in Microbiological and Biomedical Laboratories (BMBL) guidance, and any other applicable regulations and policies. The PI must understand, adhere to, and sign the UWL IBC assurance statement contained in their Biosafety Protocol Application and included below.

Assurance Statement

I certify that the information contained in this application is accurate and complete. I am familiar with and agree to abide by the current editions of the NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules, CDC Biosafety in Microbiological and Biomedical Laboratories, US Government Policy for Oversight of Dual Use Research of Concern and Pathogens with Enhanced Pandemic Potential, and the University of Wisconsin-La Crosse (UWL) Biosafety Manual. Also, I agree to abide by the following requirements:

a. I will not initiate any biological research subject to the guidance and guidelines mentioned above until that research has been registered, reviewed, and approved by the UW-La Crosse (UWL) Institutional Biosafety Committee (IBC). The purview of the UWL IBC includes biological research involving recombinant or synthetic nucleic acids; biological agents and pathogens;

human cells, tissues, materials and embryonic stem cells; non-human animal-derived cells, tissues, materials, or samples that are infectious, potentially infectious, or recombinant; animals or plants that are recombinant, exotic, and/or grown in association with pathogens, biological toxins, and/or recombinant materials; select agents and toxins; biological toxins; dual use research of concern (DURC) agents and toxins; pathogens with enhanced pandemic potential (PEPP); and the use of any of these in animal or plant research.

b. I will assure that personnel, including animal care staff or other laboratory support staff, have received appropriate information, including signage, about the biological hazards of the research outlined in this application by making available copies of approved protocols, Biosafety Manuals, and Biological Research Registrations that describe the potential biohazards and precautions to be taken to prevent exposures or release to the laboratory or the environment.

c. I will ensure that laboratory personnel understand the procedures for dealing with incidents and spills of biological materials and know the appropriate waste management procedures.

d. I will work with appropriate university personnel to comply with all training and shipping requirements for the transport of hazardous biological materials (e.g., export controls regulations, US Department of Transportation (DOT) 49 CFR 171-178, International Civil Aviation Organization (ICAO), International Air Transport Association (IATA), US Department of Agriculture (USDA) 9 CFR 122).

e. I will comply with the OSHA Bloodborne Pathogen Standard 29 CFR 1910.1030 if my research includes human cells, tissues, materials, or embryonic stem cells.

f. I will ensure that all laboratory personnel working with biological materials are listed on this application.

g. I will assure that I along with all laboratory personnel have completed all required biosafety training and that their training records are up to date.

h. I assure that all laboratory spaces associated with the research and/or instruction described in this application are listed.

i. I am familiar with and understand my responsibilities as a Principal Investigator as outlined in Section IV-B-7 of the NIH Guidelines.

j. I will assure adequate supervision of personnel and will correct work errors and conditions that could result in breaches of the guidelines and regulations pertaining to this research as listed above.

I understand that failure to adhere to all related requirements may result in penalties outlined in federal and state regulations, sponsor guidelines, and institutional policies such as the IBC Noncompliance Policy.

General Principles of Biological Safety

Risk Assessment

All researchers and instructors planning to conduct or oversee biological research must perform an initial risk assessment. Risk identification in the field, classroom, and lab is essential to the protection of personnel, the public, and the environment. A risk assessment is a subjective process that identifies the risks associated with handling and manipulating a biological agent, biological material, or recombinant materials that could potentially cause harm to humans, animals, or the environment. Multiple factors

must be considered, including its origin (i.e., human derivation, viral construct, plant pollinator genome, etc.), infectivity, transmissibility, severity of disease, availability of potential treatments, and the nature of work associated with the materials being handled. Risk assessment results provide guidance for the appropriate biosafety level, laboratory practices and procedures, PPE, safety equipment, and facility design to protect all parties from potential exposure or release. When risk is unknown, a conservative approach is best, and safeguards should be incorporated into biosafety procedures until more information is available. Personnel training can mitigate some risks and, in some cases, additional training may be warranted to safely conduct the work necessary. In general, the following should be considered when evaluating a known infectious or potentially infectious agent or material:

- The agent's biological and physical nature
- The concentration and suspension volume of the agent
- The sources likely to harbor the agent
- Host susceptibility
- The procedures that may disseminate the agent
- The best method to effectively inactivate the agent

Refer to the CDC Biological Risk Assessment for an overview of the process (also see NIH Guidelines, Section II-A-3, and BMBL, Section II). As an overview, the BMBL recommends the following steps:

1. Identify hazardous characteristics of the agent and perform an assessment of the inherent risk, which is the risk in the absence of mitigating factors.
    a. To identify an agent's risk group (RG), see the American Biological Safety Association's risk group database. Also see the Summary of Risk Groups (RGs) in this manual. The BMBL, Section VIII provides summary statements for many agents associated with laboratory-acquired infections (LAIs) or that are of increased public concern.
2. Identify the possibility of the transmission of the agent.
    a. How an agent might infect/inoculate a human, animal, or plant in a controlled lab setting could be different than in nature, and biosafety procedures should consider the work location. Atypical exposure or infection routes may be viable in a lab because materials are often used in concentrations much higher than found in nature, making non-traditional exposure routes, such as aerosolization, possible. Examples of manipulation that can generate aerosols include pipetting, centrifuging, sonicating, vortexing, changing animal bedding, and performing necropsies. The most likely routes of transmission in the laboratory are:
        i. Direct skin, eye, or mucosal membrane exposure to an agent
        ii. Parenteral inoculation by a syringe needle or other contaminated sharp, or by bites from infected animals and arthropod vectors
        iii. Ingestion of liquid suspension of an infectious agent, or by contaminated hand to mouth exposure
        iv. Inhalation of infectious aerosols
3. Identify laboratory procedure hazards.
    a. The principal lab procedure hazards are agent concentration, suspension volume, equipment, and procedures that generate small particle aerosols and larger airborne particles (droplets), and use of sharps. Procedures involving animals can present hazards such as bites and scratches, exposure to zoonotic agents, and the handling of experimentally generated infectious aerosols.
4. Determine the appropriate BSL and additional precautions indicated by the risk assessment.

a. See Summary of Biosafety Levels (BSLs) in this manual and BMBL Sections IV and V.

Risk Groups & Biosafety Levels

Biosafety level (BSL) and risk group (RG) are not always defined at the same level (see Appendix B). Microorganisms that are human pathogens can be categorized into RGs based on the transmissibility, invasiveness, virulence (i.e., ability to cause disease), and the lethality of the specific pathogen. RGs describe a biological agent, biological material, or recombinant material based on its ability to cause disease and available treatments, whereas BSLs are a combination of laboratory practices, techniques, facilities, and safety equipment appropriate for the risks posed by the material and the associated laboratory procedures. One RG of a material could be used at a higher or lower BSL depending on how it is used, or if alterations are made rendering it more hazardous (e.g., incorporating virulence factors or resistance markers into microbes capable of infecting humans, animals, or plants) or less hazardous (e.g., chemically inactivating and fixing pathogenic tissues or samples).

The American Biological Safety Association's risk group database can be used to determine the RG for a material. Consideration of RG, however, is merely a starting point for a comprehensive risk assessment. Further attention must be given to the circumstances, such as the planned procedures and the safety equipment. Precautions may be adjusted to reflect the specific situation in which the material will be used. Consideration also is extended to microorganisms that cause diseases in animals and/or plants, which are not categorized into RGs as are human pathogens. The desired containment for animal and plant pathogens is based on the severity of the disease, its ability to disseminate and become established in the local environment, and the availability of prophylactic treatment.

The progression from invasion to infection to disease following contact with an infectious agent depends upon the dose, route of transmission, invasive characteristics of the agent, virulence, and resistance of the exposed host. Not all contacts result in infection, and even when disease occurs, severity can vary. Attenuated strains should be handled with the same precautions as the virulent parental strain unless reduced pathogenicity is well documented and irreversible. Viral vectors, even if rendered replication defective, may still pose a threat of recombination with wildtype strains or unintentional delivery of their foreign genes.

RGs and BSLs do not take into account individuals and animals that may have increased susceptibility. While personnel do not have to disclose information regarding their altered susceptibility of infection, it is essential that they complete training to help them determine if they are at an increased risk due to pre-existing conditions, decreased immunity, their use of certain medications, organ transplantation, pregnancy or breast-feeding, or other circumstances. Personnel can discuss any concerns with their personal physician. Any animals or plants that may become infected with pathogens must not be removed from containment to safeguard from exposures, and actions should be taken for remediation.

Routes of Infection

Pathogens can be transmitted via several different routes in the laboratory. The most common routes of infection are inhalation of infectious aerosols or dusts, exposure of mucous membranes to infectious droplets, ingestion from contaminated hands or utensils, animal bites, or percutaneous self-inoculation (injection or incision). Precautions should be taken to avoid contamination of cell phones if used in laboratories. Increased risk is associated with pathogens that are aerosol transmitted and when high concentrations or large volumes are used.

Inhalation of infectious aerosols is implicated as the cause of many laboratory-acquired infections (LAI). Even pathogens that normally do not cause infections by inhalation route present a danger when

aerosolized. Aerosols can spread throughout the laboratory by traveling along air currents, which creates the potential for indirect laboratory acquired infections to occur. Activities that have the potential to create aerosols should be performed in a biological safety cabinet (BSC) whenever possible. The BSC protects the worker and the work environment. If the activity cannot be performed in a BSC, additional personal protective equipment (PPE) such as a respirator may be required.

Opportunistic pathogens are organisms not known to cause infection in healthy individuals but are known pathogens of persons who have been compromised in various ways including:

- Open wounds or cuts
- Antibiotic therapy
- Persons with immunocompromised, immunosuppressed, or susceptible immune status due to infection, acquired or congenital condition, or via therapy (e.g., infants or elderly, pregnancy, diabetes, complement deficiencies, AIDS, severe asthma, bone marrow or organ transplantation, chemotherapy, long-term steroid treatment)
- Exposures to high doses or atypical routes

If work with pathogens is performed in the laboratory, you are encouraged to discuss with your personal physician the agents present in the laboratory.

Biohazard Containment

Although the most important aspect of biohazard control is the awareness and care used by personnel in handling hazardous materials, certain features of laboratory design, ventilation, and safety equipment can prevent dissemination of pathogens and exposure of personnel or release to the environment should an accident occur.

Practices & Procedures

Standard microbiological practices are common to all laboratories. Special microbiological practices, safety equipment, and laboratory facilities enhance worker safety, environmental protection, and minimize the risk of handling agents. Please see the CDC Biosafety in Microbiological and Biomedical Laboratories (BMBL), Section IV for information on Laboratory Biosafety Level criteria and standard microbiological practices. It is the responsibility of all laboratory staff to effectively decontaminate equipment before it is removed from the laboratory for maintenance, relocation, sale, or disposal.

Biosafety Level 1

Biosafety Level 1 (BSL1) is suitable for work involving well-characterized agents not known to consistently cause disease in immunocompetent adult humans, and present minimal potential hazard to laboratory personnel, animals, or the environment. BSL1 laboratories are not necessarily separated from the general traffic patterns in the building. Work can typically be conducted on open bench tops using standard microbiological practices. Special containment equipment or facility design is not required but may be used as determined by appropriate risk assessment. Laboratory personnel must have specific training in the procedures conducted in the laboratory and must be supervised by a scientist with training in microbiology or a related science.

Biosafety Level 2

Biosafety Level 2 (BSL2) builds upon BSL1. BSL2 is suitable for work involving agents that pose moderate hazards to personnel, animals, or the environment. It differs from BSL1 in that: 1) laboratory personnel have specific training in handling pathogenic agents and are supervised by scientists competent in handling infectious agents and associated procedures; 2) access to the laboratory is restricted when work is being conducted; and 3) all procedures in which infectious aerosols or splashes may be created are conducted in BSCs or other physical containment equipment.

Biosafety Level 3

Biosafety Level 3 (BSL3) is applicable to clinical, diagnostic, teaching, research, or production facilities where work is performed with indigenous or exotic agents that may cause serious or potentially lethal disease through the inhalation route of exposure. Laboratory personnel must receive specific training in handling pathogenic and potentially lethal agents and must be supervised by scientists competent in handling infectious agents and associated procedures. All procedures involving the manipulation of infectious materials must be conducted within BSCs or other physical containment devices. A BSL3 laboratory has special engineering and design features.

BSL3 Manual Requirements

A BSL3 Manual is needed for all BSL3/ABSL3/ACL3 laboratories. The manual provides a summary of procedures and practices for staff to follow while working in the BSL3 laboratory. The manual is required to be specific to your laboratory, facility, agents, and procedures used, and is reviewed as part of the risk assessment. It is required that the manual and the biosafety protocol be reviewed annually by the laboratory and updated to reflect any changes in the laboratory that may affect the risk assessment. At minimum the elements below must be addressed in a BSL3 manual (see Appendix C). Some of the elements may not be applicable to your laboratory and are italicized (see Appendix C).

Summary of Safety Practices for Biosafety Levels 1-3

During the review of biosafety protocols, risk assessment will determine the required containment and practices for specific research activities (see Appendix D).

Vertebrate Animal Biosafety Level Criteria for Vivarium Research Facilities

Please also see the CDC Biosafety in Microbiological and Biomedical Laboratories (BMBL), Section V for information on Vertebrate Animal Biosafety Level Criteria.

This guidance is provided for the use of experimentally infected animals housed in indoor research facilities (e.g., vivaria), and is also useful in the maintenance of laboratory animals that may naturally harbor zoonotic infectious agents (see Appendix E). In both instances, the institutional management must provide facilities, staff, and established practices that reasonably ensure appropriate levels of environmental quality, safety, security and care for the laboratory animal. Laboratory animal facilities are a special type of laboratory. As a general principle, the biosafety level (facilities, practices, and operational requirements) recommended for working with infectious agents *in vivo* and *in vitro* are comparable (see Appendix E).

The animal room can present unique problems. In the animal room, the activities of the animals themselves can present unique hazards not found in standard microbiological laboratories. Animals may generate aerosols, they may bite and scratch, and they may be infected with a zoonotic agent. The co-application of Biosafety Levels and the Animal Biosafety Levels are determined by a protocol-driven risk assessment. These recommendations imply that laboratory animal facilities, operational practices, and quality of animal care meet applicable standards and regulations (e.g., Guide for the Care and Use of Laboratory Animals, Animal Welfare Regulations) and that appropriate species have been selected for animal experiments.

In addition, the organization must have an occupational health and safety program that addresses potential hazards associated with the conduct of laboratory animal research. The publication by the Institute for Laboratory Animal Research (ILAR), *Occupational Health and Safety in the Care and Use of Research Animals*, is helpful in this regard.

Facilities for laboratory animals used in studies of infectious or non-infectious disease should be physically separate from other activities such as animal production and quarantine, clinical laboratories,

and especially from facilities providing patient care. Traffic flow that will minimize the risk of cross contamination should be incorporated into the facility design. The recommendations detailed below describe four combinations of practices, safety equipment, and facilities for experiments with animals involved in infectious disease research and other studies that may require containment.

In addition to the animal biosafety levels described in this section, the USDA has developed facility parameters and work practices for handling agents of agriculture significance. BMBL Appendix D includes a discussion on Animal Biosafety Level 3 Agriculture (BSL-3-Ag). USDA requirements are unique to agriculture because of the necessity to protect the environment from pathogens of economic or environmental impact. BMBL Appendix D also describes some of the enhancements beyond BSL/ABSL3 that may be required by USDA-APHIS when working in the laboratory or vivarium with certain veterinary agents of concern.

Note that the IBC and IACUC may request an increase in containment to a higher animal biosafety level for some animal experiments. The evaluation of animal studies to determine required biosafety level will include pathogen-specific activities as well as pathogens commonly associated with certain species (rabies virus in bats, for instance).

Aquatic Animal Considerations

Aquatic animal research can be very specialized. Distinct considerations are needed for a “wet” facility.

Note: The Office of Laboratory Animal Welfare (OLAW) considers larval and adult forms of fish to be covered by the Public Health Service policy, and both of these forms must be counted. OLAW has made the determination that all stages of zebrafish development greater than 3 days postfertilization (dpf) must be described in animal-use protocols. Zebrafish from 4 days postfertilization onward are considered animals, and therefore must be counted.

General considerations:

- Water/waste decontaminated prior to release as per local, state, and federal regulations
- Floor and flood drains are considered, and SOPs are in place to prevent releases
- Inspection of facility for areas of water penetration and areas of concern are caulked, sealed or gasketed
- Risk assessment for any airborne pathogen concerns
- Permit requirements as applicable
- Fish tank waste removal processes
- Disposal and end of study decontamination SOPs
- Specialized hazard communication and/or signage as per risk assessment
- Room surfaces are easy to clean and impervious to moisture (floor, walls, ceiling)
- Training specific to research activities
- Spill protocols:
    - Kits stored away from the floor
    - Similar considerations as for large scale liquid activities

Aquatic facility:

- Location and facility design with respect to potential release into environment
- Release SOPs and reporting SOPs
- Exit and entry points:
    - PPE availability, use
    - Foot baths
    - Signage
    - Emergency information posted (contact information, spill information, etc.)
- Control access (Biosecurity concerns)

Wild-Caught Animal Considerations

Please contact the IBC and IACUC prior to conducting research with wild-caught animals. Some wildlife species naturally harbor zoonotic infectious agents. In addition, permits may be required from state or federal agencies prior to collecting certain animals from the wild.

Arthropod Biocontainment

Arthropods include, but are not limited to, insects (e.g., mosquitoes, black flies, sand flies, tsetse flies, midges, Hemiptera, Phthiraptera, Siphonaptera, fruit flies, cockroaches, Lepidoptera, Coleoptera) and Arachnids (e.g., ticks, mites, spiders). All lifecycle stages must be considered 'arthropods' (e.g., eggs, larvae, nymphs, adults). Complex life cycles and organism diversity require careful consideration in the risk assessment. Arthropod containment is not specifically addressed in BMBL or the NIH Guidelines. Arthropod Containment Guidelines were developed by the American Committee of Medical Entomology as a reference for research involving arthropod vectors of human and animal diseases. In addition to disease-carrying potential, risk assessment for arthropods must consider additional factors such as recombinant modifications, natural range (i.e., is the arthropod an exotic or invasive species in Wisconsin), and ecological role (e.g., is the arthropod considered a pest species). Key elements of the Arthropod Containment, including practices and facility standards are summarized in Appendix F.

Plant Biocontainment

Biosafety principles are applied to activities involving plants that are exotic, recombinant, and/or grown in association with biological toxins, pathogenic or recombinant microbes and/or pathogenic or recombinant small animals (e.g., insects). The principal purpose of plant containment is to protect the environment, not the researcher. The containment principles are based on the recognition that the organisms that are used pose no health threat to humans or higher animals (unless deliberately modified for that purpose), and that the containment conditions minimize the possibility of an unanticipated deleterious effect on organisms and ecosystems outside of the experimental facility (e.g., the inadvertent spread of a serious pathogen from a greenhouse to a local agricultural crop or the unintentional introduction and establishment of a plant in a new ecosystem). Under special circumstances, which typically require explicit approval from US Department of Agriculture-Animal and Plant Health Inspection Service (USDA-APHIS), it is possible to conduct field trials. Otherwise, release to the environment must be prevented.

Guidance for handling potentially biohazardous plants and associated organisms lag behind that available for vertebrates and their infectious agents. The USDA-APHIS regulates importation, interstate movement, and environmental release of plant pests and transgenic plants but provides minimal guidance for management of facilities. The best available information at this time comes from the NIH Guidelines. While the NIH Guidelines specifically address recombinant DNA, the recommendations regarding effective containment are equally relevant to research using non-recombinant methods.

The information in Appendix G presents portions of the NIH Guidelines that pertain to containment of transgenic plants and associated organisms. The content is consistent with that of the Guidelines, but the format has been rearranged to make it more readable. For more detailed information on Plant Biosafety Levels (BSL1-P through BSL4-P), refer to the NIH Guidelines Appendix L.

Containment for transgenic plants and their associated plant pathogens may be achieved by a combination of physical and biological means and relies more heavily on biological factors than is the norm for human and animal infectious agents. The risk assessment considers the specific organism(s), geographic/ecological setting, and the available mechanical barriers; then the selected practices are tailored to the specific situation. For example, preventing the spread or release of transgenic pollen is a form of biological containment which can be achieved by using sterile lines, altering day length to prevent flowering, or other strategies.

Determination of Plant Containment Level

Knowledge of the organisms and judgment based on accepted scientific practices should be used in all cases in selecting the appropriate level of containment. For example, if the genetic modification has the objective of increasing pathogenicity or converting a non-pathogenic organism into a pathogen, then a higher level of containment may be appropriate depending on the organism, its mode of dissemination, and its target organisms.

Experiments that fall under Section III-E of the NIH Guidelines require IBC notice simultaneous with initiation. Those that fall under Section III-D require IBC approval before initiation.

BSL1-P is recommended for most experiments with recombinant DNA-containing plants and plant-associated microorganisms (excluding those covered below for Section III-D) (see Appendix G). Example: plant transformation using recombinant Agrobacterium where the genetic modification is not expected to increase adverse characteristics.

BSL2-P Biological Containment (see Appendix G) is recommended for:

- Plants modified by rDNA that are noxious weeds or can interbreed with noxious weed in the immediate geographic area.
- Plants in which the introduced DNA represents the complete genome of a nonexotic infectious agent.
- Plants associated with recombinant DNA-modified non-exotic microorganisms that have a recognized potential for serious detrimental impact on managed or natural ecosystems.
- Plants associated with recombinant DNA-modified exotic microorganisms that have no recognized potential for serious detrimental impact on managed or natural ecosystems.
- Experiments with recombinant DNA-modified arthropods or small animals associated with plants, or with arthropods or small animals with recombinant DNA-modified microorganisms associated with them if the recombinant DNA-modified microorganisms have no recognized potential for serious detrimental impact on managed or natural ecosystems.

BSL3-P Biological Containment (see Appendix G) is recommended for:

- Experiments involving most exotic infectious agents with recognized potential for serious detrimental impact on managed or natural ecosystems when recombinant DNA techniques are associated with whole plants.
- Experiments involving plants containing cloned genomes of readily transmissible exotic infectious agents with recognized potential for serious detrimental effects on managed or natural ecosystems in which there exists the possibility of reconstituting the complete and functional genome of the infectious agent by genomic complementation in plants.
- Experiments with microbial pathogens of insects or small animals associated with plants if the recombinant-DNA modified organism has a recognized potential for serious detrimental impact on managed or natural ecosystems.
- Experiments involving sequences encoding potent vertebrate toxins introduced into plants or plant-associated organisms.

Biological Containment of Plants

Effective dissemination of plants by pollen or seed can be prevented by one or more of the following procedures:

- Cover the reproductive structures to prevent pollen dissemination at flowering and seed dissemination at maturity;
- Remove reproductive structures by employing male sterile strains, or harvest the plant material prior to the reproductive stage;

- Ensure that experimental plants flower at a time of year when cross-fertile plants are not flowering within the normal pollen dispersal range of the experimental plant; or ensure that cross-fertile plants are not growing within the known pollen dispersal range of the experimental plant.

Biological Containment of Microorganisms Associated with Plants

Effective dissemination of microorganisms beyond the confines of the greenhouse can be prevented by one or more of the following procedures:

- Confine all operations to injections of microorganisms or other biological procedures (including genetic manipulation) that limit replication or reproduction of viruses and microorganisms or sequences derived from microorganisms, and confine these injections to internal plant parts or adherent plant surfaces;
- Ensure that organisms, which can serve as hosts or promote the transmission of the virus or microorganism, are not present within the farthest distance that the airborne virus or microorganism may be expected to be effectively disseminated;
- Conduct experiments at a time of year when plants that can serve as hosts are either not growing or are not susceptible to productive infection; use viruses and other microorganisms or their genomes that have known arthropod or animal vectors, in the absence of such vectors;
- Use microorganisms that have an obligate association with the plant; or
- Use microorganisms that are genetically disabled to minimize survival outside of the research facility and whose natural mode of transmission requires injury of the target organism or assures that inadvertent release is unlikely to initiate productive infection of organisms outside of the experimental facility.

Biological Containment of Macro-organisms Associated with Plants

Effective dissemination of arthropods and other small animals can be prevented by using one or more of the following procedures:

- Use non-flying, flight-impaired, or sterile arthropods;
- Use non-motile or sterile strains of small animals;
- Conduct experiments at a time of year that precludes the survival of escaping organisms;
- Use animals that have an obligate association with a plant that is not present within the dispersal range of the organism; or
- Prevent the escape of organisms present in run-off water by chemical treatment or evaporation of run-off water

Clinical and Pathological Specimens

Every specimen from humans or animals may contain infectious agents. Personnel in laboratories and clinical areas handling human blood or body fluids should practice Universal Precautions, an approach to infection control wherein all human blood and certain human body fluids are treated as if known to be infectious for human immunodeficiency virus (HIV), hepatitis B virus (HBV), and other bloodborne pathogens. Such personnel are required by OSHA to complete bloodborne pathogen training. Bloodborne pathogen training is available through UWL Environmental Health & Safety (EHS) and must be renewed annually. See the UWL EHS Laboratory Safety & Chemical Disposal Guide, Appendix G: Training for Laboratory Personnel and EHS Bloodborne Pathogens Exposure Control Program for more information. Hepatitis B vaccination is available through your personal physician. Per the CDC BMBL guidelines, work involving human-derived materials (e.g., human cells, cell culture, organs, tissues, biological samples) must at minimum be conducted in accordance with Biosafety Level 2 (BSL2) practices and procedures.

UWL's Bloodborne Pathogens Exposure Control Program provides methods to control exposure of laboratory and other personnel to human blood or other potentially infectious materials (OPIM). OPIM is

defined in the regulations as semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, and any body fluids in situations where it is difficult or impossible to differentiate between body fluids. Any unfixed human tissue, organ, blood, primary cells or established cell lines, HIV- or HBV-containing culture media or other solutions, and cells or tissues from experimental animals administered human-derived material, HIV, or HBV are also included are also subject to oversight. Contact UWL Environmental Health & Safety for more information on precautions and regulatory requirements.

Cultures

When a cell or tissue explant culture is inoculated with or known to contain a pathogen, it should be classified and handled at the same biosafety level as the agent. BSL2 containment and practices are used for human-derived cells (primary cells and established cell lines), all human clinical material (e.g., tissues and fluids obtained from surgery or autopsy), nonhuman primate cells and tissues, and any non-human cells exposed to or transformed by an oncogenic virus. A biosafety cabinet should be used for manipulations that have potential to create aerosols.

Biological Toxins

Labs may utilize biological toxins in their research programs, sometimes in conjunction with animals and microbes. Biological toxins are toxic substances that are produced by microorganisms, animals, and plants and are capable of causing harm to other living organisms. Chemicals or products not produced by living organisms are not considered biological toxins but can be equally harmful. Biological toxins (e.g., bacterial toxins, mycotoxins, seafood toxins) handled, stored, or intentionally produced in your laboratory must be listed on laboratory biosafety protocols, depending on factors such as toxicity (e.g., LD_{50}). Toxins must be appropriately stored in a designated location and clearly labeled. Toxic synthesized chemicals and antibiotics are not considered to be biological toxins and should not be listed in your biosafety protocol. Contact the IBC if you are unsure whether a material is considered to be a biological toxin or if a material must be listed on your biosafety protocol. The IBC will work with laboratories to determine the required biosafety level, handling practices, and inactivation methods for studies involving biological toxins.

Potential exposure routes, toxicity, and effects of exposure vary widely between biological toxins, and may include acute as well as chronic effects. Numerous biological toxins are considered to be potent carcinogens, especially mycotoxins. Symptoms from exposure to some toxins can have a very rapid onset, while symptoms from exposure to other toxins may not be noticeable until years after the exposure. Some toxins accumulate over time and even exposure to very small amounts can be harmful over time, whereas others are rapidly eliminated. Inactivation procedures also vary for specific toxins. It is thus important to understand the specific properties, intoxication routes, and inactivation procedures of a biological toxin prior to use in laboratories. Extreme caution is needed when handling concentrated lyophilized biological toxins as it can create an inhalation risk, even if the toxin is not known to normally cause intoxication via the inhalation route. BSL2 is generally required for handling purified biological toxins, and a BSC, chemical fume hood, or other engineering control is often required, depending on the toxin's specific properties and procedure for its use. Rodents treated parenterally (IV, IM, IP, or subcutaneously) with some biological toxins, in the absence of known pathogens, can often be subsequently housed at ABSL1, depending on the toxin's properties.

Some high-risk biological toxins are considered Select Agents. To learn which biological agents and toxins are considered Select Agents, see the HHS and USDA Select Agents and Toxins List. Please contact the IBC if you are unsure whether a biological toxin in your lab is considered a Select Agent toxin. Select Agent biological toxins are exempt from the Select Agent regulations if the total quantity under the control of a PI falls below a certain threshold (see permissible toxin amounts on the Select

Agents website). IBC will provide information about required inventory and storage regulations to laboratories possessing sub-threshold amounts of Select Agent toxins.

Animals

Exercise care and thoughtfulness when using animals in research. Numerous risks may be present when animals are used in studies of microorganisms and an investigator will need containment and PPE that protects against the biological hazards. Precautions commonly include use of a lab coat, gloves, and eye protection when handling animals and their bedding; respiratory protection may be recommended when specific conditions present a concern.

There are some inherent risks in working with animals (e.g., allergenicity, bites, and scratches). Laboratory and wild-trapped animals may harbor microorganisms that can produce human diseases following bites, scratches, or exposure to excreted microorganisms. Rhesus macaques present a significant potential for hazards, requiring that stringent procedures be followed to guard against Herpes B virus. Even in the absence of known hazards, animal care providers should use precautions to avoid exposure to animal allergens.

In the process of inoculating animals, an investigator can be exposed to infectious material by accidental self-inoculation or inhalation of infectious aerosols. During surgical procedures, necropsies, and processing of tissues, aerosols can be produced inadvertently, or the operator can inflict self-injury with contaminated instruments. Since animal excreta can also be a source of infectious microorganisms, investigators should take precautions to minimize aerosols and dust when changing bedding and cleaning cages. Use of a biosafety cabinet is sometimes appropriate for performing cage changes. Bedding from animals infected or potentially infected with pathogens must be decontaminated prior to disposal, typically by autoclaving.

Transfer of human cells, primate cells or opportunistic microbes, whether newly isolated or well-established, into immunocompromised animals could result in propagation of pathogens that would be suppressed in the normal host. ABSL2 containment must be applied to mitigate against such risks and to prevent spread of animal pathogens within a research colony. Mixed waste disposal methods require a thorough risk assessment. Please contact the IBC and IACUC for assistance.

Gene Drive Modified Organisms (GDMOs)

Research involving gene drive modified organisms (GDMOs) must meet additional requirements detailed in the NIH Guidelines. Per Section I-E-7, “gene drive is a technology whereby a particular heritable element biases inheritance in its favor, resulting in the heritable element becoming more prevalent than predicted by Mendelian laws of inheritance in a population over successive generations.” Experiments involving GDMOs generated by recombinant or synthetic nucleic acid molecules must be conducted at a minimum of Biosafety Level 2 (BSL2), Animal Biosafety Level 2 (ABSL2), or Plant Biosafety Level 2 (BSL2-P) containment (Section III-D-8). GDMO research “may require risk assessments that incorporate a broader scope of considerations because of greater uncertainty of the technology and potential uncertainty of the impact of the newly modified organism. Specific attention must be paid to risks of an unintended release from the laboratory and the potential impact on humans, other populations of organisms, and the environment” (Section II-A-3). Additional considerations for conducting risk assessments of GDMO research are outlined in Section II-A-3.

The PI and the IBC are required to determine “whether a GDMO has a potential for serious detrimental impact on managed (agricultural, forest, grassland) or natural ecosystems in consultation with scientists knowledgeable of gene drive technology, and of the environment, and ecosystems in the geographic area of the research” (Section V-N). The IBC must ensure adequate expertise on the committee to make such determinations (e.g., specific species containment, ecological or environmental risk assessment), using ad hoc consultants if necessary. If research involving GDMOs is proposed to be

conducted at the university, in advance of the research being reviewed, the IBC membership must also include a Biological Safety Officer (BSO).

Aerosol Generating Activities

Routine manipulations of biological materials may also release hazardous agents via aerosol formation. Examples include:

- Removing stoppers from culture vessels
- Opening vessels after vigorous shaking or vortexing
- Flame-sterilizing utensils
- Electroporation
- Centrifugation
- Sonicating, homogenizing, blending, or grinding tissues
- Pipetting
- Animal inoculations
- Surgery or necropsy
- Tissue sectioning
- Flow cytometry

Manipulate cultures of infectious material carefully to avoid aerosols. Centrifugation should involve the use of gasket-sealable tubes and rotors. Seal microplate lids with tape or replace the lids with adhesive-backed Mylar film. Load, remove, and open tubes, plates, and rotors within a biosafety cabinet. Accidental spilling of liquid infectious cultures is an obvious hazard due to the generation of aerosols (airborne droplets containing microorganisms).

Equipment used for manipulations of infectious materials, such as sonicators, flow cytometers, cell sorters, and automated harvesting equipment, must be evaluated to determine the need for secondary containment and to consider decontamination issues. When preparing aliquots of infectious material for long-term storage, consider that viable lyophilized cultures may release high concentrations of dispersed particles if vials are not properly selected and not properly sealed. Breakage or leakage of cryogenic vials in liquid nitrogen may also present hazards because pathogens may survive and disperse in the liquid phase.

Personal Protective Equipment (PPE)

The UWL Environmental Health & Safety (EHS) Personal Protective Equipment (PPE) policy outlines the roles and responsibilities of all personnel relating to hazard assessments and analysis, training, and care, maintenance, and use of PPE.

In research laboratories, it is necessary to wear closed-toe shoes and clothing that covers the leg down to the shoe. Individual labs may have additional clothing requirements depending on activities. For example, may require the use of lab-dedicated clothing (scrubs or personal clothing) kept solely to wear in the laboratory that does not “go home” unless decontaminated.

Laboratory coats provide a removable barrier that protects the worker’s skin and clothing from hazardous materials in the laboratory. To avoid bringing hazardous materials out of the laboratory, lab coats are removed before exiting and remain in the laboratory. Lab coats should be laundered onsite or through a laundry service and never taken home for cleaning.

Gloves should be worn whenever there is the potential for contact with hazardous materials. They further serve to maintain the integrity of the material being handled. Many different types of gloves are available, and the choice depends on the nature of the hazard. Gloves must be removed in a manner that prevents contamination of hands. Gloves must be removed before exiting the laboratory. Disposable gloves should not be reused.

The eyes and mucous membranes are vulnerable routes of exposure. Eye protection should always be worn in the laboratory. Contact lenses may be worn with discretion and in combination with eye

protection. Depending on the activities, it may be appropriate to use safety glasses with side shields, goggles, and/or a splash shield.

The background level of microbes in the research laboratory should be negligible when good microbiological techniques are employed. Respiratory protection should be considered carefully and used only when there is risk of aerosol exposure that cannot be mitigated through the use of alternative procedures or containment equipment. A concern regarding respiratory protection is that, if used improperly, the user has a false sense of security. A surgical mask or common dust mask has poor fit to the contours of the face, provides minimal protection against large particles, and is inappropriate for work with infectious agents.

A high efficiency particulate air (HEPA) filtered face piece (e.g., N95 or N100) is appropriate for many situations where protection against animal allergens and microbes is desired, but the protection will only be as good as the respirator's fit to the face. Furthermore, HEPA filtration is ineffective against volatile chemicals. A full head cover with a Powered Air Purifying Respirator (ative air pressure differential ensures that air will enter the laboratory and not egress to the hallway or adjacent rooms. To maintain negative room pressure, laboratory doors must be kept closed. Exhaust air from laboratories should not be recirculated into other parts of the building. It should be ducted to the outside and released from a stack remote from the building air intake. In certain special situations, air exhausting from a hazardous facility should be filtered through certified HEPA (high efficiency particulate air) filters that are tested at least annually and verified to retain microorganisms.

Summary of Standards for Facilities and Equipment for Biosafety Levels

Appendix H describes the relationship between biosafety levels and engineering controls, which include laboratory design, laboratory ventilation, and biological safety cabinets.

Existing facilities that do not meet these standards may need to address deficiencies during future maintenance or remodeling.

Disposal of Wastes from Biological Laboratories

Guidelines on laboratory safety and chemical disposal can be found in UWL Environmental Health & Safety's Laboratory Safety & Chemical Disposal Guide. The waste disposal guidelines are designed to protect not only the public and the environment, but also laboratory and custodial personnel, waste haulers, and landfill/incinerator operators at each stage of the waste-handling process. Workers who generate biohazardous waste in the laboratory must assure that the labeling, packaging, and disposal of waste conform to these guidelines. Decontamination, inactivation, and disposal procedures outlined in laboratory biosafety protocols must be followed. The appropriate packaging of all waste is fundamental for assuring protection of the handler and proper disposal.

Decontamination is defined as the process of reducing the number of disease-producing microorganisms and rendering an object safe for handling.

Disinfection is defined as a process that kills or destroys most disease-producing microorganisms, except spores.

Sterilization is defined as a process by which all forms of microbial life, including spores, viruses, and fungi, are destroyed.

Types of Biohazardous Waste

The following items require decontamination or inactivation prior to disposal:

- Microbiological laboratory waste: Cultures derived from clinical specimens and/or pathogenic microorganisms.
- Medical waste: Tissues, liquid blood, cells and body fluids from humans. Exceptions are urine, saliva, tears, sweat, or feces from humans that are not anticipated to contain pathogens and not visibly contaminated with blood.
- Zoonotic waste: Tissues, liquid blood, cells, body fluids, and bedding from an animal that is carrying an infectious agent that can be transmitted to humans.
- Recombinant waste: Recombinant organisms, recombinant DNA/RNA.
- Exotic or virulent plant and animal pathogens.
- Sharps waste: Contaminated medical and nonmedical sharps.
- Biological toxins
- Plant waste: All portions of exotic and non-endemic plants.

Mixed Waste

Please contact Environmental Health & Safety with disposal questions for biological materials mixed with hazardous chemicals and/or radioisotopes.

Sharps & Laboratory Glass

See the UWL Laboratory Safety & Chemical Disposal Guide, Part I: Sharps & Laboratory Glass Disposal for comprehensive guidelines.

Medical sharps are instruments designed to cut or penetrate skin. Examples include syringes with needles, stand-alone needles, lancets, scalpels, and razor blades, regardless of their actual use. These items must be disposed of in a puncture-resistant, ASTM-certified medical sharps container. Do not overfill beyond the “fill” line on the container. Note that even if these items are unused and in their original packages/sleeves, they still must be properly disposed of in a medical sharps container. When filled and ready for disposal, securely close the lid. Medical sharps require special handling and may not go directly to the landfill.

Non-medical sharps are lab materials that can cut, or puncture the skin, but are not intended to do so. Examples include fragile glass, glass slides and cover slips, metal wires, pipets, and pipette tips. These items must be disposed of in a manner that prevents harm to others. They must be decontaminated prior to disposal if used with infectious agents or recombinant materials.

Infectious, Microbial, & Recombinant Waste

Materials from laboratories and animal facilities, such as cultures, tissues, media, and plastics contaminated with biohazardous, potentially biohazardous, or recombinant substances must be decontaminated before disposal. Collect contaminated materials in leak-proof containers labeled with the universal biohazard symbol; autoclavable biohazard bags are recommended.

See the UWL Laboratory Safety & Chemical Disposal Guide, Appendix J: Autoclave Operational & Safety Guide for comprehensive guidelines on precautions, general sterilization procedures, and autoclaving tips. Also see Part H of the guide, under “Disposal of Other Biohazardous Waste.”

Liquid Waste

Liquid waste that is contaminated with infectious agents or biological toxins must be rendered safe by chemical or autoclave treatment before sewer disposal. Care must be taken to avoid splashing and generating aerosols. Sewer lines should be decontaminated by flushing with hypochlorite (1:10 dilution of household bleach containing 5.25%-6.15% sodium hypochlorite) prior to servicing.

Waste from Animal Experiments

Animal waste (e.g., bedding, feces, urine) may require disinfection/inactivation by methods as described in your biosafety protocol followed by disposal via trash or sanitary sewer. Animal carcasses are to be disposed by incineration or via chemical digestion. Disposal outside of these regular routes must be detailed in biosafety and/or animal protocols.

Animal waste which does not require disinfection/inactivation as described in the biosafety protocol is disposed via trash or sanitary sewer. Disposal outside of these regular routes must be reviewed and approved.

All animal carcasses covered under Appendix M of the NIH Guidelines (containing recombinant or synthetic nucleic acid molecules or a recombinant or synthetic nucleic acid molecule-derived organism) should be disposed of by incineration or chemical digestion to avoid its use as food for human beings or animals unless specifically authorized by an approved federal agency.

See the UWL Laboratory Safety & Chemical Disposal Guide, Part H: Animal Tissue Disposal for additional guidelines.

Noninfectious Waste

The following are usually not included in the definition of infectious waste but should be placed in containers such as plastic bags prior to disposal to contain the waste. If these items have been mixed with infectious wastes, they have to be managed as though they are infectious. Non-infectious waste may include:

- Items soiled or spotted, but not saturated, with human blood or body fluids. Examples: blood-spotted gloves, gowns, dressings, and surgical drapes.
- Containers, packages, non-fragile waste glass, laboratory equipment, and other materials that have had no contact with blood, body fluids, clinical cultures, or infectious agents.
- Noninfectious animal waste such as manure and bedding, and tissue, blood, body fluids, or cultures from an animal that is not known or suspected to be carrying an infectious agent transmissible to humans.

Methods of Decontamination

Choosing the right method to eliminate or inactivate a biohazard is not always simple; it is difficult to prescribe methods that meet every contingency. Decisions are best left to the personnel directly involved, provided they are well informed and prepared to verify the effectiveness of the treatment. The choice depends largely on the treatment equipment available, the target organism, and the presence of interfering substances (e.g., high organic content) that may protect the organism from decontamination. Other common factors that influence the efficacy of disinfection are contact time, temperature, water hardness, and relative humidity.

Various treatment techniques are available, but practicality and effectiveness govern which is most appropriate. For example, there is a practical limit to the time that can be spent autoclaving waste, and alternative methods might be more effective and economical. The efficacy of the selected method against the particular biohazard must be documented by reference to accepted procedures or quantitative testing.

Use extreme caution when treating waste that is co-contaminated with volatile, toxic, or carcinogenic chemicals, radioisotopes, or explosive substances. Autoclaving this type of waste may release dangerous gases (e.g., chlorine from bleach) into the air. Such waste should be chemically decontaminated. Consult with Environmental Health & Safety for guidance.

Ideally, biohazardous waste should be decontaminated before the end of each working day unless it is to be picked up for special waste treatment. Biohazardous waste should never be compacted. Ordinary, non-hazardous laboratory waste should be disposed of routinely as much as possible so as to reduce the amount of waste requiring special handling.

See the UWL Laboratory Safety & Chemical Disposal Guide, Appendix J: Autoclave Operational & Safety Guide.

Steam Sterilization

Decontamination is best accomplished by steam sterilization in a properly functioning autoclave that is efficacy tested as needed, but at least twice a year, with biological (i.e., *Bacillus stearothermophilus* spore testing) or chemical (i.e., 3M™ Comply™ SteriGage™) indicators that verify adequate temperatures and times have been reached inside the material/load to kill microorganisms. Efficacy test results must be recorded and retained, preferably on or near the autoclave. Indicator tape provides assurance only that a high temperature was reached; it does not indicate if it was heated for the proper time. The tops of autoclavable biohazard bags should be opened to allow steam entry. For dry materials, it may be necessary to add water to the package prior to autoclaving.

Although autoclaving all biohazardous wastes for at least one hour is recommended, the nature of the waste in a load should determine cycle duration. For example, if the waste contains a dense organic substrate such as animal bedding, manure, or soil, one hour may be insufficient to inactivate certain pathogens buried within. A considerably longer exposure time (e.g., 8 to 12 hours) may be required to effectively decontaminate such waste.

Chemical Disinfection

Where autoclaving is not appropriate or feasible, an accepted alternative is to treat material with a chemical disinfectant, freshly prepared at a concentration known to be effective against the microorganisms in use. The disinfectant of choice should be one that quickly and effectively kills the target pathogen at the lowest concentration and with minimal risk to the user. Allow sufficient exposure time to ensure complete inactivation. Other considerations such as economy and shelf life are also important. The susceptibility to chemical disinfection is generally greater for enveloped viruses than for non-lipid viruses, and greater for vegetative bacteria and fungi than for spores. Mycobacteria are more resistant to inactivation than most bacteria, while prions are notably resistant to most chemicals. Appendix I offers a brief overview of possible chemical disinfectants, but cannot do justice to the complexity of this subject. Additional references should be consulted, and testing done to verify the efficacy for a given usage.

It is important to be aware that common laboratory disinfectants can pose hazards to users (see Appendix I). Some examples include that ethanol and quaternary ammonium compounds may cause contact dermatitis. Chlorine in high concentrations irritates the mucous membranes, eyes, and skin. The toxicity of aldehydes limits their usefulness.

Large-volume areas such as fume hoods, biological safety cabinets, or rooms may be decontaminated using gases such as formaldehyde, ethylene oxide, or peracetic acid. These gases, however, must be applied with extreme care. Only experienced personnel who have the specialized equipment and protective devices to do it effectively and safely should perform gas decontamination.

UV Treatment

The efficacy of UV light for disinfection is limited by a number of factors (e.g., age, cleanliness, temperature, humidity), and thus UV lights cannot be used as the only disinfection method. UV light is only effective on surfaces it contacts, has little ability to penetrate materials, and the UV output

decreases as the lamp ages. Additionally, the use of UV lights in BSCs is not recommended as the sole decontamination technique by the CDC and the NIH. UV lamps should be cleaned to remove dust and fingerprints that may block the germicidal effectiveness of the ultraviolet light, and the UV intensity should be checked with a UV meter. Personnel should avoid exposure to light in this wavelength region since brief exposure can cause erythema (sunburn) and eye injury.

Emergency Plans

See the UWL Laboratory Safety & Chemical Disposal Guide, Part E: Emergency Procedures.

Also see the UWL Emergency Response Plan for comprehensive information regarding emergency plans and below for specific sections of the plan most relevant to biosafety:

- Airborne releases
- Chemical spill
- Explosion
- Fire
- Medical & first aid
- Radiation emergency

Emergency plans should be tailored for the laboratory. The laboratory supervisor should prepare instructions specifying immediate steps to be taken, and all personnel should understand basic emergency measures. It is recommended the instructions are displayed prominently in the laboratory and annually reviewed with personnel. No single plan will apply to all situations, but the following general principles should be considered:

- Always know the location of emergency response materials, such as spill kits, fire extinguishers, eyewashes, safety showers, first aid kits, automated exterior defibrillators (AED), contact numbers and first aid kits.
- Attention to immediate personal danger overrides containment considerations.
- If necessary, call 9-1-1 or University Police (non-emergency: 608.789.9000, emergency: 608.789.9999).
- Fire, security, and police personnel may enter a BSL1 or BSL2 laboratory, as they are adequately prepared to enter BSL1 and BSL2 biological laboratories. For BSL3 biological laboratories, a lab-specific plan needs to be in place for emergency personnel.
- The supervisor should always be notified.
- Notify the IBC of any spills outside containment, potential exposures, violations of the NIH Guidelines, or any research-related accidents and illnesses.

Exposure Response

PIs are asked in the context of the biosafety protocol to consider the consequences of an accidental exposure to agents (e.g., microbes, DNA, toxins) used in their research and prepare an appropriate response procedure. At times, it is difficult to ascertain whether an illness is laboratory or community acquired, and you should not discount the possibility that an illness could be related to research activities. For any possible or identifiable exposure (e.g., ingestion, skin puncture, inhalation) to a hazardous substance, individuals must seek immediate medical assessment.

Be prepared to respond to accidental exposure. The best approach is to have a well-prepared exposure response plan and to provide training to personnel according to this plan. Following are the basic elements of a plan:

- A description of the agent(s) and the signs and symptoms of infection or intoxication
- Distinct characteristics of the laboratory strain(s), such as known antibiotic resistance, transmissibility, atypical tissue tropism, foreign genes that alter pathogenicity, and so forth.

- Recommendations for treatment regarding effective drugs, quarantine, and so forth.
- A test to establish a history of exposure at the start of employment and periodically thereafter may be appropriate for work with a few pathogens such as Mycobacterium tuberculosis.

Biohazardous Spills

Laboratories should be prepared to immediately address biohazardous spills by training personnel in advance and having appropriate spill-control materials in place. Note that biohazardous materials being transported outside of laboratories, including to autoclaves, should be in secondary containment capable of completely containing the spills.

In addition to spill-prevention procedures, information regarding spill-control procedures should be displayed in laboratories and periodically reviewed with personnel. **In the event of emergency, call 911**. Environmental Health & Safety can be contacted for additional assistance and information at 608.785.6800. More emergency contact information is available in UWL's Emergency Response Plan.

Recommended Supplies

Appropriate materials to handle biohazardous spills should be prepared in advance, placed in strategic locations inside or outside the laboratory, and all laboratory personnel informed of the location(s). The items that are generally recommended include personal protective equipment (PPE), absorbent materials, disinfectant(s), clean-up tools, and signage. Contact Environmental Health & Safety for more information on preparing a spill kit.

Considerations for Teaching Laboratories

A teaching laboratory/space is a specialized environment where students are exposed to scientific techniques and experimental design, and basic biosafety is integrated into the curriculum. Adding biosafety to the teaching curriculum not only promotes a safe environment but also enhances the comprehensive experience and education of the students. In preparation for the course, instructors should consider the following when designing the curriculum and choosing the experiment:

- Hazard communication plan and emergency plan
  - See the EHS Hazard Communication Program policy.
- Training resources for students, instructors, and/or staff
  - IBC and biosafety-specific training modules are available for all UWL faculty, staff, and students via CITI. For information on how to access training, see the ORSP website.

Some general biosafety guidelines for the teaching laboratory include the following:

- Wear closed toed shoes
- Wear clothing covering legs
- Wear eye protection
- Wear lab coat
- Signage
- Handwashing after experiment and before leaving the laboratory
- Decontamination of surfaces, equipment, and microbes
- Keep exits and emergency equipment clear
- Post emergency response procedures (potential exposures, spills)
- Personal items should be stored outside of the laboratory
- No food or drink in laboratory

If experiments performed in teaching labs are subject to the NIH Guidelines, a biosafety protocol is required. In the absence of recombinant work, a biosafety protocol is recommended for lab courses and can be reviewed by the IBC to ensure proper biosafety precautions are taken.

Additional resources:

- UWL Laboratory Safety & Chemical Disposal Guide:
  - Appendix E: Laboratory Safety Survey
  - Appendix G: Training for Laboratory Personnel
- CDC Biological Risk Assessment
- CDC poster

Dual Use Research of Concern (DURC) & Pathogens with Enhanced Pandemic Potential (PEPP)

Research within Scope

The US Government Policy for Oversight of Dual Use Research of Concern (DURC) and Pathogens with Enhanced Pandemic Potential (PEPP) and accompanying Implementation Guidance outline requirements for conducting and managing certain types of federally funded life sciences research on biological agents and toxins. Per the policy, dual use research of concern (DURC) is "life sciences research that, based on current understanding, can be reasonably anticipated to provide knowledge, information, products, or technologies that could be misapplied to do harm with no, or only minor, modification to pose a significant threat with potential consequences to public health and safety, agricultural crops and other plants, animals, the environment, material, or national security." A pathogen with enhanced pandemic potential (PEPP) "is a type of pathogen with pandemic potential (PPP) resulting from experiments that enhance a pathogen's transmissibility or virulence, or disrupt the effectiveness of pre-existing immunity, regardless of its progenitor agent, such that it may pose a significant threat to public health, the capacity of health systems to function, or national security. Wild-type pathogens that are circulating in or have been recovered from nature are not PEPPs but may be considered PPPs because of their pandemic potential." While the federal policy applies to federally funded research, given the significant potential risks of working with such agents, UWL follows the federal policy for all research, regardless of funding source, that falls within the scope of the policy to ensure the safety of researchers, the community, and the environment. Researchers who believe their work may fall within the scope of Category 1 or Category 2 Research, as defined by the federal policy and Implementation Guidance, must contact the Office of Research & Sponsored Programs (ORSP) to receive guidance on fulfilling related risk assessment, protocol review, training, and other compliance requirements.

At UWL, the institutional review entity (IRE) for DURC and PEPP research is the IBC. The IBC Coordinator serves as UWL's Institutional Contact for Dual Use Research (ICDUR). The ICDUR serves as an internal resource regarding the oversight of Category 1 and Category 2 research and, for federally funded projects, serves as the liaison between the university and federal funding agencies as needed.

The scope of research subject to DURC & PEPP policy requirements is defined within two categories summarized in Appendix J. Research that meets the definition of both Category 1 and 2, is defined as Category 2.

Principal Investigator (PI) Responsibilities

PIs are responsible for the following in relation to research that falls within the scope of Category 1 or Category 2 research:

- Maintaining current training and knowledge about university and federal requirements related to DURC and PEPP research

- Assessing research at the planning stage and continuously throughout the research lifecycle to identify whether research may be within scope of Category 1 or Category 2 research (refer to the Implementation Guidance: Steps for PIs to Conduct Assessment, p. 26-30)
- Referring research that may be Category 1 or 2 to the IBC for review
- As appropriate, developing risk-benefit assessment and risk mitigation plan
- Conducting research in accordance with the approved risk mitigation plan
- Provide any required progress reports to the university and/or federal funding agency (e.g., semi-annual review)
- Ensure personnel conducting research have received and maintain appropriate education and training and demonstrate competency
- Communicate research in a responsible manner, following measures in the approved mitigation plan

Oversight Framework & Procedures

The procedures for university oversight of research that falls within the scope of the federal DURC and PEPP policy is as follows:

1. The PI conducts an assessment to determine whether their work *may* constitute Category 1 or Category 2 research. The assessment should be conducted in accordance with the Implementation Guidance: Guidance for PIs: Assessment for Potential Category 1 and Category 2 Research and Other Responsibilities (p. 26-30). PIs are responsible for assessing their work at the planning stage and continuously through the research lifecycle.
    a. A PI should refer an existing project to the IBC if the research uses a Category 1 or 2 biological agent or toxin, and the activities can be reasonably anticipated to produce one or more of the Category 1 or 2 experimental outcomes. PIs can also refer an existing project to the IBC for review if they are not certain whether the agent/toxin and/or experimental outcomes may be within the scope of Category 1 or 2 but the PI believes the project should undergo IBC review. If research is identified as potentially Category 1 or 2 during the course of experimentation, the PI must halt further work and contact the IBC to conduct the required assessments. If federally funded, the PI must also notify the federal agency.
2. If a PI assesses that their research *may* constitute Category 1 or Category 2 research, the PI submits their assessment information to the IBC for review.
    a. If the PI is developing a federal funding proposal for research that may be within the scope of Category 1 or 2, the PI must include a notification to the federal agency in the proposal. Follow funding agency guidelines.
3. The IBC reviews the PI's assessment, consults with ad hoc experts as needed, determines whether research falls within the scope of Category 1 or Category 2, and communicates the determination to the PI. The assessment should be conducted in accordance with the Implementation Guidance for IREs: Review Process for Category 1 and Category 2 Research (p. 31-42). Assessment methods are outlined in Part E of the Implementation Guidance.
    a. If the project is federally funded, the IBC also notifies the federal agency within 30 days of institutional review whether the research falls within the scope of Category 1 or 2. The federal agency evaluates and verifies the university's assessment.
    b. The IBC will ensure its membership has sufficient expertise, including biosafety and biocontainment expertise, to assess the applicability of DURC and PEPP requirements to the research being conducted and understand biosafety and biosecurity implications of such research. The IBC can invite ad hoc members from the university or community to provide expertise and consultation as needed.
    c. If the PI disagrees with the determination of the IBC regarding whether their research falls within the scope of Category 1 or 2, the PI may submit a written appeal initially to the IBC (grants@uwlax.edu) outlining the rationale for their dispute of the original determination. Rationale must be based on NIH standards and guidelines. If the appeal

is not resolved at this time, the appeal may be escalated to the RIO at the PI's request. The RIO will then review the information submitted, consult with ad hoc experts from the university or community as needed, and determine whether to uphold the IBC's classification of the research. The RIO may alternately, or in addition, refer the proposed research to an externally administered IBC for review. In that case, the PI is responsible for identifying funding to cover the review costs for an externally administered IBC (e.g., extramural funding, start-up costs).

4. The IBC works with the PI to conduct a risk-benefit assessment and develop a risk mitigation plan. The risk mitigation plan should be drafted in accordance with the Implementation Guidance: Guidance for IREs: Drafting Risk Mitigations Plans (p. 43-46). Examples of risk mitigation approaches are described in Part F of the Implementation Guidance. The IBC ensures the plan is reviewed, approved, and implemented before research begins.
    a. For federally funded research, the IBC provides a copy of the risk mitigation plan to the federal agency within 90 days from the time the IBC determines the research to be Category 1 or 2.
5. At minimum, the PI submits an annual progress report for Category 1 research or a semi-annual progress report for Category 2 research to the IBC. More frequent reports may be prescribed by the risk mitigation plan as necessary.
    a. Progress report will be prompted by ORSP as determined by the approved risk mitigation plan.
    b. For federally funded projects, the PI is responsible for submitting required progress reports to the agency.
6. At minimum, the IBC reviews Category 1 research annually and Category 2 research semi-annually to determine if additional modifications to the risk mitigation plan are needed. More frequent assessment may be prescribed by the risk mitigation plan.
    a. For federally funded projects, the IBC will annually provide formal assurance to relevant federal agencies that the university is operating consistent with the federal policy.
7. When Category 1 or 2 research is completed, PIs are responsible for completing an IBC Protocol Closure Form that describes the disposition of the biological agent(s)/toxin(s) to ensure they are properly accounted for and destroyed when no longer needed. The closure form must be accompanied by written confirmation from the relevant lab manager that the measures described in the form have been completed.
8. ORSP maintains all records of reviews, risk mitigation plans, reports, training completion, and other associated documentation in accordance with federal and state record retention requirements.

For federally funded projects, the IBC will report instances of failure to follow federal policy and mitigation measures to prevent recurrences within 30 calendar days of when the university becomes aware of the failure or is notified of the failure.

Training

The university is responsible for providing education and training on research oversight for Category 1 or 2 research for individuals conducting life sciences research that *may* be within the scope of the federal DURC & PEPP policy. Consequently, researchers working with applicable materials must complete the Biosafety and Biosecurity training modules in CITI every 3 years, which addresses the United States Government Policy for Oversight of DURC and PEPP. Refer to Training.

Research with Select Agents & Toxins

Biological Select Agents or Toxins (BSATs) are biological agents that have been declared by the US Department of Health and Human Services (HHS) or by the US Department of Agriculture (USDA) to have the "potential to pose severe threat to public health and safety." The Federal Select Agent Program regulates the laboratories which may possess, use, or transfer select agents within the United

States. To acquire more information on the federal select agent program, including a complete list of biological agents and toxins which fall under these regulations, see www.selectagents.gov. All select agents and toxins are subject to the federal DURC and PEPP policy and related university requirements (refer to DURC & PEPP section). If a researcher is considering starting work with select agents, please contact the IBC Coordinator.

Biosafety Regulations & Resources

Regulations

- **Federal Guidelines**: Certain research is subject to federal guidelines and regulations prescribed by the NIH, CDC, the US Department of Agriculture (USDA), the US Environmental Protection Agency, and the U.S. Food and Drug Administration. Investigators utilizing human blood and other potentially infectious human materials must meet certain requirements.
    - National Institutes of Health (NIH) Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules (NIH Guidelines)
    - Centers for Disease Control and Prevention (CDC) Biosafety in Microbiological and Biomedical Laboratories (BMBL)
    - US Government Policy for Oversight of Dual Use Research of Concern (DURC) and Pathogens with Enhanced Pandemic Potential (PEPP) and Implementation Guidance
- **Wisconsin Department of Commerce Regulations/OSHA Bloodborne Pathogens Standard**: As a public institution, the university must also comply with regulations prescribed by the Wisconsin Department of Commerce, including the Bloodborne Pathogens Standard mandated by the Occupational Safety and Health Administration (OSHA). At UWL, this compliance area is overseen by Environmental Health & Safety.
- **State Law Regarding rDNA Field Studies**: The State of Wisconsin has enacted a law requiring that the Wisconsin Department of Natural Resources or Department of Agriculture, Trade and Consumer Protection (DATCP) be notified of intended field studies of genetically engineered organisms.
- **Wisconsin Department of Natural Resources Guidelines for Waste Disposal**: The DNR has established regulations for the decontamination and elimination of infectious and medical wastes. Appropriate disposal of these wastes is an important aspect of a comprehensive safety program. WI Administrative Codes Chapter NR 526 Medical Waste Management, 2006.
- **Transport of Hazardous Biological Materials**: Shipping requirements for hazardous biological materials are governed by multiple federal agencies and organizations, such as federal export controls regulations, US Department of Transportation (DOT) 49 CFR 171-178, International Civil Aviation Organization (ICAO) Technical Instructions for the Safe Transport of Dangerous Goods by Air (Doc 9284), International Air Transport Association (IATA), and US Department of Agriculture (USDA) 9 CFR 122 (Organisms & Vectors Guidance & Permitting).

UWL Policies, Procedures, & Resources

- UWL Institutional Biosafety Committee
- Laboratory Safety & Chemical Disposal Guide, Environmental Health & Safety (EHS)
- Bloodborne Pathogens Exposure Control Program, EHS
- Chemical Hygiene Plan, EHS
- Particularly Hazardous Substance Prior Approval Form, EHS
- Emergency Response Plan, Police Services
- Electrical Safety Policy, EHS
- Hazard Communication Program, EHS
- Personal Protective Equipment Policy, EHS
- Respiratory Protection Program, EHS

Other Resources

- Arthropod Containment Guidelines, American Committee of Medical Entomology, American Society of Tropical Medicine & Hygiene
- Biological Agents, OSHA
- Biosafety in Microbiological and Biomedical Laboratories (BMBL), CDC/NIH
- Biological Risk Assessment, CDC
- Biological Safety Cabinets, National Sanitation Foundation (NSF)
- Bloodborne Pathogens and Needlestick Prevention, OSHA
- National Research Council Recommendations Concerning Chemical Hygiene in Laboratories (Non-Mandatory), OSHA Lab Standard, 29 CFR 1910.1450 Appendix A
- IBC Self-Assessment Tool, NIH
- NIH FAQs on IBC Administration, NIH
- NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules, NIH
- NTP Report on Carcinogens, National Toxicology Program, US Department of Health and Human Services
- Practical Guide to Containment: Plant Biosafety Research in Research Greenhouses, Traynor et al. (2008), Information Systems for Biotechnology
- Risk Group (RG) Database, American Biological Safety Association (ABSA)
- Select Agents and Toxins List, HHS, USDA
- Toxicology information (formerly TOXNET) – resources on toxicology, hazardous chemicals, and related areas, National Library of Medicine (NLM)
- World Health Organization (WHO) Laboratory Biosafety Manual

Glossary of Terms

Appendix K defines various technical terms and words used throughout this document.

Glossary of Acronyms

Appendix L describes various acronyms used throughout this document.

Appendix A – Materials Requiring a Biosafety Protocol *(see pg. 8)*

Area	Description
Recombinant or synthetic nucleic acid molecules	Recombinant materials, including those that are chemically or otherwise modified but can base pair with naturally occurring nucleic acid molecules, or cells, organisms, and viruses containing such molecules.
Microorganisms and viruses	Agents associated with human disease that pose moderate hazards to personnel and the environment. Microorganisms include bacteria, protozoa, algae, and fungi. Although viruses are not considered living organisms, they are included in this classification.
Prions	Prions are abnormal, pathogenic proteins that are transmissible and are able to induce abnormal folding of specific normal cellular proteins called prion proteins that are found most abundantly in the brain.
Non-human animal tissues, cell lines, or blood products	All cell and organ cultures and materials of non-human animal origin that are infectious, potentially infectious, or recombinant.
Human cells and cell culture, organs or tissues, or biological samples	All cell and organ cultures and materials of human origin.
Genetically modified live animals	Animals (vertebrate and/or invertebrate) that are recombinant (transgenic), exotic, and/or grown in association with pathogens and/or recombinant materials. Research involving recombinant DNA introduced into vertebrate animals will require both IBC and IACUC approval.
Plants and soils	Plants that are recombinant (transgenic), exotic, and/or grown in association with pathogenic or recombinant microbes and/or pathogenic or recombinant small animals (insects, etc.). Research involving soils, seeds, plants, plant pathogens, or other materials as regulated by state or federal policy or law. Samples from a general population that is not considered to be at an increased risk for contamination with pathogens do not need a Biosafety Protocol. Samples that *may* be at an increased risk for contamination with pathogens do require a Biosafety Protocol.
Biological toxins	Biological toxins are poisonous substances produced by certain microorganisms, animals, and plants; this includes protein toxins and low molecular weight toxins, as described in the CDC BMBL, Section VIII-G. This does not include toxic chemicals or antibiotics, which instead require Chemical Hygiene Plan review and approval by Environmental Health & Safety.
Dual Use Research of Concern (DURC)	DURC is life sciences research that can be reasonably anticipated to provide knowledge, information, technologies, and/or products that could be misapplied to do harm with no, or only minor, modification to pose a significant threat with potential consequences to public health and safety, agricultural crops or other plants, animals, the environment, or national security. See DURC & PEPP.
Pathogens with Enhanced Pandemic Potential (PEPP)	PEPP is a type of pathogen with pandemic potential (PPP), or that is likely capable of wide and uncontrollable spread in a human population and would likely cause moderate to severe disease and/or mortality in humans. This pathogen is resulting from experiments that enhance a pathogen's transmissibility or virulence, or disrupt the effectiveness of pre-existing immunity, regardless of its progenitor agent, such that it may pose a significant threat to public health, the capacity of health systems to function, or national security. Wild-type pathogens that are circulating in or have been recovered from nature are not PEPPs but may be considered PPPs because of their pandemic potential. See DURC & PEPP.
Select Agents and Toxins	Biological Select Agents and Toxins (BSATs) are biological agents that have been declared by the US Department of Health and Human Services (HHS) or by the US Department of Agriculture (USDA) to have the "potential to pose severe threat to public health and safety." See www.selectagents.gov.

Appendix B – Risk Groups & Biosafety Levels *(see pg. 17-18)*

Summary of Risk Groups (RGs)

Risk Group 1 (RG1)	Agents that are not associated with disease in healthy adult humans Examples: *E. coli* K-12, *Saccharomyces cerevisiae*
Risk Group 2 (RG2)	Agents that are associated with human disease which is rarely serious and for which preventive or therapeutic interventions are *often* available Examples: Adenovirus, Enteropathogenic *E. coli* strains, *Salmonella*, *Cryptosporidium*, *Staphylococcus aureus,* SARS-CoV-2
Risk Group 3 (RG3)	Agents that are associated with serious or lethal human disease for which preventive or therapeutic interventions *may be* available (high individual risk but low community risk) Examples: Human immunodeficiency virus, *Brucella abortus*, *Mycobacterium tuberculosis,* SARS-CoV, Middle East Respiratory Syndrome (MERS-CoV)
Risk Group 4 (RG4)	Agents that are likely to cause serious or lethal human disease for which preventive or therapeutic interventions are *not usually* available (high individual risk and high community risk). Examples: Ebola virus*, Herpesvirus simiae* (Herpes B or Monkey B virus)

Sources: NIH Guidelines, Biosafety Considerations for Research Involving SARS-CoV-2; *NIH Guidelines*, Appendix B, Classification of Human Etiologic Agents on the Basis of Hazard

Summary of Biosafety Levels (BSLs)

Biosafety Level (BSL)	Agents	Special Practices[1]	Primary Barrier & PPE	Facilities (Secondary Barriers)
1	Well-characterized agents not known to consistently cause disease in immunocompetent adult humans and present minimal potential hazard to laboratory personnel and the environment	Standard microbiological practices	No primary barriers required; protective laboratory clothing; protective face, eyewear, as needed	Laboratory doors; sink for handwashing; laboratory bench; windows fitted with screens; lighting adequate for all activities
2	Agents associated with human disease and pose moderate hazards to personnel and the environment	Limited access; occupational medical services including medical evaluation, surveillance, and treatment, as appropriate; all procedures that may generate an aerosol or splash conducted in a biosafety cabinet (BSC); decontamination process needed for laboratory equipment	BSCs or other primary containment device used for manipulations of agents that may cause splashes or aerosols; protective laboratory clothing; other PPE, including respiratory protection, as needed	Self-closing doors; sink located near exit; windows sealed or fitted with screens; autoclave available
3	Indigenous or exotic agents; may cause serious or potentially lethal disease through the inhalation route of exposure	Access limited to those with need to enter; viable material removed from laboratory in primary and secondary containers; opened only in BSL-3 or ABSL-3 laboratories; all procedures with infectious materials performed in a BSC	BSCs for all procedures with viable agents; solid front gowns, scrubs, or coveralls; two pairs of gloves, when appropriate; protective eyewear, respiratory protection, as needed	Physical separation from access corridors; access through two consecutive self-closing doors; hands-free sink near exit; windows are sealed; ducted air ventilation system with negative airflow into laboratory; autoclave available, preferably in laboratory
4	Dangerous and exotic agents that pose high individual risk of aerosol-transmitted laboratory infections and life-threatening disease that are frequently fatal, for which there are no vaccines or treatments; and related agents with unknown risk of transmission	Clothing change before entry; daily inspections of essential containment and life support systems; all wastes decontaminated prior to removal from laboratory; shower on exit	BSCs for all procedures with viable agents; solid front gowns, scrubs, or coveralls; gloves; full-body, air-supplied, positive-pressure suit	Entry sequence; entry through airlock with airtight doors; walls, floors, ceilings form sealed internal shell; dedicated, non-recirculating ventilation system required; double-door, pass-through autoclave required

Source: CDC *BMBL*, Section IV, Table 1. Summary of Laboratory Biosafety Levels, p. 68-69

[1] Each successive BSL contains the recommendations of the preceding level(s) and the criteria.

Appendix C – Practices & Procedures: BSL3 Manual Requirements *(see pg. 19)*

1. Title, table of contents
2. Emergency contacts
3. Revision history and Record Keeping
    a. Specific changes made, who made the changes and date
    b. Review dates (e.g., IBC review and annual review)
4. Facility Design and Specifications
    a. Number and location of rooms
    b. Engineering controls (e.g., HEPA filters, exhaust, air handling systems, pressure gauges)
    c. Generator for power outages
    d. Security description (e.g., fingerprint scanners, retina scanners, ID card scanners, high security keys)
    e. Waste collection system (e.g., Effluent Decontamination System (EDS))
5. Facility Reverification
    a. Annual certifications or performance testing (e.g., BSC, Fume Hood, HVAC, HEPA filters)
    b. Description of procedures performed during reverification (e.g., preventative maintenance of equipment, work stopped, materials secured, biohazard trash removed, decontamination of surfaces performed)
    c. Describe record keeping (e.g., EH&S keeps records of facility reverification)
6. Facility Decontamination
    a. Yearly requirements
    b. At the end of facility use
    c. When repairs are needed
7. Biosafety Level 3 (BSL3) Description: (BMBL, these elements may be covered in other sections)
    a. Standard Microbiological Practices
    b. Special practices (e.g., describe special regulations for non-research related plants, animals)
    c. Safety Equipment
    d. Laboratory Facilities
8. Animal Biosafety Level 3 (ABSL3) Description: (BMBL, these elements may be covered in other sections)
    a. Standard Microbiological Practices
    b. Special practices
    c. Safety Equipment
    d. Laboratory Facilities
9. Personnel Requirements
    a. Training
        i. Describe training procedures
        ii. Documentation of personnel proficiency
        iii. Documentation of training/notification of BSL3 manual/research activity changes
    b. Any applicable background checks, clearances, evaluations
    c. Understanding of hazards
        i. Microbes
            1. List agent(s) and describe brief history, host range, route of transmission, biosafety level practices recommended, genetic manipulation performed on the agent(s) (how that affects the risk assessment), other important information to understand the risk of manipulating the agent(s)
            2. May also develop a laboratory-specific medical response sheet
            3. May also develop a pathogen specific data sheet
        ii. Other biological hazards (e.g., toxins, cell lines, etc.)

        iii. Procedural hazards
        iv. Other hazards
    d. Understanding health and medical requirements
    e. Describe fit testing of respirators (testing, medical clearance, refer to detailed SOP for respirator use)
    f. Understand and comply with any agent specific programs (quarantine, allergy etc.)
10. Service Personnel and Visitor Requirements
    a. Escorting
    b. Use of PPE
    c. Visitor training (e.g., hazard communication)
    d. Visitor log
    e. Vaccination requirements
11. Health and Medical Monitoring
    a. Depending on the agent, certain restrictions, vaccinations or monitoring may need to be in place for BSL3 work.
    b. Outline as applicable to your agent (e.g., symptoms for each agent, reporting, what to do when you are sick, emergency procedures, contact numbers, testing requirements)
    c. List types of accidental exposure:
        i. Needle stick
        ii. Animal bite
        iii. Break in PPE
        iv. Broken vessel outside BSC v. unknown exposure with symptoms
12. Laboratory Research Practices
    a. List specific practices beyond the already required inherent BSL1 and BSL2 practices required to work at BSL3
    b. Describe any special practices for: specific agents (e.g., agent A may not be handled when agent B is being handled); activities performed outside of containment (e.g., use of specialized equipment)
    c. Cleaning and maintaining equipment and surfaces (e.g., frequency, disinfectant exposure time and concentration, eye wash maintenance)
    d. Describe animal experimental procedures or summarize and reference specific standard operating procedures (SOPs) (cleaning, housing, monitoring, PPE, who performs tasks)
    e. Procedures for waste removal
    f. Record keeping
13. Decontamination of Laboratory Waste
    a. Autoclave use
    b. Documentation
    c. Efficacy testing
    d. Equipment decontamination (large and small) procedures
    e. Animal waste decontamination (cages, waste, bedding, animals)
    f. Sharps disposal
14. Emergency Response
    a. Detail spill protocols (inside and outside of containment)
    b. List emergency contacts and reporting procedures
    c. Exposure procedures
    d. Breech of containment
    e. Health Emergency/Fire/Weather Emergency
    f. Theft/missing agents
15. Removal of equipment from the BSL3 area (e.g., maintenance, repair, replacement)
    a. Detail decontamination procedures and documentation
16. Material Intake and Removal Procedures
    a. Shipping and receiving requirements/training
    b. Documentation (inactivation, confirmation, validations, assurances)

c. Permit requirements

17. Pest Control
    a. Insect and Pest Control Program written and in place
    b. Describe regulation requirements
18. Appendices:
    a. Relevant SOPs
    b. Facility map
    c. Consent forms
    d. Training forms
    e. List of approved users
    f. Entry and exit
    g. PPE donning and doffing
    h. Inactivation of infectious materials
    i. Infectious waste disposal
    j. Decontamination of BSC and items in BSC
    k. Trash disposal
    l. Record keeping
    m. Additional information as needed or per IBC
    n. Chart on risk assessment for specific activities (e.g., deviation from typical BMBL practices)

Appendix D – Summary of Safety Practices: Biosafety Level 1-3 *(see pg. 20)*

	BSL 1	BSL 2	BSL 3
Before Entering			
Access to the laboratory is controlled.	Yes	Yes	Yes
Doors are kept closed when not entering or exiting.	Yes	Yes	Yes
Laboratory Emergency Information door card must be posted at the entrance to the laboratory. Reviewed and dated annually for accuracy.	Yes	Yes	Yes
A sign incorporating the universal biohazard symbol must be posted at the entrance to the laboratory. The sign includes the biohazards in use and the name and phone number of the laboratory supervisor or other responsible personnel. Reviewed and dated annually for accuracy.	No	Yes	Yes
Hazards communication: All persons, including visitors and service personnel, entering the lab must be advised of the potential hazards and meet specific entry/exit requirements, such as vaccinations, TB testing or donning and doffing of PPE.	Desirable	Yes	Yes
The laboratory personnel must receive lab specific training regarding hazards, risk mitigation, emergency procedures, and occupational health considerations. Training must be documented. The IBC recommends refresher training at least once per year.	Yes	Yes	Yes
Laboratory personnel must be provided medical surveillance, as appropriate, and offered available immunizations for agents handled or potentially present in the laboratory.	No	Yes	Yes
The laboratory supervisor, PI, or designee must ensure that laboratory personnel demonstrate proficiency in standard and special microbiological and/or laboratory techniques/practices before working with all materials/agents.	Desirable	Yes	Yes
Animals and plants not associated with the work being performed must not be permitted in the laboratory.	Desirable	Yes	Yes
Practices to reduce cardboard are in place.	Desirable	Desirable	Yes
Practices to reduce pests, mold, fire hazards are in place (e.g., reduce cardboard, reduce clutter).	Desirable	Desirable	Yes
All personnel will don minimal entry PPE as listed in the biosafety protocol prior to entry.	Yes	Yes	Yes
Within Laboratory			
Don extra PPE according to activities being performed.	Yes	Yes	Yes
Mouth pipetting is prohibited; pipetting devices must be used.	Yes	Yes	Yes
Procedures for safe handling of medical sharps (e.g., needles, scalpels) and non-medical sharps (e.g., pipettes, broken glassware) must be followed.	Yes	Yes	Yes
Plastic ware should be substituted for glass wherever possible.	Desirable	Desirable	Yes
Potentially infectious materials must be placed in a durable, leak-proof container during collection, handling, processing,	Yes	Yes	Yes

storage, or transport within a facility. If this is not possible, a risk assessment is performed.			
Perform procedures to minimize the creation of splashes and/or aerosols.	Yes	Yes	Yes
All procedures involving the manipulation of infectious materials that may generate an aerosol are conducted within a BSC or other physical containment device.	Desirable	Desirable	Yes
Laboratory equipment should be routinely decontaminated, as well as, after spills, splashes, or other potential contamination.	Yes	Yes	Yes
Equipment must be decontaminated before repair, maintenance, or removal from the laboratory.	Yes	Yes	Yes
All cultures, stocks, and other forms of potentially infectious or recombinant materials must be inactivated using an effective method either by the laboratory or an approved vendor before disposal.	Yes	Yes	Yes
Spills involving infectious materials must be contained, decontaminated, and cleaned up by laboratory personnel properly trained and equipped to work with infectious material.	Yes	Yes	Yes
Incidents that may result in exposure to infectious materials must be immediately evaluated and treated according to procedures described in the laboratory biosafety protocol.	Yes	Yes	Yes
Decontaminate work surfaces after completion of work and after any spill or splash of potentially hazardous material with an effective disinfection method.	Yes	Yes	Yes
Materials & People Leaving the Laboratory			
Persons must wash hands before leaving the laboratory.	Yes	Yes	Yes
Practices to prevent spills and potential exposures during movement of materials in hallways, elevators, or public spaces are in place.	Yes	Yes	Yes
Transport of biohazardous materials should occur in a secondary container that is durable, leak proof, labeled, and surface disinfected.	Yes	Yes	Yes
Biowaste should be transported in a manner that prevents leaks, spills, exposures, or releases.	Yes	Yes	Yes

Appendix E – Animal Biosafety *(see pg. 20)*

Animal Biosafety Level 1

Animal Biosafety Level 1 (ABSL1) is suitable for work in animals involving well-characterized agents that are not known to cause disease in immunocompetent adult humans, and present minimal potential hazard to personnel and the environment. ABSL1 facilities should be separated from the general traffic patterns of the building and restricted as appropriate. Special containment equipment or facility design may be required as determined by appropriate risk assessment. (See BMBL, Section II, Biological Risk Assessment.) Personnel must have specific training in animal facility procedures and must be supervised by an individual with adequate knowledge of potential hazards and experimental animal procedures.

Animal Biosafety Level 2

Animal Biosafety Level 2 (ABSL2) builds upon the practices, procedures, containment equipment, and facility requirements of ABSL1. ABSL2 is suitable for work involving laboratory animals infected with agents associated with human disease and pose moderate hazards to personnel and the environment. It also addresses hazards from ingestion as well as from percutaneous and mucous membrane exposure. ABSL2 requires that: 1) access to the animal facility is restricted; 2) personnel must have specific training in animal facility procedures, the handling of infected animals and the manipulation of pathogenic agents; 3) personnel must be supervised by individuals with adequate knowledge of potential hazards, microbiological agents, animal manipulations and husbandry procedures; and 4) BSCs or other physical containment equipment are used when procedures involve the manipulation of infectious materials, or where aerosols or splashes may be created. Appropriate personal protective equipment must be utilized to reduce exposure to infectious agents, animals, and contaminated equipment. Implementation of employee occupational health programs should be considered.

Animal Biosafety Level 3

Animal Biosafety Level 3 (ABSL3) involves practices suitable for work with laboratory animals infected with indigenous or exotic agents, agents that present a potential for aerosol transmission, and agents causing serious or potentially lethal disease. ABSL3 builds upon the standard practices, procedures, containment equipment, and facility requirements of ABSL2. The ABSL3 laboratory has special engineering and design features. ABSL3 requires that: 1) access to the animal facility is restricted; 2) personnel must have specific training in animal facility procedures, the handling of infected animals, and the manipulation of potentially lethal agents; 3) personnel must be supervised by individuals with adequate knowledge of potential hazards, microbiological agents, animal manipulations, and husbandry procedures; and 4) procedures involving the manipulation of infectious materials, or where aerosols or splashes may be created, must be conducted in BSCs or by use of other physical containment equipment. Appropriate personal protective equipment must be utilized to reduce exposure to infectious agents, animals, and contaminated equipment. Employee occupational health programs must be implemented.

Appendix F – Arthropod Containment Level 1-3 *(see pg. 21-22)*

Arthropod Containment Level 1

Arthropod Containment Level 1 (ACL1) is suitable for work with uninfected arthropod vectors or those infected with a non-pathogen including arthropods already present in the local region (regardless of whether there is active vector-borne disease transmission and exotic arthropods that would be non-viable upon escape or only temporarily could establish).

ACL1 practices:

- Arthropod containers and incubators are located to minimize accidental release (e.g., out of the general traffic flow, avoid hallways)
- Materials that provide breeding sites and harborages are minimized to allow detection of escaped arthropods
- Eliminate accidental sources of arthropods (e.g., clean after spills, eliminate standing water)
- Cages or containers are cleaned and maintained to prevent survival or escape
- Bags, rearing trays are used to effectively prevent leakage. Screened mesh may be used if durable and of appropriate size. All life cycle stages are considered.
- All life stages of arthropods are killed prior to disposal (e.g., hot water, freezing)
- Labels attached to container identify species, strain or other relevant information for hazard communication
- Each level of containment and life cycle stage is considered to prevent dispersal on persons
- An effective arthropod trapping program is recommended to monitor the escape prevention program in place
- A program is in place to prevent entrance of wild arthropods and rodents (prevent contamination, predation, inadvertent infection)
- ACL1 signage is posted
- Vertebrate animals used as hosts or blood sources when housed in the insectary, are adequately protected from escaped arthropods
- During feeding on host animals:
    - Primary container integrity examined
    - Precautions in place to prevent escape via flying, screens, covers
    - Host animals are inspected (ears, axillae, fur, etc.) to prevent escape
- Blood sources are considered. If feasible, use of sterile blood or sources known to be pathogen free are used. If human volunteers are used, risk assessment is required.
- Gloves are used when handling host animals
- Lab coats, gowns or uniforms should be worn at all times
- Risk assessment performed to determine the need for arthropod specific PPE (e.g., respirators for allergies, particle masks, head covers)

ACL1 facilities:

- Insectary is separated from general building traffic
- Insectary doors minimize escape and entrance of arthropods (ridged panels, screens, glass, plastic sheets, cloth)
- If facility is not designed as an insectary it may be used considering the following:
    - Arthropods held by a ‘cage within a cage’
    - Use of practices preventing escape (e.g., chilling containers before removing mosquitos, non-flying species manipulated in pans within moats of water)
    - Use of Plexiglas glove boxes

Arthropod Containment Level 2

Arthropod Containment Level 2 (ACL2) builds upon ACL1 and is more stringent in physical containment, disposal, and facility requirements. ACL2 is suitable for work with exotic and indigenous arthropods known or suspected to be infected with RG2 agents associated with animal or human disease. It is also appropriate for uninfected genetically modified arthropod vectors of disease provided the genetic modification does not or is not anticipated to increase viability, host range, survival, or vector capacity.

ACL2 practices:

- Laboratory is designed to detect escaped arthropods
    - Equipment and supplies not needed for operation are located outside of the insectary
    - Supplies needed are not located on open shelves (recommend closed storage room or cabinets with tight fitting doors)
    - Insect diet kept in sealed containers
- Cages are shatter proof and screened to prevent escape; may be disposable or autoclavable and designed to prevent escape
- All life stages of uninfected arthropods must be killed prior to disposal freezing or other suitable method
- All life stages of infected arthropods should be autoclaved or decontaminated with chemical disinfectant prior to disposal based on agent specific risk assessment
- Uninfected and infected arthropod containers are clearly labeled; separate rooms are recommended
- Wash hands before leaving the insectary and after handling infected arthropods or cultures
- PPE that is reused is checked for infestation prior to insectary exit
- Species-appropriate escape measure(s) are in place (e.g., oviposition traps, ground-level flea traps, oil-filled channels surrounding tick colonies, light traps for mosquitoes)
- Exterior monitoring for exotic species is recommended
- Breeding and harborage areas are eliminated, furniture and lab space are easy to clean
- Sharps use and disposal as per the biosafety protocol
- Equipment and work surfaces are routinely cleaned as per biosafety protocol
- Appropriate signage is posted
    - BSL2 sign is posted if applicable
    - ACL2 sign is posted (arthropod species, agent, name and phone number of responsible person, any special entry requirements)
- Insectary access is limited to trained persons, guests are escorted and provided hazard communication
- Animals used as hosts or blood sources are not housed with arthropods and protected from escapees
- Living arthropods are moved from ACL1 to ACL2 for infection and are not transported from ACL2 to ACL1
- Escaped arthropods are killed, disposed of or re-captured and returned to their container; infected arthropods are not killed with bare hands and are manipulated with other means
- Accidental release procedure is posted including reporting procedures
- All equipment is decontaminated and disinfested before moving between rooms within the insectary and before removal from the insectary
- Clothing should minimize exposed skin

ACL2 facilities:

- Locate arthropods in dedicated rooms, closets, incubators out of traffic flow to prevent accidental contact and release
    - Recommend at least two self-closing doors; not opened simultaneously

  - Entrance door prevents flying and crawling arthropod escape o Increased isolation (e.g., separate building, wing, suite)
  - Windows are not recommended; if present, they need to be resistant to breakage and well-sealed
  - Outlets, vacuum systems, floor drains, plumbing, electrical fixtures are designed to prevent accidental release of arthropods and agents (e.g., filters, traps filled with disinfectant, walls light colored, minimal wall floor and ceiling penetrations, sealed, avoid lighted or dark openings that attract arthropods
  - Additional barriers may be needed based on lab-specific space assessment (e.g., screened partitions, hanging curtains)
  - Recommend dedicated area for handling infected arthropods (e.g., walk-in incubator, screen room, separate cubicle)
- HVAC requirements as per BSL2 laboratory requirements
- Handwashing sinks available

Arthropod Containment Level 3

Arthropod Containment Level 3 (ACL3) containment builds on the ACL1 and ACL2 recommendations and focuses on microbiological containment. ACL3 is suitable for work with arthropods that are known or potential vectors of RG3 microbes or are likely to be infected with RG3 microbes.

ACL3 practices:

- Housing is designed to prevent contact and release of arthropods
  - Incubators serve as an additional layer of containment
  - Less mobile vector arthropods (e.g., ticks) held within vials contained in desiccator cabinets or other escape-proof secondary or tertiary housing if incubator not used
- Manipulation of arthropods in a BSC is difficult and can increase the risks associated with arthropod vector research. Because BMBL states, “All procedures involving the manipulations of infected materials are conducted within a biological safety cabinets or other physical containment devices,” a risk assessment is performed by the IBC for procedures performed outside of containment.
- Materials used to wipe or mop insectary are autoclaved prior to disposal
- Special spill protocols are in place and only trained persons perform spill cleanup
- Special considerations to aerosol generation are needed, even for disinfestation and decontamination of containers. The IBC will review and perform a risk assessment.
- Living infected arthropods should be killed by freezing or other appropriate method prior to autoclaving or incineration
- Only arthropods requiring ACL3 should be housed in the ACL3 insectary
- Viable potentially infected arthropods and infected arthropods of all life stages should not leave the ACL3 insectary. If integral to the research, a risk assessment is performed by the IBC.
- Recommend “count in, count out” method
- Recommend that the number of arthropods in a container be on the label
- Footwear dedicated for the ACL3 is recommended
- Pesticide for emergency use is available in areas of likely arthropod escape
- Operational procedures are reviewed by the IBC

ACL3 facilities:

- Dedicated BSL3 rooms, wings, or suites
- Insectary features:
    - Insectary is locked and access is controlled (e.g., key, proximity reader, or card key)
    - Double door entry with a change room
    - If applicable, showers are plumbed to prevent arthropod escape
    - Autoclave available
    - Internal doors are self-closing; kept closed during arthropod manipulation
    - Additional barriers like hanging curtains are recommended
    - Windows are not recommended
    - Floor drains are not recommended
    - Troughs surrounding door frames may be installed and have a sticky material to trap crawling arthropods, as per risk assessment
    - HEPA filtered exhaust may be required for some agents
    - HEPA filtered supply recommended for some agents
    - Visual directional airflow verification
    - Audible alarms present for systems failure
    - Engineering testing performed annually

Appendix G – Plant Biocontainment: Biosafety Level 1- 3 *(see pg. 22-23)*

Plant Biosafety Level 1

BSL1-P is designed to provide a moderate level of containment for experiments for which there is convincing biological evidence that precludes the possibility of survival, transfer, or dissemination of recombinant DNA into the environment, or in which there is no recognizable and predictable risk to the environment in the event of accidental release.

BSL1-P relies upon accepted scientific practices for conducting research in most ordinary greenhouse or growth chamber facilities and incorporates accepted procedures for good pest control and horticultural practices. BSL1-P facilities and procedures provide a modified and protected environment for the propagation of plants and microorganisms associated with the plants and a degree of containment that adequately controls the potential for release of biologically viable plants, plant parts, and microorganisms associated with them.

BSL1-P:

- Access to the greenhouse shall be limited or restricted
- Prior to entering the greenhouse, personnel shall be required to read and follow instructions on greenhouse practices and procedures. All procedures shall be performed in accordance with accepted greenhouse practices that are appropriate to the experimental organism.
- A record shall be kept of experiments currently in progress in the greenhouse facility.
- Experimental organisms shall be rendered biologically inactive by appropriate methods before disposal outside of the greenhouse facility.
- A program shall be implemented to control undesired species (e.g., weed, rodent, or arthropod pests and pathogens)
- Arthropods and other motile macroorganisms shall be housed in appropriate cages. If macroorganisms (e.g., flying arthropods, nematodes) are released within the greenhouse, precautions shall be taken to minimize escape from the greenhouse facility.
- Experiments involving other organisms that require a containment level lower than BSL1-P may be conducted in the greenhouse concurrently with experiments that require BSL1-P containment, provided that all work is conducted in accordance with BSL1-P greenhouse practices.
- The term “greenhouse” refers to a structure with walls, a roof, and a floor designed and used principally for growing plants in a controlled and protected environment. The walls and roof are usually constructed of transparent or translucent material to allow passage of sunlight for plant growth.
- The term "greenhouse facility" includes the actual greenhouse rooms or compartments for growing plants, including all immediately contiguous hallways and head-house areas, and is considered part of the confinement area.
- The greenhouse floor may be composed of gravel or other porous material. At a minimum, impervious (e.g., concrete) walkways are recommended.
- Windows and other openings in the walls and roof of the greenhouse facility may be open for ventilation as needed for proper operation and do not require any special barrier to contain or exclude pollen, microorganisms, or small flying animals (e.g., arthropods and birds); however, screens are recommended

Plant Biosafety Level 2

BSL2-P builds upon BSL1-P. BSL2-P is designed to provide a greater level of containment for experiments involving plants and certain associated organisms in which there is a recognized possibility of survival, transmission, or dissemination of recombinant DNA containing organisms, but the consequence of such an inadvertent release has a predictably minimal biological impact. Experiments requiring BSL2-P or a higher level of containment involve plants that are noxious weeds, that can interbreed with noxious weeds in the immediate geographic area; or have recognized potential for rapid and widespread dissemination or for serious detrimental impact on managed or natural ecosystems.

BSL2-P:

- A record shall be kept of experimental plants, microorganisms, or small animals that are brought into or removed from the greenhouse facility.
- If recombinant: The Principal Investigator shall report any greenhouse accident involving the inadvertent release or spill of microorganisms to the Greenhouse Director, Institutional Biosafety Committee, NIH Office of Science Policy (OSP) and other appropriate authorities immediately (if applicable).
- Experiments involving other organisms that require a containment level lower than BSL2-P may be conducted in the greenhouse concurrently with experiments that require BSL2-P containment provided that all work is conducted in accordance with BSL2-P greenhouse practices.
- A sign shall be posted indicating that a restricted experiment is in progress. The sign shall indicate the following: (i) the name of the responsible individual, (ii) the plants in use, and (iii) any special requirements for using the area.
- If organisms are used that have a recognized potential for causing serious detrimental impacts on managed or natural ecosystems, their presence shall be indicated on a sign posted on the greenhouse access doors.
- If there is a risk to human health, a sign shall be posted incorporating the universal biosafety symbol.
- A greenhouse practices manual shall be prepared or adopted. This manual shall: (i) advise personnel of the potential consequences if such practices are not followed, and (ii) outline contingency plans to be implemented in the event of the unintentional release of organisms.
- A greenhouse floor composed of an impervious material. Concrete is recommended, but gravel or other porous material under benches is acceptable unless propagules of experimental organisms are readily disseminated through soil. Soil beds are acceptable unless propagules of experimental organisms are readily disseminated through soil.
- An autoclave shall be available for the treatment of contaminated greenhouse materials.
- If intake fans are used, measures shall be taken to minimize the ingress of arthropods. Louvers or fans shall be constructed such that they can only be opened when the fan is in operation.
- BSL2-P greenhouse containment requirements may be satisfied by using a growth chamber or growth room within a building provided that the external physical structure limits access and escape of microorganisms and macroorganisms in a manner that satisfies the intent of the foregoing clauses.

Plant Biosafety Level 3

BSL3-P builds upon BSL2-P. BSL3-P describes additional containment conditions for research with plants and certain pathogens and other organisms that require special containment because of their recognized potential for significant detrimental impact on managed or natural ecosystems.

BSL3-P:

- Authorized entry into the greenhouse shall be restricted to individuals who are required for program or support purposes.
- Prior to entering the greenhouse, personnel shall be required to read and follow instructions on BL3-P practices and procedures. All procedures shall be conducted in accordance with accepted greenhouse practices that are appropriate to the experimental organisms.
- All experimental materials shall be sterilized in an autoclave or rendered biologically inactive by appropriate methods before disposal, except those that are to remain in a viable or intact state for experimental purposes; including water that comes in contact with experimental microorganisms or with material exposed to such microorganisms, and contaminated equipment and supplies.
- Experiments involving organisms that require a containment level lower than BSL3-P may be conducted in the greenhouse concurrently with experiments that require BSL3-P containment provided that all work is conducted in accordance with BSL3-P greenhouse practices.
- Experimental materials that are brought into or removed from the greenhouse facility in a viable or intact state shall be transferred to a non-breakable sealed secondary container. At the time of transfer, if the same plant species, host, or vector are present within the effective dissemination distance of propagules of the experimental organism, the surface of the secondary container shall be decontaminated. Decontamination may be accomplished by passage through a chemical disinfectant or fumigation chamber or by an alternative procedure that has demonstrated effective inactivation of the experimental organism.
- Disposable clothing (e.g., solid front or wrap-around gowns, scrub suits, or other appropriate clothing) shall be worn in the greenhouse if deemed necessary by the Greenhouse Director because of potential dissemination of the experimental microorganisms.
- Protective clothing shall be removed before exiting the greenhouse and decontaminated prior to laundering or disposal.
- Personnel are required to thoroughly wash their hands upon exiting the greenhouse.
- All procedures shall be performed carefully to minimize the creation of aerosols and excessive splashing of potting material/soil during watering, transplanting, and all experimental manipulations.
- The need to maintain negative pressure should be considered when constructing or renovating the greenhouse.
- The greenhouse floor shall be composed of concrete or other impervious material with provision for collection and decontamination of liquid run-off.
- Windows shall be closed and sealed. All glazing shall be resistant to breakage (e.g., double pane tempered glass or equivalent). The greenhouse shall be a closed self-contained structure with a continuous covering that is separated from areas that are open to unrestricted traffic flow. The minimum requirement for greenhouse entry shall be passage through two sets of self-closing locking doors.
- The greenhouse facility shall be surrounded by a security fence or protected by equivalent security measures.

- Internal walls, ceilings, and floors shall be resistant to penetration by liquids and chemicals to facilitate cleaning and decontamination of the area. All penetrations into these structures and surfaces (e.g., plumbing and utilities) shall be sealed.
- Bench tops and other work surfaces should have seamless surfaces that are impervious to water and resistant to acids, alkalis, organic solvents, and moderate heat.
- The greenhouse contains a foot, elbow, or automatically operated sink, which is located near the exit door for hand washing.
- An autoclave shall be available for decontaminating materials within the greenhouse facility. A double-door autoclave is recommended (not required) for the decontamination of materials passing out of the greenhouse facility.
- An individual supply and exhaust air ventilation system shall be provided. The system maintains pressure differentials and directional airflow, as required, to assure inward (or zero) airflow from areas outside of the greenhouse.
- The exhaust air from the greenhouse facility shall be filtered through high efficiency particulate air-HEPA filters and discharged to the outside. The filter chambers shall be designed to allow in situ decontamination before filters are removed and to facilitate certification testing after they are replaced. Air filters shall be 80-85% average efficiency by the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Standard 52-68 test method using atmosphere dust. Air supply fans shall be equipped with a backflow damper that closes when the air supply fan is off. Alternatively, a HEPA filter may be used on the air supply system instead of the filters and damper. The supply and exhaust airflow shall be interlocked to assure inward (or zero) airflow at all times.
- BSL3-P greenhouse containment requirements may be satisfied using a growth chamber or growth room within a building provided that the location, access, airflow patterns, and provisions for decontamination of experimental materials and supplies meet the intent of the foregoing clauses.
- Vacuum lines shall be protected with high efficiency particulate air/HEPA or equivalent filters and liquid disinfectant traps.

Appendix H – Standards for Facilities & Equipment for Biosafety Levels *(see pg. 28)*

	BSL 1	BSL 2	BSL 3
Laboratory visit by Environmental Health & Safety	Desirable	Yes	Yes
Isolation of laboratory from public areas	-	-	Yes
Eyewash, plumbed	Desirable	Yes	Yes
Interior surfaces impervious, cleanable:	Yes	Yes	Yes
Bench tops	Yes	Yes	Yes
Laboratory furniture	Yes	Yes	Yes
Floors, non-absorbent	Yes	Yes	Yes
Floors, seamless with integral cove base	-	Desirable	Yes
Ceiling, conventional or suspended	Yes	Yes	-
Ceiling, permanent and sealed	-	-	Yes
Sinks in laboratory	Yes	Yes	Yes
Hands-free	-	-	Yes
Water supply protected	-	-	Yes
Windows allowed	Yes	Yes	Yes
May be opened	No	No	No
Must be sealed	No	No	Yes
Room penetrations sealed for gas decontamination (pressure decay testing)	No	No	Desirable
Ventilation (supply/exhausted not recirculated):	Yes	Yes	Yes
Inward air flow (negative pressure)	Yes	Yes	Yes
Mechanical, centralized system	Yes	Yes	Yes
Mechanical, independent system	No	No	Desirable
Filtered exhaust required	No	No	Desirable
Interlocked supply required	No	No	Yes
Annually test filters/HVAC systems	No	No	Yes
Annually test controls/alarms	No	No	Yes
Doors (self-closing):	Desirable	Desirable	Yes
Double-door entry required	No	No	Yes
Airlock with shower required	No	No	Desirable
Autoclave on-site:	Desirable	Yes	Yes
In laboratory room	-	-	Desirable
Pass-through (double-ended)	-	-	Desirable
Biological safety cabinets:			
Annual certification	Desirable	Yes	Yes
Class I or Class II	-	Desirable	Yes
Class III	-	-	Desirable
Vacuum lines should be protected with liquid trap or in-line HEPA filter	Desirable	Yes	Yes
Waste effluent treatment	-	-	Desirable
Centrifuge with sealed rotors, buckets, or safety cups; HEPA filter required	-	Desirable	Yes

Appendix I – Chemical Disinfection *(see pg. 31)*

Disinfectant	Properties	Ex. Products
Alcohol (ethanol, isopropanol)	Effective against vegetative forms of bacteria, including mycobacteria and fungi, and hydrophobic (enveloped) viruses, but will not destroy spores or hydrophilic viruses. The recommended strength is 70–90%; higher levels may be less efficacious. Alcohol typically is used for disinfection of instruments or surfaces that have low organic burden. Characteristics limiting usefulness are flammability, poor penetration of protein-rich materials, and rapid evaporation making extended contact time difficult to achieve. Alcohol-based hand-rubs may be used for the decontamination of lightly soiled hands in situations where proper handwashing is inconvenient or impossible.	
Aldehydes (formaldehyde, glutaraldehyde)	Have broad germicidal activity, but toxicity to humans limits their usefulness as laboratory disinfectants.	• Cidex • Wavicide-01
Peroxygen compounds	Provide a wide range of bactericidal, viricidal, and fungicidal activity, although activity is variable against bacterial spores and mycobacteria. Corrosivity varies with different products but is less problematic than with hypochlorite disinfectants. Their detergent properties combine cleaning with disinfection.	• Virkon
Halogens	Can be inexpensive and highly effective in decontaminating large spills. Their drawbacks include short shelf life, easy binding to nontarget organic substances, and corrosiveness, even when diluted. Household bleach typically contains 5.25%-6.15%. NaOCl Solutions should be stored in an opaque bottle to reduce decay during storage. A freshly prepared solution should be used for sanitary purposes such as cleaning a blood spill. Solutions containing bleach should not be autoclaved as chlorine gas will be released. Also be aware that using chlorine compounds to disinfect substances co-contaminated with radioiodine may cause gaseous release of the isotope. Contact with skin should be avoided.	• Clidox • Clorox • Household bleach (active ingredient of Hypochlorite)
Iodophors	Complexes of iodine and carrier have good germicidal properties with relatively low toxicity and irritancy. Efficacy has been demonstrated against bacteria including mycobacteria, viruses, and fungi; prolonged contact time may be needed to kill certain fungi and bacterial spores.	• Povidine • Betadine
Phenolic compounds	Effective against vegetative bacteria, particularly gram-positive species, and enveloped viruses but not against spores. Phenolics may be used in combination with detergents for one-step cleaning and disinfection of surfaces. Phenolic disinfectants maintain their activity in the presence of organic material and are generally considered safe, although prolonged exposure of skin may cause irritation.	• Vesphene • LpH
Quaternary ammonia disinfectants	Kill most fungi and vegetative gram-positive bacteria but lack efficacy against mycobacteria, spores, and some viruses including adenovirus. Quaternary ammonium compounds generally have low toxicity and irritancy and are relatively inexpensive.	• CaviCide • HB Quat • Roccal • Solucide

Appendix J – DURC & PEPP Risk, Scope, and Review *(see pg. 34)*

Summary of DURC & PEPP Risk, Scope, and Review

	Category 1 Research	Category 2 Research
Primary risk	Research constitutes DURC as assessed by the IBC and/or federal funding agency.	Research can be reasonably anticipated to result in the development, use, or transfer of a PEPP or an eradicated or extinct PPP that may pose a significant threat to public health, the capacity of health systems to function, or national security, through the potential accidental or deliberate introduction of a PEPP or an eradicated or extinct PPP into a human population. It may also have dual use risks.
Types of pathogens in scope	The general scope includes: • All Biological Select Agents & Toxins in 9 CFR 121.3-121.4, 42 CFR 73.3-73.4, 7 CFR 331.3, and regulated by the USDA and/or HHS • All Risk Group 4 pathogens in Appendix B of the NIH Guidelines • A subset of Risk Group 3 pathogens listed in Appendix B of the NIH Guidelines[2] • For biological agents affecting humans that have not been assigned a Risk Group in the NIH Guidelines, agents affecting humans that are recommended to be handled at BSL3 or BSL4 per the BMBL[3] (Section VIII)	• Any pathogen modified in such a way that is reasonably anticipated to result in the development, use, or transfer of a PEPP. Includes development of new PPPs from non-PPPs as well as the enhancement of existing PPPs • Eradicated or extinct PPPs that may pose significant threat to public health, the capacity of health systems to function, or national security
Types of experimental outcomes in scope	Experimental outcomes or actions with a pathogen are reasonably anticipated to: • Increase transmissibility of a pathogen within or between host species; • Increase the virulence of a pathogen or convey virulence to a non-pathogen; • Increase the toxicity of a known toxin or produce a novel toxin;	Experimental outcomes or actions with a pathogen are reasonably anticipated to: • Enhance transmissibility of the pathogen in humans; • Enhance the virulence of the pathogen in humans; • Enhance the immune evasion of the pathogen in humans such as by modifying the pathogen to

[2] Subset includes all RG3 pathogens in NIH Guidelines, Appendix B **except** HIV, HTLV, SIV, Htb (including *Mycobacterium bovis*), Clad II of MPVX viruses unless containing nucleic acids coding for clade I MPVX virus virulence factors, Vesicular stomatitis virus, *Coccidioides immitis*, *C. posadasii*, *Histoplasma capsulatum*, and *H. capsulatum var. dubiosii*. The list may be updated periodically.

[3] If no RG or BSL has been assigned to an agent (e.g., newly emerging pathogen or chimeric agent), the IBC should perform a risk assessment to determine the appropriate BSL for handling the agent given the experimental protocol being proposed. The assessment should take into account known properties of the agent and similarities to existing agents. Agents requiring BSL3 or BSL4 handling are subject to the policy (under Section 4.1.1).

	• Increase the stability of a pathogen or toxin in the environment, or increase the ability to disseminate a pathogen or toxin; • Alter the host range or tropism of a pathogen or toxin; • Decrease the ability for a human or veterinary pathogen or toxin to be detected using standard diagnostic or analytical methods; • Increase resistance of a pathogen or toxin to clinical and/or veterinary prophylactic or therapeutic interventions; • Alter a human or veterinary pathogen or toxin to disrupt the effectiveness of preexisting immunity, via immunization or natural infection, against the pathogen or toxin; or • Enhance the susceptibility of a host population to a pathogen or toxin.	disrupt the effectiveness of pre-existing immunity via immunization or natural infection; or • Generate, use, reconstitute, or transfer an eradicated or extinct PPP, or a previously identified PEPP.
Level of federal review[4] (if research is federally funded)	Funding agency review	Funding agency and federal department-level review

[4] Only applicable if project is federally funded

Extended checklist of Category 1 Biological Agents and Toxins

	Biological Agents and Toxins[1]	
HHS Select Agents and Toxins	• Abrin • *Bacillus cereus* Biovar anthracis • Botulinum neurotoxins • *Clostridium botulinum* and neurotoxin-producing species of *Clostridia* • Conotoxins (Short, paralytic alpha conotoxins containing the following amino acid sequence X1CCX2PACGX3X4X5X6CX7) • *Coxiella burnetii* • Crimean-Congo hemorrhagic fever virus • Diacetoxyscirpenol • Eastern equine encephalitis virus • Ebola virus • *Francisella tularensis* • Lassa fever virus • Lujo virus • Marburg virus • Mpox virus Clade I • 1918-1919 H1N1 including reconstructed replication competent forms of the 1918 pandemic influenza virus containing any portion of the coding regions of all eight gene segments (Reconstructed 1918 Influenza virus) • Ricin • *Rickettsia prowazekii*	• Severe acute respiratory coronavirus (SARS-CoV) • SARS-CoV/SARS-CoV-2 chimeric viruses resulting from any deliberate manipulation of SARS-CoV-2 to incorporate nucleic acids coding for SARS-CoV virulence factors • Saxitoxin • Chapare virus • Guanarito virus • Junín virus • Machupo virus • Sabía virus • Staphylococcal enterotoxins (subtypes A, B, C, D, E) • T-2 toxin • Tetrodotoxin • Tick-borne encephalitis complex virus: Far Eastern subtype • Tick-borne encephalitis complex virus: Siberian subtype • Kyasanur Forest disease virus • Omsk hemorrhagic fever virus • Variola major virus (Smallpox virus) • Variola minor virus (Alastrim) • *Yersinia pestis*
Overlap Select Agents and Toxins	• *Bacillus anthracis* • *Bacillus anthracis Pasteur strain* • *Brucella abortus* • *Brucella melitensis* • *Brucella suis* • *Burkholderia mallei*	• *Burkholderia pseudomallei* • Hendra virus • Nipah virus • Rift Valley fever virus • Venezuelan equine encephalitis virus
USDA Veterinary Services (VS) Select Agents and Toxins	• African horse sickness virus • African swine fever virus • Avian influenza virus [this is included here as a veterinary select agent in 9 CFR 121.3. Low pathogenicity strains are excluded.] • Classical swine fever virus • Foot-and-mouth disease virus • Goat pox virus • Lumpy skin disease virus	• *Mycoplasma capricolum* • *Mycoplasma mycoides* • Newcastle disease virus • Peste des petits ruminants virus • Rinderpest virus • Sheep pox virus • Swine vesicular disease virus
USDA Plant Protection and Quarantine (PPQ) Select Agents and Toxins	• *Coniothyrium glycines* • *Peronosclerospora philippinensis (Peronosclerospora sacchari)* • *Ralstonia solanacearum*	• *Sclerophthora rayssiae* • *Synchytrium endobioticum* • *Xanthomonas oryzae*

	• *Rathayibacter toxicus*
Other Risk Group 4 Pathogens[2]	• Tick-borne encephalitis virus complex including Absetterov, Central European encephalitis, Hanzalova, Hypr, and Kumlinge • Herpesvirus simiae (herpes B or monkey B virus) • Hemorrhagic fever agents and viruses as yet undefined
Other Risk Group 3 Pathogens[3]	• *Bartonella* • *Brucella* • *Orientia tsutsugamushi* • *Pasteurella multocida* type B -"buffalo" and other virulent strains • *Rickettsia akari, R. australis, R. canada, R. conorii, R. rickettsii, R, siberica, R. typhi (R. mooseri)* • Chikungunya virus except the vaccine strain 181/25 • Semliki Forest virus • St. Louis encephalitis virus • Flexal virus • Lymphocytic choriomeningitis virus (LCM) (neurotropic strains) • Hantaviruses, including Hantaan virus • Middle East respiratory syndrome coronavirus (MERS-CoV) • Severe acute respiratory coronavirus 2 (SARS-CoV-2) • Japanese encephalitis virus except strain SA 14-14-2 • West Nile virus • Yellow fever virus • Human influenza A virus H2N2 (1957-1968) • Highly pathogenic avian influenza A virus H5Nx strains within the Goose/Guangdong/96-like H5 lineage (e.g., H5N1, H5N6, H5N8 etc.) • Transmissible spongiform encephalopathy (TSE) agents (e.g., Creutzfeldt-Jacob disease and kuru agents)
Other	• Any attenuated pathogen or vaccine strain that is currently excluded from the Select Agent Regulations that exhibits the recovery of virulence at or near the wild-type • Mpox virus clade I/II chimeric viruses resulting from any deliberate manipulation of clade II to incorporate nucleic acids coding for clade I virulence factors

[1]Full checklist obtained from NIH Implementation Guidance, Appendix C (p. 62-66).

[2] Pathogens listed in this part of the list are Risk Group 4 but not controlled by the Select Agent Regulations, please refer to the NIH Guidelines for any relevant strain exclusions.

[3] Pathogens listed in this part of the list are Risk Group 3 but not controlled by the Select Agent Regulations, please refer to the NIH Guidelines for any relevant strain exclusions.

Appendix K – Glossary of Terms *(see pg. 38)*

Biological Agents: Biological agents include bacteria, viruses, fungi, other microorganisms, and their associated toxins, which have the ability to directly threaten the health and safety of individuals, animals, and plants, or pose risks to animal or plant products. Their ability to adversely affect human, animal, and plant health can occur in a variety of ways, ranging from mild conditions (i.e., allergic reactions, treatable diseases, or tissue irritation/damage) to serious conditions (i.e., incurable disease, crop decimation, or death). Such biological agents are widespread in the natural environment and are found in water, soil, plants, and animals. Because many microbes and viruses reproduce rapidly, sometimes requiring minimal resources to do so, they represent a potential danger in numerous settings. In some forms, biological agents can also be weaponized for use in bioterrorism or other crimes. The Occupational Safety & Health Administration (OSHA) recognizes a list of biological agents, and a list of *select* agents and toxins (with some overlap) is recognized by Health & Human Services (HHS) and US Department of Agriculture (USDA).

Biological Materials: Biological materials are broadly defined as any biological entity, containing any organisms, viruses, or portions thereof, dead or alive. The focus on biological materials for the purpose of biosafety is restricted to those materials that have the potential to cause disease in humans, animals, plants, and pose risks to animal or plant products. The key distinction between a biological agent (select or otherwise) and a biological material in this document is that a *potential* risk *may* exist in a biological material, but that risk is unknown or unlikely without further isolation, enrichment, or other alteration of that material. Biological agents carry known risks. In some instances, a biological material (like a soil sample or human blood) may contain a biological agent (and even a select biological agent), but without isolation, enrichment, and expansion of the agent from within, that biological material is unlikely to pose a direct risk to humans, animals, plants, or animal or plant products. Such cases will depend on the nature of the biological material, the manipulation of that material, and the potential biological agent(s) contained therein.

Biological Safety Cabinet (BSC): A BSC is a primary engineering control used to protect personnel against biohazardous or infectious agents and to help maintain quality control of the material being worked with, as it filters both the inflow and exhaust air. It is sometimes referred to as a laminar flow or tissue culture hood. BSCs are primarily designed to protect against exposure to particulates or aerosols. A portion of the air in most BSCs is recirculated back into the lab through an exhaust HEPA filter. This purifies the air of potentially infectious aerosols, animal dander, or both but does not reduce exposure to chemicals.

Biological Safety Officer (BSO): A BSO is a required member of the IBC if an institution conducts research with recombinant or synthetic nucleic acid molecules at Biosafety Level 3 (BSL3) or higher or in large-scale (greater than 10 liters), or if the institution conducts any research involving gene drive modified organisms (GDMOs). BSO requirements and duties are outlined in the NIH Guidelines, Section IV-B-3.

Biosafety Level (BSL): The four primary Biosafety Levels (BSLs) (BSL-1 through BSL-4) for laboratories consist of combinations of facility design features and safety equipment (primary and secondary barriers), facility practices and procedures, and personal protective equipment. Selection of the appropriate combinations to safely conduct the work should be based upon a comprehensive facility-specific biosafety risk assessment that documents the properties of the biological agents and toxins to be used, potential host characteristics, potential routes of infection, and the laboratory work

practices and procedures conducted or anticipated to be used in the future. BSLs are not necessarily equated with Risk Groups. (Also see Biosafety Levels & Risk Groups in this guide.)

Biosafety Protocol Application: This document is the application for all research or instructional activities that pose a potential biosafety hazard to personnel or the environment. Prior to beginning research or teaching involving a potential biosafety hazard, a PI or instructor must complete the appropriate sections of the Biosafety Protocol Application and have the protocol approved by the IBC.

Dual Use Research of Concern (DURC): Life sciences research that, based on current understanding, can be reasonably anticipated to provide knowledge, information, products, or technologies that could be misapplied to do harm with no, or only minor, modification to pose a significant threat with potential consequences to public health and safety, agricultural crops and other plants, animals, the environment, material, or national security. Refer to the US Government Policy for Oversight of Dual Use Research of Concern (DURC) and Pathogens with Enhanced Pandemic Potential (PEPP), Implementation Guidance, and DURC & PEPP section of this guide.

Gene Drive Modified Organism (GDMO): Per NIH Guidelines, Section I-E-7, "gene drive is a technology whereby a particular heritable element biases inheritance in its favor, resulting in the heritable element becoming more prevalent than predicted by Mendelian laws of inheritance in a population over successive generations."

Institutional Biosafety Committee (IBC): The IBC consists of a group of faculty, staff, and non-university affiliated members of the general public appointed by the university to oversee biosafety documentation of related practices at the university or associated sites. This committee is responsible for reviewing and approving proposed biosafety protocol applications *before* activities may be conducted with various biological agents, biological materials, or recombinant materials.

Institutional Contact for Dual Use Research (ICDUR): Official designated by the research institution to serve as an internal resource for application of the US Government Policy for Oversight of Dual Use Research of Concern (DURC) and Pathogens with Enhanced Pandemic Potential (PEPP) as well as serve as the liaison (as necessary) between the institution and the relevant federal funding agency.

Institutional Review Entity (IRE): Entity established by the research institution to execute the institutional oversight responsibilities outlined in the US Government Policy for Oversight of Dual Use Research of Concern (DURC) and Pathogens with Enhanced Pandemic Potential (PEPP).

Laboratory: For the purposes of this document, a laboratory refers to any space where applicable teaching and research activities occur involving biological materials that entail a potential risk to humans, animals, plants, or the environment, a UWL faculty or staff member.

Pathogen with Enhanced Pandemic Potential (PEPP): PEPP is a type of pathogen with pandemic potential (PPP) resulting from experiments that enhance a pathogen's transmissibility or virulence, or disrupt the effectiveness of pre-existing immunity, regardless of its progenitor agent, such that it may pose a significant threat to public health, the capacity of health systems to function, or national security. Wild-type pathogens that are circulating in or have been recovered from nature are not PEPPs but may be considered PPPs because of their pandemic potential. "Progenitor agent" refers to the starting pathogen of the proposed experiment, which may be a PPP in its wild-type form or a pathogen that is not considered a PPP in its wild-type form, but that when modified meets the definition of a PEPP. Refer to the US Government Policy for Oversight of Dual Use Research of Concern (DURC) and

Pathogens with Enhanced Pandemic Potential (PEPP), Implementation Guidance, and DURC & PEPP section of this guide.

Pathogen with Pandemic Potential (PPP): Pathogen that is likely capable of wide and uncontrollable spread in a human population and would likely cause moderate to severe disease and/or mortality in humans.

Personal Protective Equipment (PPE): PPE is any attire that helps protect the user's body from injury from a variety of sources (e.g., physical, electrical, heat, noise, chemical) or potential exposure to biological hazards and airborne particulate matter. PPE includes gloves, coats, gowns, shoe covers, closed-toe laboratory footwear, respirators, face shields, safety glasses, goggles, or ear plugs. PPE is usually used in combination with other biosafety controls (e.g., BSCs, centrifuge safety cups, small animal caging systems) that contain the hazardous biological agents and toxins, animals, or materials being handled. (Also see Personal Protective Equipment (PPE) in this guide.)

Personnel: In this manual, personnel are broadly defined as anyone taking part in research or instructional activities, biological shipping/receiving and disposal, or other aspects of any project involving biological agents, biological materials, or recombinant materials. Examples of personnel include but are not limited to faculty, staff, students, and collaborators.

Principal Investigator (PI): In this manual, a PI is the lead individual on an approved Biosafety Protocol Application. For the purposes of activities requiring IBC review and approval, only a university faculty or staff member with a continuing appointment may be listed as the PI on a Biosafety Protocol. Students are not eligible to be listed as PIs on Biosafety Protocols.

Recombinant and synthetic nucleic acids: (i) Molecules that a) are constructed by joining nucleic acid molecules and b) that can replicate in a living cell, i.e., recombinant nucleic acids; (ii) nucleic acid molecules that are chemically or by other means synthesized or amplified, including those that are chemically or otherwise modified but can base pair with naturally occurring nucleic acid molecules, i.e., synthetic nucleic acids, or (iii) molecules that result from the replication of those described in (i) or (ii).

Risk Group (RG): RGs are used to describe an agent and its ability to cause disease in healthy human adults and spread within the community, as well as whether or not treatments are available. Agents are classified by the following criteria: (i) Risk Group 1 (RG1) agents are not associated with disease in healthy adult humans. (ii) Risk Group 2 (RG2) agents are associated with human disease which is rarely serious and for which preventive or therapeutic interventions are often available. (iii) Risk Group 3 (RG3) agents are associated with serious or lethal human disease for which preventive or therapeutic interventions may be available. (iv) Risk Group 4 (RG4) agents are likely to cause serious or lethal human disease for which preventive or therapeutic interventions are not usually available. (Also see Biosafety Levels & Risk Groups in this guide.)

Select Agents and Toxins: Biological Select Agents and Toxins (BSATs) are biological agents that have been declared by the US Department of Health and Human Services (HHS) or by the US Department of Agriculture (USDA) to have the "potential to pose severe threat to public health and safety." The Federal Select Agent Program regulates the laboratories that may possess, use, or transfer select agents within the United States. See the full list online.

Visitors: Visitors are anyone entering a research space or classroom in which a potential biosafety-related risk exists and who are not listed on the Biosafety Protocol and are not an IBC member. Visitors should be made aware of the specific biosafety-related risks associated with lab or classroom spaces, particularly as they relate to the heightened risks involving biosafety level-2 procedures.

Appendix L – Glossary of Acronyms *(see pg. 38)*

APHIS: Animal & Plant Health Inspection Service

ABSA: American Biological Safety Association

ABSL: animal biosafety level

BBP: bloodborne pathogens

BMBL: Biosafety in Microbiological and Biomedical Laboratories

BSATs: biological select agents and toxins

BSC: biosafety cabinet

BSL: biosafety level

BSO: Biological Safety Officer

CDC: Center for Disease Control & Prevention

CFR: Code of Federal Regulations

CHP: Chemical Hygiene Plan

CITI: Collaborative Institutional Training Initiative

DOT: Department of Transportation

DURC: Dual Use Research of Concern

EHS: Environmental Health & Safety

GDMO: gene drive modified organism

HEPA: high efficiency particulate air

HHS: US Department of Health and Human Services

IACUC: Institutional Animal Care & Use Committee

IATA: International Air Transport Association

IBC: Institutional Biosafety Committee

ICAO: International Civil Aviation Organization

ICDUR: Institutional Contact for Dual Use Research

IRB: Institutional Review Board for the Protection of Human Subjects

IRE: Institutional Review Entity

LD_{50}: median lethal dose

NIH: National Institutes of Health

OLAW: Office of Laboratory Animal Welfare

OPIM: other potentially infectious materials

ORSP: Office of Research & Sponsored Programs

OSHA: Occupational Safety & Health Administration

OSP: NIH Office of Science Policy

PBSL: plant biosafety level

PEPP: pathogen with enhanced pandemic potential

PPP: pathogen with pandemic potential

PI: principal investigator

PPE: personal protective equipment

RG: risk group

RIO: Research Integrity Officer

USDA: US Department of Agriculture

WHO: World Health Organization