Responsible Conduct of Research: Safe Laboratory Practices

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Overview of safe practices when using chemical, radioactive, and physical hazards
...from the perspective of a scientist/PI
Goals for safe laboratory practices

- Minimize the potential for accidents.
- Minimize the potential for dangerous consequences in case a lab accident does occur.
Studies have shown that most accidents result from human error rather than mechanical or equipment failure. Human judgment often errs, but **knowledge** and observance of policies and procedures listed in this Safety Guide and those related to your particular work activity, plus the application of good **common sense**, will go far to control these judgment factors.

*Safety Guide*
*Office of Environmental Health and Safety*
*Tulane University*
4 hurt in blast in University of Missouri science building

Monday, June 28, 2010 www.stltoday.com
“Fire investigators attributed the blast to human error, Hartman said. Someone in the lab turned on the hydrogen supply to a piece of lab equipment but was not familiar with the warning system designed to alert when the hydrogen level got dangerously high. When the gas reached an ignition source, it exploded.”
And an anecdote about the lack of common sense...
In order to achieve the goals for safe laboratory practices

- Knowledge
- Common sense
General lab safety
General lab safety

- Obtain and post appropriate lab door labels to indicate lab hazards and emergency contact information.
General lab safety

- Obtain and post appropriate lab door labels to indicate lab hazards and emergency contact information.

- Do not eat, drink, chew gum, apply cosmetics, or handle contact lenses in the lab area.

- Do not place food or drinks in refrigerators which are used for chemical, radiological, or biological materials storage.

- Know the location of the nearest safety shower, eyewash station, and fire extinguisher. Know how to operate them.

- Know when and how to use personal protective equipment.

- Dress appropriately when working with hazardous materials. Sandals, open-toed shoes, and shorts should not be worn in lab areas.

- Individuals using hazardous chemicals should not work alone. Another individual capable of coming to the aid of the worker should be in visual or audio contact.
Chemical Safety
Chemical Safety

1. Know the hazardous properties of the chemicals in your lab.

2. Keep inventories to a minimum.

3. Know what chemicals are in the lab.

4. Know how to safely store and handle the chemicals.

5. Know how to safely dispose of the chemicals.

6. Know what to do if a chemical spill occurs.
1. **Know the hazardous properties of the chemicals in your lab.**

- **Material Safety Data Sheets (MSDS)** provide critical safety data information and must be kept for all chemicals. Develop standard operating procedures (SOPs).

- Everyone working in a lab must know where and when to access the MSDS for a chemical.

- MSDS library must be in a visible and easily accessible area.
2. Keep inventories to a minimum.

Purchase the smallest amount of a chemical that you need. What you don’t have can’t hurt you!
3. Know what chemicals are in the lab.  
- Keep an updated chemical inventory.
3. Know what chemicals are in the lab.  
- Properly label your chemicals.

<table>
<thead>
<tr>
<th>Chemical Name</th>
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<tbody>
<tr>
<td>Health and Physical Hazards</td>
</tr>
<tr>
<td>Non Toxic</td>
</tr>
<tr>
<td>Toxic</td>
</tr>
<tr>
<td>Highly Toxic</td>
</tr>
<tr>
<td>Reproductive Toxin</td>
</tr>
<tr>
<td>Irritant</td>
</tr>
<tr>
<td>Corrosive</td>
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<tr>
<td>Sensitizer</td>
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<tr>
<td>Carcinogen</td>
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Other:

<table>
<thead>
<tr>
<th>Personal Protective Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Glasses with Sideshields</td>
</tr>
<tr>
<td>Chemical Splash Goggles</td>
</tr>
<tr>
<td>Faceshield</td>
</tr>
<tr>
<td>Gloves: Type</td>
</tr>
<tr>
<td>Fume Hood</td>
</tr>
<tr>
<td>Respirator</td>
</tr>
<tr>
<td>Apron: Type</td>
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<tr>
<td>Other: List</td>
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</tbody>
</table>

TULANE UNIVERSITY  
OFFICE OF ENVIRONMENTAL HEALTH & SAFETY 588-5400
4. Know the appropriate way to store and handle the chemicals.

- Properly store your chemicals.

- Chemicals should be stored according to their hazard and compatibility class as found on the MSDS. Keep incompatible chemicals separated.

- Do not store chemicals on top of lab benches, out in the open, in hoods, or above eye level.

- Flammables should be stored in flammable storage cabinet.

- All cabinets containing chemicals should be labeled.
4. Know the appropriate way to store and handle the chemicals.

- Properly handle your chemicals.

- Determine and use appropriate personal protection equipment.

- Use safe transport methods.
5. Know how to safely dispose of chemicals.

- Indiscriminate disposal by pouring waste chemicals down the drain or into the trash is unacceptable.

- Hoods should not be used as a means for disposal of volatile chemicals.

- Each waste container should be properly labeled as to its contents.

- Arrangements should be made with the Office of Environmental Health & Safety for pick up.
6. Know what to do if a chemical spill occurs.
   - Minor chemical spill

- A minor chemical spill is one that the on-site staff is capable of handling safely without the assistance of OEHS and other emergency response personnel. Chemical storage and use areas should be equipped with spill kits and absorbents for cleanup of minor spills, as well as personal protective equipment to be worn by cleanup personnel.

- Turn off or remove sources of ignition if the spilled material is flammable.
- Confine the spill.
- Alert people in the immediate area of the spill and if necessary, evacuate the spill area. Notify the area supervisor.
- Consult the Material Safety Data Sheet (MSDS) for spill cleanup procedures.
6. Know what to do if a chemical spill occurs.
- Major chemical spill

- Alert people in the affected area to evacuate and obtain MSDS.
- Turn off or remove sources of ignition if spilled material is flammable.
- Confine the spill.

- Notify the area supervisor, OEHS (downtown 988-5486/uptown 865-5307), and Tulane Police/Public Safety. Provide the following information:
  - Name and phone number of caller
  - Name and type of material.
  - Known hazards of material.
  - Amount of the material spilled.
  - Location of the spill (room number and department if available).
  - Whether the spilled material is a solid or a liquid.
  - Brief description of the occurrence.
Working safely with radioactivity
Working safely with radioactivity

- Obtain a **Radioactive Materials License**. Read the **Radioactive Safety Manual**. Follow guidelines found at the **Radiation Safety Program** link at the Tulane OEHS website.

- Designate and label an area of the lab for radioactivity use. Restrict access as appropriate according to guide.

- Keep record of inventory and use.

- Ensure that weekly radiation/contamination surveys are performed and documented during periods of continuous use. Decontamination must be performed at levels twice background cpm.

- Do health monitoring as appropriate for radioisotopes used in the lab.

- Follow radioactivity waste disposal guidelines.
Other common hazards
When we as scientists make a decision to use chemical/radioactive/physical hazards in our labs, we commit to the responsibility of handling and storing them safely and disposing of them in a safe and environmentally acceptable manner.
For list of important contacts and emergency numbers, see Tulane’s OEHS “contact us” link.
Biological Laboratory Safety
Tulane University

Lucy C. Freytag, Ph.D.
Department of Microbiology and Immunology
School of Medicine
Importance of Biosafety

It is our obligation to protect:

- Ourselves
- Coworkers (employees, staff)
- Community
- Environment
Biosafety principles

- Be Informed
- Comply with established regulations (Lab, University, Federal)
- Promptly report incidents and follow-up
Welcome to the new OEHS web site. Best viewing and printing with Firefox 3.5.x

Director's Welcome

The mission of the Tulane University Office of Environmental Health & Safety (OEHS) is to support the Healthcare, Teaching, and Research activities of the University and to ensure, as practicable as possible, a safe and healthful environment for students, employees, patients, and visitors of the University and to assure that University activities do not adversely affect the health and safety of the communities which surround the campuses. OEHS is an advisory and service-oriented Department that has both a preventive and a responsive role in University Health and Safety.

OEHS Commitment to Service

To further our commitment to serving the greater Tulane Community, we would like to encourage everyone to send us feedback by taking a short survey.

Environmental Health & Safety !! Audit !!

What's New!

- Architecture Shop Safety Guide
- Influenza and Flu Links
- OSHA’s 300a Summary for 2010 Posting (February 1st - April 30)
- Safety Guide
- Art Safety Guide
- Department of Homeland Security Chemicals of Interest (COI) List
- Forms from the OEHS Policies & Procedures Manual
- Chemical Inventory Program

Alerts

- Potential Hazard - Floor Lamp

Quick Links

- OEHS Home Page
- Asbestos
- Chemical Safety
- Departmental Safety Reps
- Ergonomics
- Fire Safety
- Food Safety & Sanitation
- Pest Control
- Posters
- Radiation Safety
- Safety Wave

Vital Resources

- EHS Policies & Procedures
- Emergency Action Plans
- Bloodborne Pathogens (BBP) Program
- MSDS
OFFICE OF BIOSAFETY

Overview

The Office of Biosafety at Tulane University was created in 2006 under the Office of the Vice President for Research to support the Tulane research community.

With an increased focus on vaccine development and infectious disease studies at the School of Medicine, School of Public Health and Tropical Medicine, and Tulane National Primate Research Center, as well as the expansion of the Cancer and Gene Therapy Centers, research with biological materials at Tulane is expanding rapidly. The Office of Biosafety strives to support this important and innovative research by addressing challenges associated with it.

We are focused on minimizing the health risk to those involved in research using biohazard materials including recombinant DNA, infectious agents, and biological toxins, and in turn to protect the greater Tulane community, the general public, and the environment. In order to accomplish this goal we maintain an interactive partnership between the Office of Biosafety, the principal investigators, and the laboratory support staff. In addition, the Office of Biosafety, in cooperation with the Institutional Biosafety Committee, is charged with oversight of regulatory compliance at the university with regard to the storage and use of hazardous biological materials. The director, Dr. Don Sibley, serves as Institutional Biosafety Officer.

The Office of Biosafety fulfills its mission and promotes a safe and productive research environment at Tulane by assuring compliance with regulatory requirements, by serving as a technical resource for both research labs and the Institutional Biosafety Committee, by assisting principal investigators in registering their research with the Institutional Biosafety Committee, by developing safe research protocols, and by facilitating the acquisition of all required regulatory approvals and permits.

If you would like to know more about the Office of Biosafety or if you need assistance, please feel free to contact...
ABOUT US

The use of recombinant DNA or infectious agents has the potential of endangering the health of members of society, individual laboratory members, human research participants and/or vertebrate animals. Federal regulations require that all procedures involving the use of recombinant DNA (rDNA) undergo review by the Institutional Biosafety Committee. The Institutional Biosafety Committee is responsible for reviewing all activities utilizing rDNA or infectious agents, assuring the safe conduct of the research, assessing decontamination and containment levels, and ensuring the rDNA research is conducted in compliance with the NIH Guidelines for Use of Recombinant DNA Molecules.

This site describes the current policies of Tulane University's Institutional Biosafety Committee and how it regulates research involving biohazardous agents. It is intended to help investigators, Committee members and Biosafety Officers comply with federal, state and local regulations.
Tulane
Information/Questions/Reporting

- Departmental Safety Representative

- Director of OESH: Jim Balsamo
  http://tulane.edu/oehs/

- Director office of Biosafety: Dr. Don Sibley
  http://tulane.edu/asvpr/biosafety/index.cfm

- Institutional Biosafety Committee: Dr. Lucy Freytag
  http://tulane.edu/asvpr/biosafety/committee/
Online resources

- **CDC**: Biosafety in Microbiological and Biomedical Laboratories: BMBL 5th edition

- **WHO** laboratory Safety Manual

- **NIH** Office of Biotechnology (OBA)

- **ABSA** American Biological Safety Association
  - [http://www.absa.org/](http://www.absa.org/)
Principles of Biosafety

• Biological Risk identification and Assessment
  • Type of biological hazard
  • Levels of containment- BSL1-BSL4

• Safe Practices
  • Primary & secondary barriers
  • Biological Safety cabinets
  • PPE & Respiratory protection
  • SOPs (Standard Operating Procedures)
  • Compliance with university, local and federal guidelines

• Biological hazards
  • Biological waste
  • Spill prevention
  • Sharps hazards
  • Disinfection/Sterilization/Decontamination

• Reporting and post-incidence procedures
Identify and assess biological hazards

- Pathogenic Microorganisms
- Toxins, Allergens
- Blood and bodily fluids
- Recombinant DNA
- Unknown/undetermined samples
Risk assessment is a process used to identify, the hazardous characteristics of a known infectious or potentially infectious agent or material, the outcome of a person’s exposure to the agent, the likelihood that such exposure will cause a LAI* and the probably consequences of such infection

* laboratory acquired infection

Taken from BMBL, 5th Edition
Risk Assessment

- Determine:
  - The risk level of the agent
  - Risk to personnel and environment
  - Appropriate containment facilities
  - Appropriate safety controls
  - Mitigation procedures
  - Contingency plans
“By 1978, four studies by Pike and Sulkin collectively identified 4,079 LAIs resulting in 168 deaths occurring between 1930 and 1978.

These studies found that the ten most common causative agents of overt infections among workers were *Brucella sp.*, *Coxiella burnetii*, *hepatitis B virus (HBV)*, *Salmonella typhi*, *Francisella tularensis*, *Mycobacterium tuberculosis*, *Blastomyces dermatitidis*, *Venezuelan equine encephalitis virus*, *Chlamydia psittaci*, and *Coccidioides immitis*”

*BMBL 5th Edition*
The assessor(s)

- Principal Investigator
  - Operator
- Biosafety Office
- Institutional Biosafety Committee (IBC)
- OEHS
- OBA, RAC and Federal guidelines
- NSABB
NIH classification of agents on the basis of hazard to humans

<table>
<thead>
<tr>
<th>Risk Group 1 (RG1)</th>
<th>Agents that are not associated with disease in healthy adult humans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Group 2 (RG2)</td>
<td>Agents that are associated with human disease which is rarely serious and for which preventive or therapeutic interventions are <em>often</em> available</td>
</tr>
<tr>
<td>Risk Group 3 (RG3)</td>
<td>Agents that are associated with serious or lethal human disease for which preventive or therapeutic interventions <em>may be</em> available (high individual risk but low community risk)</td>
</tr>
<tr>
<td>Risk Group 4 (RG4)</td>
<td>Agents that are likely to cause serious or lethal human disease for which preventive or therapeutic interventions are <em>not usually</em> available (high individual risk and high community risk)</td>
</tr>
</tbody>
</table>
# Biosafety Level Containment

<table>
<thead>
<tr>
<th>Risk Group</th>
<th>Biological Safety Levels</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>BSL1</strong>&lt;br&gt;Standard Microbiological practices:&lt;br&gt;• Access to laboratory is limited&lt;br&gt;• No eating or drinking on work area&lt;br&gt;• All surfaces decontaminated daily&lt;br&gt;• Hazardous waste disposal practices&lt;br&gt;(Complete BSL1 practices: NIH guidelines)</td>
<td><em>E. coli</em> K12 bacteriophage λ</td>
</tr>
<tr>
<td>2</td>
<td><strong>BSL2</strong>&lt;br&gt;All BSL1 practices plus:&lt;br&gt;• Access to laboratory is restricted&lt;br&gt;• No eating or drinking&lt;br&gt;• Biohazard signage is posted&lt;br&gt;• Appropriate PPE at all times&lt;br&gt;• Biological Safety cabinets&lt;br&gt;(Complete BSL2 practices: NIH guidelines)</td>
<td>Human samples&lt;br&gt;Pathogenic <em>E. coli</em>&lt;br&gt;Salmonella&lt;br&gt;Herpes simplex virus&lt;br&gt;Plasmodium</td>
</tr>
<tr>
<td>Risk Group</td>
<td>Biosafety Level Containment</td>
<td>Examples</td>
</tr>
<tr>
<td>------------</td>
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</table>
| 3          | **BSL3:** All BSL2 practices plus:  
Access to Laboratory is restricted to authorized personnel only  
Special training of personnel  
Mandatory PPE (Respiratory protection)  
Updated Biosafety manuals and SOPs in place  
Strict guidelines for air exhaustion/circulation (Complete BSL3 practices: NIH guidelines) |  
*Mycobacterium tuberculosis*  
*Yersinia pestis*  
St. Louis encephalitis virus  
(Tulane: only at TNPRC) |
| 4          | **BSL4** All BSL3 practices plus:  
Generally a separate building  
Biological safety cabinets III  
Strict waste management and air ventilation  
Decontamination procedures entrance/exit (Complete BSL4 practices: NIH guidelines) |  
Ebola virus  
Lassa virus  
Tulane: Not permitted: |
Biosafety levels for working with animals

- ABSL1 (BL-1N)
- ABSL2 (BL2-N)
- ABSL3 (BL3-N)
- ABSL4 (BL4-N)

Biosafety levels for working with insects.

Biosafety levels for working with genetically modified plants

Level of containment: Established according to laboratory safety levels and associated risks
Safe Practices

Primary barriers:
- Personal Protective Equipment (PPE)
- Aerosol proof practices/equipment
- Biological safety cabinets

Secondary Barriers
- Building/laboratory design
  - i.e. Separate BSL1/BSL2/
- Air exhaustion Ventilation
Personal Protective Equipment (PPE)

- Lab coats
- Gloves
- Safety glasses
- Face shields
- Proper footwear
- Respiratory protection:
  - Masks, N95, PAPR
- Hazmat suits
Avoiding aerosolization

- Aerosol-proof equipment and disposables.
- Animal cages with filter tops.
- Safe practices: i.e. no open-container vortexing
Biological Safety Cabinets

Class I, II or III: provide different levels of protection to user and/or product
Class I, II or III: provide different levels of protection to user and/or product
Secondary barriers
Building/lab design

University:
Self closing lockable (single/double doors) doors
Hands-free sinks /eye wash stations/
Autoclaves
Ducted exhaust air–ventilation.
Hepa filters

Investigator:
Non–impervious surfaces(i.e. lab chairs)
Vacuum traps
Biosafety practices

- **PI responsibilities**
  - Standard Operating Procedures: SOPs
  - Good Laboratory Practices (GLP) (GMP)
    - Develop
    - Distribute
    - Update
    - Ensure compliance
Biohazardous materials: Spill prevention/control

- No large scale work (i.e. larger than 10 liters) unless absolutely necessary
- Plastic-backed liners
- Spill kit

General procedures (when needed)
- Leave area
- Place warning signage
- Report incident
Biohazardous waste: Working with sharps

- Autoclavable approved containers
- Single use
- Follow procedure (no over-filling)

- Report accidental skin-puncturing with contaminated sharps (Blood Borne Pathogens!)
Biosafety practices

Contaminated biohazardous waste

Resistance to biocides

MOST RESISTANT
- bacterial spores (e.g., Clostridium difficile)
- mycobacterial (e.g., M. tuberculosis)
- nonlipid or small viruses (e.g., Poliovirus)
- fungi (e.g., Candida)
- lipid or medium sized viruses (e.g., HIV)
- vegetative bacteria (e.g., Staphylococcus, Pseudomonas)

LEAST RESISTANT

sterilisation
- high level disinfection
- intermediate level disinfection
- low level disinfection
Biosafety principles

Decontamination/ Disinfection/ Sterilization (DDS)

1. Proper /approved disposal
2. Method of DDS (examples)
   a. Heat: dry or moist heat
      Steam Autoclaving.
   b. Chemical
      Ethylene Oxide, glutaraldehyde, gas plasma
   c. Physical
      Radiation
      Filtration
**Biosafety principles**

- Post-exposure Incident Reporting
  - VERY IMPORTANT!!
    - Immediate supervisor
    - If applicable: Bloodborne pathogen Coordinator (OEHS).
    - Office of Biosafety/IBC
    - Medical evaluation:
      - surveillance/treatment/quarantine
    - Incident investigation
    - Corrective actions
    - Follow-up
Biosafety principles

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  - Follow-up
Federal regulations:
NIH Guidelines for Research Involving Recombinant DNA
**Mandatory** compliance

Tulane IBC (Institutional Biosafety Committee)
- Use of rDNA or RNA
- rDNA work on Risk group 2, 3, and 4 pathogens
- rDNA work in animals (including transgenics)
- rDNA work in humans
- rDNA work in plants

Visit: [http://tulane.edu/asvpr/biosafety/committee/](http://tulane.edu/asvpr/biosafety/committee/)
Biosafety: Established programs/policies reduce or eliminate exposure of individuals and the environment to potentially hazardous biological agents. (BMBL)

Biosecurity: protection of microbial agents from loss, theft, diversion or intentional misuse. Definition is consistent with current WHO and American Biological Safety Association (ABSA) usage of this term (BMBL)

NSABB: Nat. Science advisory Board for Biosecurity
- Dual Use: Research yielding new technologies or information with the potential for both benevolent and malevolent applications (NIH–OBA)