POWERED BY THE PENNSYLVANIA BIOTECHNOLOGY CENTER

Environmental Health & Safety Manual 2022

B+labs
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1.0 Chemical Hygiene Plan - B+labs Commitment to Safety

B+labs adheres to a policy of providing its tenants with a safe and healthful work environment. This Safety Manual has been formulated around fundamental principles of accident prevention. The Safety Manual complies fully with the OSHA Laboratory Standard as well as other environmental health and standards established by federal, state and municipal laws, regulations, industry standards and guidelines. Personnel at all levels are expected to comply with requirements of the Safety Manual and participate in the safety program. Personnel are encouraged to report to their supervisor unsafe processes or conditions as well as to provide ideas to improve the safety of the work environment at BLABS.

This EHS Manual, as well as overall safety in the work environment is to be endorsed and supported by all levels of management. Maintaining safety at B+labs must have the full support and commitment of all personnel.

1.1 Purpose

The purpose of the EHS Manual is to provide guidance to BLABS tenants and laboratory personnel for working safely in the laboratory environment. The Safety Manual complies with the requirements of the Occupational Safety and Health Administration's (OSHA) Laboratory Standard and describes proper laboratory practices, procedures, protective equipment, and hazard identification. The Safety Manual is available on the site intranet.

1.2 Scope

The provisions of the Environmental Health & Safety Manual apply to all B+labs tenants and laboratory personnel, other personnel who routinely visit or occasionally work in the laboratory, and all contractors who might be exposed to laboratory hazards while at BLABS. Laboratory personnel are encouraged to contribute their skills and knowledge to the Safety Manual such as routine activities, chemical safety, hazardous material handling, or procedures to minimize chemical exposures.

B+labs Management will review the Manual annually for effectiveness and amend as necessary. New B+labs tenant laboratory personnel will be required to review and understand the EHS Manual (or equivalent).

2.0 Roles and Responsibilities

2.1 Tenant Organizations

2.1.1 Will appoint a Laboratory Environmental Health & Safety Lead

2.1.1.1 The EHS Lead will act as the point of contact for all Laboratory EHS-related activities.

2.5 B+labs Management

- Responsible for providing guidance in the development and the implementation of the EHS Manual.
- Collaborate with laboratory personnel and their employers to develop and implement chemical hygiene policies.
- Review the EHS Manual with appropriate committees as necessary.
- Assist laboratory personnel in the development of laboratory-specific safety procedures and the selection of engineering controls and personal protective equipment.
- Along with the Laboratory Manager/Supervisor, investigate accidents, spills and near misses in the laboratory.

2.6 Chemical Hygiene Officer (CHO)

The Chemical Hygiene Officer (CHO) is charged with the responsibility of implementing and monitoring the chemical hygiene plan. The Site Chemical Hygiene Officer is Bob Rovinsky.

All tenants should assign a lab representative such as the EHS Lead to be a lab-specific CHO.

Responsibilities include:

- The development of chemical hygiene policies and procedures.
- Conduct safety inspections of all laboratory spaces.
- Assist lab personnel in complying with federal and state regulatory agencies and developing a healthy workplace environment.
- Conduct implementation and monitoring procedures in accordance with approved policies and procedures.
- Certify the performance of protective equipment.
- Monitor procurement, use, and disposal of chemicals used in the lab.
- Help supervisors develop precautions and adequate facilities.
- Know the current legal requirements concerning regulated substances.
- Provide general training.

3.0 Standard Operating Procedures

B+labs supports the implementation of prudent laboratory practices when working with chemicals in a laboratory. These include general and laboratory-specific procedures for work with hazardous chemicals, emergency procedures, and laboratory waste procedures. Procedures have been put in place to protect laboratory personnel from health hazards and physical hazards in BLABS laboratories.

3.1 Laboratory General Safety Procedures

General lab procedures to ensure that laboratory personnel maintain healthy and safe work practices in the laboratory. All laboratory personnel working in laboratories must adhere to the following policies when laboratory work involves the use of hazardous chemicals.

- Always read and understand the Safety Data Sheet for the chemicals you work with before handling.
- Do not use broken or chipped glassware. Rather dispose of it in a designated marked container (e.g., "broken glass only").
- Never pipette by mouth. Always use a pipette aid or suction bulb.
- Do not apply cosmetics in the laboratory.
- Wash hands and arms thoroughly before leaving the laboratory, even if gloves have been worn.
- Food and drink are forbidden in the laboratory.
- All chemical containers such as test tubes, beakers, and flasks must be labeled with the full chemical name. (Note; If these items are under the user's immediate control, labeling is not necessary).
- Do not work alone in the laboratory if the procedures being conducted are hazardous.

3.2 Accident and Incident Reporting

All accidents, incidents, and near misses that result in personal injury or illness, damage, and/or a potential for significant injury or property loss to BLABS property shall be properly reported to the Laboratory EHS Lead and BLabs Management an investigated by both parties, and documented on an Incident Reporting Form.

3.3 Chemical Storage

- All chemicals in the laboratory should have a designated storage area and should be returned after each use or at the end of each work shift whichever occurs first.
- Avoid storing chemicals on bench tops and floors.
- Storage trays or secondary containers should be used to minimize spillage of material if a container breaks or leaks.
- Avoid storing chemicals in the fume hood because containers and equipment can interfere with airflow, clutter the workspace, and increase the amount of material that could become involved in a hood fire.
- Avoid storing chemicals in direct sunlight or near a heat source.
- Physically separate incompatible chemicals using a secondary containment bin or tray, and or store at another designated location.
- All chemical containers must be properly labeled and stored in labeled storage areas.
- Refrigerators used for storage of flammable chemicals must be explosion-proof, laboratory-safe units.
- The chemical inventory must be kept as small as possible. Any old, expired, or unused chemicals should be properly disposed.
- Do not store chemicals on top of high cabinets or shelves. Liquids, in particular corrosives or other hazardous liquids, should not be

stored over 5 feet in height. The only exception is that non-hazardous liquids may be stored above 5 feet if there are space limitations. There is no height restriction for solids.

- Keep exits, passageways, areas under tables, and emergency equipment areas free of stored chemicals.
- Do not store chemicals on bench tops or in fume hoods, except for those chemicals being used currently.
- Ventilated storage cabinets shall be used to store extremely hazardous chemicals. The vents must be directed outside the building.
- Use chemical storage refrigerators and freezers only for chemical storage. Label these refrigerators with the following signage: "**No Food or Drink – Chemical Storage Only**"
- Safety containers must be used when transporting chemicals (i.e., carts, rubber totes, secondary containers, etc.), especially outside of the lab area.
- Observe all precautions regarding the storage of incompatible chemicals.
- Dry chemicals (solid materials) shall not be stored with liquid chemicals. If stored in the same cabinet, liquids are always stored under solid chemicals.
- Separate chemicals into the following hazard classes:
    1. Flammables
    2. Acids
        - Organic Acids
        - Inorganic Acids
    3. Bases
        - Organic Bases
        - Inorganic Bases
    4. Oxidizers
    5. Reactive
    6. Poisons (Toxic)
    7. Non-hazardous or non-regulated chemicals.

- The above hazard classes must be separated from each other. This can be accomplished by 1) placing them in different cabinets, 2) placing them on different shelves, or 3) separating them by placing the different hazard classes into separate secondary containment containers. The trays must be able to contain any spills or leaks and must be made of material compatible with the chemicals they contain.
- Alphabetical storage of chemicals is not allowed. This may result in incompatibles appearing together on a shelf. Chemicals should first be segregated appropriately by hazard class and then may be stored alphabetically within each hazard class.

- Chemicals classified as Irritants may be stored separately or with Non-Hazardous Chemicals.
- Weak acids or bases, in their dry form, often can either be stored as Non-Hazardous or separated out as acids or bases, unless the label specifically classifies it as “Corrosive”. Any chemical specifically labeled as “Corrosive” must be separated out as an acid or a base.
- Store all flammable liquids in a grounded, flammable storage cabinet with self-closing doors.
- The maximum quantity of flammable liquids in use at one time shall be 1.5 gal (5.68L). The maximum quantity of flammable liquids stored in the lab shall be 60 gal (227L).
- Organic Acids can be stored in the flammable storage cabinet; however, overspill containers must be used to contain any spills and to act as a means of separation.
- Acids must be stored separate from bases. Storage in the same cabinet is possible **ONLY IF OVERSPILL CONTAINERS ARE USED TO CONTAIN ANY SPILLS.**
- Separate inorganic and organic bases. These can be stored in the same cabinet. Shelves or overspill containers can be used as a means of separation.
- Separate inorganic and organic acids. These can be stored in the same cabinet. Shelves or overspill containers can be used as a means of separation. In particular, nitric acid and acetic acid must not be stored together.
- Store nitric acid, perchloric acid, and hydrofluoric acid separately from all other chemicals if possible (including from each other). Otherwise store them with other inorganic acids.
- Peroxide-forming chemicals may become unstable and potentially explosive when exposed to air. As such, all peroxide-forming chemicals must have a receive date and an open date written on their labels. Examples of commonly used peroxide-forming chemicals include: Tetrahydrofuran, Ethyl Ether, Dioxanes, Isopropyl Ether, Styrene, Vinyl Pyridine, and 2-Propanol. Most peroxide-forming chemicals must be disposed of after 12 months. Perchloric Acid is another potentially explosive chemical which should be disposed of after 12 months. While not as potentially hazardous as other peroxide-formers, older containers of 2-Propanol should be handled with care. To track how old the chemicals are, all labs are required to write the receive date and open date on the containers of peroxide-formers, unless there is an expiration date already present.
- **DO NOT** handle any peroxide forming chemical if there are signs of crystal growth or precipitation. Contact B+labs Management **IMMEDIATELY** if this occurs and leave the area. Disposal arrangements will be made.
- Oxidizers must be stored in a cabinet separate from all other chemicals. Some oxidizers may cause combustible materials to catch fire on contact. Avoid storing in wood cabinets/shelves and cardboard boxes.
- Reactive chemicals must be segregated and stored appropriately i.e. flammable cabinet, explosion proof refrigerator, dedicated container etc.
- Toxic chemicals, including carcinogens, must be properly labeled. Small containers should be stored together in unbreakable

chemical-resistant secondary containers. These secondary containers must be labeled either “Caution: High Chronic Toxicity,” or “Cancer Suspect Agent.”

- Cylinders of compressed gases, empty or full, must be labeled, strapped or chained at all times to a wall or bench top, and must be capped when not in use.
- Oxygen and other oxidizing gases must not be stored adjacent to flammable gases (except when in use).
- Do not store flammable gases near sources of heat or ignition.
- If unable to determine the best possible storage options consult the SDS for the chemical. If further assistance is need contact BLabs Management.

Chemical Segregation and Storage Table

Chemical Segregation

Class of Chemicals	Common Chemical Examples	Additional Concerns and Storage Recommendations	Common Incompatible Chemical Types	Possible Reaction if Mixed/Health Concerns
Corrosive Acids-Organic 	Acetic Acid Glacial Acetic Acid Butyric Acid Trifluoroacetic Acid Picric Acid Propionic Acid Formic Acid	Store in ventilated corrosives cabinet on protected shelving using secondary containment, keep away from water sources *Do not store under the sink *Do not store acids on metal shelving	Flammable Liquids Flammable Solids Bases Oxidizers Inorganic Acids Cyanides Sulfides Poisons/Toxins	Heat Gas Generation Violent Reaction * DO NOT POUR WATER INTO ACID
Corrosive Acids-Inorganic 	Nitric Acid Sulfuric Acid Perchloric Acid Phosphoric Acid Hydrochloric Acid Chromic Acid Hydrofluoric Acid	Store concentrated Nitric acid (≥68%) and Sulfuric acid (≥93%) in a secondary container Store in a corrosive cabinet labeled “Acid” or on shelving using a secondary containment *Do not store under the sink *Do not store acids on metal shelving *Hydrofluoric acid should be stored in an area accessible only by authorized personnel; do not store in glass; use plastic containers and secondary containment	Flammable Liquids Flammable Solids Bases Oxidizers Organic Acids Cyanides Sulphides Poisons/Toxins	Heat Gas Generation Violent Reaction *DO NOT POUR WATER INTO ACID *Perchloric acid vapor can form explosive compounds within fume hood ducts *Hydrofluoric acid can result in severe burns to skin and lungs
Corrosive Bases-Organic/Caustic 	Hydroxylamine Tetramethylethylamine Diamine Triethylamine	Store in separate cabinet, preferably with ventilation, corrosive cabinet or storage area with a spill tray, away from potential water sources (DO NOT store under the sink)	Acids Oxidizers Flammable Liquids Flammable Solids Inorganic Bases Poisons/Toxins	Heat Gas Generation Violent Reaction

Corrosive Bases- Inorganic/Caustics 	Ammonium Hydroxide Potassium Hydroxide Sodium Hydroxide Calcium Hydroxide	Store in separate cabinet, preferably with ventilation, corrosive cabinet or storage area with a spill tray, away from potential water sources (DO NOT store under the sink); Store solutions of inorganic hydroxides in labeled polyethylene containers	Acids Oxidizers Flammable Liquids Flammable Solids Organic Bases Poisons/Toxins	Heat Gas Generation Violent Reaction

Class of Chemicals	Common Chemical Examples	Additional Concerns and Storage Recommendations	Common Incompatible Chemicals Types	Possible Reaction if Mixed/Health Concerns
Flammable Solids 	Charcoal Carbon Paraformaldehyde Phosphorus Magnesium	Keep in a dry, cool area away from oxidizers and corrosives	Acids Bases Oxidizers Poisons/Toxins	Fire Hazard Violent Reaction
Flammable Liquids 	Ethanol, Ethyl Acetate, Methanol, Acetone, Benzene, Xylene, Toluene Diethyl Ether Tetrahydrofuran Acetonitrile Glacial Acetic Acid Acetone liquids with flashpoints < 100 F	Flammable storage cabinet or refrigerator rated for flammable/ hazardous storage/explosion proof *Peroxide-forming chemicals must be dated upon delivery and opening (two dates)	Oxidizers Acids Bases Reactives Poisons/Toxins	Fire Hazard Heat Violet Reaction
Poisons/Toxins 	Chloroform Cyanides Heavy metal compounds (e.g. Cadmium, Mercury, Osmium, Oxalic Acid, Phenol, Formic Acid), Formamide, Carbon Tetracholride, 2-Mercaptoethanol Phenol, *Hydrofluoric Acid - Hydrofluoric Acid is a highly acute poison Acrylamide Ethidium Bromide Sodium Azide	Store in a dark, dry, ventilated, cool area in an unbreakable chemically resistant secondary container (polyethylene) * Store volatile toxins with evaporation rate above 1.0 - (ether =1.0) in flammable cabinet; Store non-volatile liquid poisons in a refrigerator or cabinet; amounts less than 1 liter can be stored in a cabinet above bench level, ONLY if the cabinet has sliding doors (not swinging)	Flammable liquids Acids Bases Reactives Oxidizers Corrosives Please consult Division of Environmental Protection (DEP) for assistance *Hydrofluoric Acid should be stored in an area accessible only by authorized personnel; do not store in glass; use plastic containers and secondary containment	Generation of Toxic and Flammable Gas Combustion Heat Fire Hazard Explosion Hazard Violent Reaction Chloroform explosively reacts with chemically-reactive metals (e.g., Aluminum or Magnesium powder, Sodium, and Lithium), Strong Oxidizers, Strong Caustics (e.g., Alkalis), and decomposes in sunlight
Explosives 	Picric Acid Ammonium Nitrate Nitro Urea Trinitroaniline Benzoyl Peroxide Trinitrobenzene Trinitrobenzoic Acid Trinitrotoluene Urea Nitrate Trinitrophenol Diazoisbutylnitrile	Store in a secure location away from other chemicals; store in an area away from friction or shock	Please consult the SDS and the DEP	Explosion Hazard Violent Reaction Heat Shock Friction

Class of Chemicals	Common Chemical Examples	Additional Concerns and Storage Recommendations	Common Incompatible Chemicals Types	Possible Reaction if Mixed/Health Concerns
Oxidizers 	Peroxides, Nitrates, Perchlorates Permanganates Sodium Hypochlorite Ethyl Acetate, Iodine, Benzoyl Peroxide Potassium Dichromate Chlorates, Bromates, and Superoxides, Ammonium Persulfate, Ferric chloride	Store in secondary containment separately from combustibles and flammable materials	Combustibles Flammables Organic Materials Reducing Agents	Fire Hazard Gas Generation Toxic Gas
Peroxide Formers 	Acrylonitrile Isopropyl Alcohol Ethers (e.g. Diethyl ether, Isopropyl Ether), Acetals and Ketals, especially Cyclic Ethers and those with primary and/or secondary Alkyl groups Aldehydes (e.g. Acetaldehyde, Benzaldehyde) Vinyl and Vinylidene compounds, Dienes Tetrahydrofuran Dioxane Butylated Hydroxytoluene (BHT) Isopropyl Ether	Store in airtight bottles, away from light and heat in a dark, cool dry area; avoid using containers with loose-fitting lids and ground glass stoppers; crystallization, discoloration, and formation or deposition of layers are signs a peroxide former may have become shock sensitive; do not use or move such containers: contact DEP; all bottles of peroxideforming chemicals must have the received date marked on the container; when the bottle is first opened, the container must be marked with the date opened	Always consult the Safety Data Sheet (SDS) and the	Explosion Hazard Violent Reaction Shock Sensitive Combustion (Exothermic Reaction) If an old or expired container of a peroxide-forming chemical or reactive is found, do not move it.

Water Reactive	Sodium Metals Lithium Metals Potassium Metals Sodium Borohydride Alkali Metal Hydrides	Store in a dry, cool area away from potential spray from fire sprinklers and other water sources (DO NOT store under the sink) Label this area for water-reactive storage	Aqueous solutions Oxidizers Please consult the Safety Data Sheet (SDS) and the Division of Environmental Protection (DEP)	Heat Violent Reaction

Class of Chemicals	Common Chemical Examples	Additional Concerns and Storage Recommendations	Common Incompatible Chemicals Types	Possible Reaction if Mixed/Health Concerns
Flammable Compressed Gases  	Methane Acetylene Butane Propane Hydrogen Silane Ethane Arsine Germane	Handle flammable compressed gases in a chemical fume hood Store in well-ventilated areas; store away from oxidizers, open flames, sparks, and other sources of heat ignition; post NO SMOKING signs around storage area(s) or entrance(s) to storage room(s); flammable gases stored outdoors where ambient temperatures exceed 125 deg F (51.7 deg C) shall be protected from direct sunlight Use a spark proof wrench to attach regulators and make other connections; install a flame/flash arrestor at the regulator outlet flow valve	Oxidizers Toxic Compressed Gases	Fire Hazard Explosion Hazard

Oxidizing Compressed   Gases	Oxygen Chlorine Fluorine Nitrogen oxides Gas mixtures containing Oxygen higher than atmospheric concentrations	Store oxidizers separately from flammable gas containers or combustible materials; minimum separation requirement from these materials is 20 ft or a 5 ft noncombustible barrier with a fire resistance rating of at least 30 minutes Clean equipment used for oxygen and nitrous oxide with oxygencompatible materials free from oils, greases, and other contaminants Fluorine shall be handled in specially passivated containers and associated equipment	Flammable Compressed Gases Toxic Compressed Gases	Fire Hazard Explosion Hazard
Toxic Compressed Gases 	Carbon Monoxide Hydrogen Chloride Hydrogen Sulfide Nitrogen Dioxide	Handle toxic compressed gases in a chemical fume hood Indoor storage or use of toxic compressed gases shall be provided with a gas cabinet, exhausted enclosure, or gas room Refer to the SDS information for additional guidance on the storage and compatibility requirements	Flammable Compressed Gases Oxidizing Compressed Gases	Release of Toxic Gas Hydrogen Sulfide is a colorless, flammable, extremely hazardous gas with a “rotten egg” smell; Prolonged exposure may cause nausea, tearing of the eyes, headaches or loss of sleep, airway problems (bronchial constriction) in some asthma patients; possible fatigue, loss of appetite, headache,
		Contact DOHS to determine if a fail- safe valve and/or continuous monitoring for toxic gas may be required during use		irritability, poor memory, dizziness and slight conjunctivitis
Class of Chemicals	Common Chemical Examples	Additional Concerns and Storage Recommendations	Common Incompatible Chemicals Types	Possible Reaction if Mixed/Health Concerns
Strong Reducing Agents	Acetyl Chloride Thionyl Chloride Maleic Anhydride Ferrous Sulfide	Store in cool, dry, well-ventilated location Water reactive Segregate from all other chemicals	Please consult the specific SDS and DEP	Please consult the specific SDS and DEP

Carcinogens 	Benzidine Beta-Naphthylamine Benzene Methylene Chloride Beta-Propiolactone Carbon Tetrachloride	Label all containers as "Cancer Suspect Agents" or the equivalent. Store according to the hazardous nature of the chemical, using appropriate security when necessary	Please consult the specific SDS and DEP	Please consult the specific SDS and DEP
Teratogens 	Lead Compounds Mercury Compounds Benzene Aniline	Label all containers as "Suspect Reproductive Hazard" or “Reproductive Effecter” Store according to the hazardous nature of the chemical, using appropriate security when necessary	Aniline incompatible with Nitric Acid and hHdrogen Peroxide Please consult the specific SDS and DEP	Please consult the specific SDS and DEP
General Stock Chemicals	Sodium Bicarbonate Sodium Chloride Agar Salt buffer Most non-reactive salts	Store on shelves, or laboratory benches or shelving preferably behind glass doors and below eye level with like chemicals	Please consult the SDS and DEP	Please consult the specific SDS and DEP

Table 2. Suggested Storage Time Limits for Common Peroxide

Peroxide Forming Compounds

Under proper conditions, these chemicals will form explosive peroxides which can be detonated by shock or heat. Follow manufacturer's storage time limits and expiration date. Although storage under inert gas or with a stabilizer may prolong shelf-life, test the container for peroxides before use beyond the expiration date or before any possible distillation procedure.

MOST DANGEROUS: Discard after 3 months. Peroxide formation hazard during storage.		
Diisopropyl ether Divinyl acetylene Potassium metal	Sodium amide Vinylidene chloride	
DANGEROUS: Discard after one year. Peroxide formation hazard during storage and on concentration (i.e., distillation) of compound.		
Acetal Acetaldehyde Cumene Cyclohexene Diacetylene	Dicyclopentadiene Diethyl ether 1,4-Dioxane Ethylene glycol dimethyl ether Methyl acetylene	Methyl cyclopentane Methyl isobutyl ketone Tetrahydrofuran Tetrahydronaphthalene Vinyl ethers
DANGEROUS: Discard after one year. Peroxide formation causes initiation of hazardous polymerization.		
Acrylic acid Acrylonitrile 1,3-Butadiene 2-Butanol	Chloroprene Chlorotrifluoroethylene Methyl methacrylate 2-Propanol Styrene	Tetrafluoroethylene Vinyl acetate Vinyl acetylene Vinyl chloride Vinyl pyridine

Adapted from *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals*, National Research Council, 1995.

This list is illustrative, not comprehensive. Check the SDS of your chemical to determine if it forms peroxides. If so, there will be a warning under the heading *Precautionary Labeling or Fire* and *Explosion Hazard Data* on the SDS. If a substance does not appear on the lists and the SDS does not indicate that it is a peroxide former, but you suspect that it is a peroxide former, evaluate the molecular structure of the

chemical for peroxide forming functional groups and the chemical families of peroxide formers below:

ORGANIC

A. Ethers, acetals
B. Olefins with allylic hydrogens, chloro- and fluoro-olefins, terpenes
C. Dienes, vinyl acetylenes
D. Aldehydes
E. Ureas, amides, lactams
F. Vinyl monomers including vinyl halides, acrylates, methacrylates, vinyl esters

INORGANIC

A. Alkali metals, particularly potassium
B. Alkali metal alkoxides and amides

Organometallics

3.4 Hazardous Waste Management and Disposal

3.4.1 Management

Hazardous waste chemicals regulated by the Environmental Protection Agency (EPA) and the Pennsylvania Department of Environmental Protection (PADEP) must be collected, labeled, packaged, and disposed of according to federal and state hazardous waste regulations. Hazardous waste is any solid, liquid, sludge, or containerized gas that is discarded, has served its intended use, or is manufacturing by-product, and exhibits any of the characteristics identified below:

- Flammable
- Corrosive
- Reactive
- Toxic

It is the responsibility of the waste generator to adhere to proper waste management and disposal policies. Hazardous waste shall be collected in an appropriate container pending disposal.

3.4.2 General Procedures for Disposal

- All waste shall be collected in a manner consistent with the direction of B+labs.
- Offsite waste disposal shall be coordinated by B+labs.
- Any material that meets the criteria of a hazardous waste shall not be treated or otherwise changed to alter its characteristics as a hazardous waste.
- Empty containers of hazardous materials shall be rinsed three times and all labels removed before disposal. The first rinse shall be collected as hazardous waste.
- Dispose of all waste in designated, labeled containers. Any questions about proper disposal methods should be directed to B+labs Management.
- Do not combine different waste streams (i.e. bio-hazardous and hazardous chemical or incompatible hazardous waste materials).
- Do not overfill containers.
- Common laboratory wastes, (paper towels, etc.) may be disposed in the general trash.

3.4.3 Storage and Handling for Hazardous Waste

- All hazardous waste generated at B+labs must be accumulated and stored in a designated area.

- B+labs can supply containers for the accumulation of waste.
- All containers shall be labeled with company name, contents and waste code.
- All waste containers must be closed and sealed when not in use.
- Waste must be stored in containers compatible with the constituents of the waste.
- Secondary containment bins must be used to prevent mixing of incompatible waste streams.

3.4.4 Lab-Pack Chemicals

Expired or unwanted chemicals should not remain in laboratory areas. Notify B+labs Management for removal of the waste chemicals.

3.4.5 Biological Waste

Biological waste is characterized as waste which may pose a health hazard. Biological waste consists of contaminated animal carcasses, needles and syringes, cell culture wastes, and any biologically contaminated laboratory waste.

3.4.5a Non-Sharps Disposal

All regulated medical waste (non-sharps) must meet the following criteria prior to disposal:

- Biowaste is collected in red-rigid containers in the lab.
- All containers must be lined with a red bag.
- Do not place leaking waste into the bags.
- Do not overfill bags.
- Full bags must be tied-off or taped.
- Full containers shall be transported to the waste room by Laboratory personnel.
- Supplies of new containers and bags are available in the waste room.

3.4.5b Sharps Disposal

- All contaminated sharps (needles, syringes, broken glass, razor blades, glass pipettes, etc.) shall be disposed of in an approved sharps container.
- All needle/syringe assemblies are to be disposed of intact. In order to prevent needle stick injuries, needles are not to be recapped, bent, or broken.
- All used needles and syringes are considered contaminated sharps and should be disposed of in

sharps containers.

- Syringes/needles used with potentially infectious materials shall be disinfected prior to being placed into the sharps container.
- When the sharps container is full, cap the top of the container.
- Place the sharps container in the large red-rigid container.

3.4.6 Broken Glass Disposal

- Broken glass and sharp objects shall never be disposed in general trash receptacles, autoclave bags, or recycling bins.
- Glass bottles or broken glass must be disposed of in cardboard "Deposit Glass Here" boxes.
- Seal the top of the broken glass box closed with tape when it is full and label it 'trash'.

3.4.7 Universal Waste Management

- Fluorescent lamps, NiCad or rechargeable batteries, and mercury containing devices such as thermostats are classified as Universal Waste in Pennsylvania and cannot be disposed in the general trash. Collection containers for these items are in the Waste Room.

3.5 Chemical Procurement

Before a chemical is received, information on proper handling, storage, and disposal should be reviewed by the Laboratory EHS Lead.

3.6 Housekeeping

- Laboratory fume hoods and work areas should be kept clean and free of debris at all times.
- Do not allow trash to accumulate in any area. It can be a fire hazard and/or obstruct emergency equipment and egress.
- Do not store food or drink in any laboratory.
- Access to exits, emergency equipment, and utility controls should never be blocked.

3.7 Spill Control Procedures

In the event of a chemical spill immediately implement the appropriate spill control procedures as outlined below.

a. Immediately turn off all ignition sources (i.e. open flame, heating mantle, etc.).

b. If contaminated with hazardous material, immediately implement Personal Decontamination Procedures below and notify B+labs Management.

- **Eye Contact**: Promptly flush eyes with water for a prolonged period (15 minutes). Obtain information from SDS.
- **Ingestion**: Call Emergency Operator (9-911), Poison Control Center. Do not induce vomiting or drink large quantities of water unless directed to do so by a medical professional.
- **Skin Contact**: Promptly flush the affected area with water for 15 minutes. Remove all contaminated clothing. Use a safety shower when contact is extensive.

c. Assess the Risk:

- Identify material, (i.e. acid, caustic or solvent).
- Determine if spill is a Major spill (equal to or greater than 500 ml/500 g, or any amount of an acutely hazardous material), or a Minor spill (less than 500 ml/500 g of non-acutely hazardous materials).
- If major spill, implement the major spill procedures as outlined below in section d.
- If minor spill, implement the minor spill procedures as outlined below in Item e.

d. Major Spills:

In the event of a major spill in a laboratory or common area, all laboratory personnel will implement the following plan:

1. Notify persons in the immediate area that a spill has occurred.
2. Avoid breathing vapors, mists or dust of the spilled material.
3. Turn off all ignition sources (if possible).
4. Evacuate room and close the door.
5. Immediately call the emergency contacts included with this document to provide emergency notification and assessment.

In order to assess the situation be prepared to provide the following information:

- Name and call back number
- The location of the spill (building and room number)
- Type of material spilled

- The amount of material that spilled

6. Remain on or near the telephone until you have received instructions from emergency response personnel on how to proceed.

e. Minor Spills:

In the event of a minor spill, laboratory personnel (Laboratory Supervisor/Laboratory Technician/Laboratory Manager) will implement the following steps for cleaning up:

1. Review SDS prior to cleanup.

2. Proper personal protective equipment will be donned during cleanup of all hazardous materials. Refer to SDS for proper personnel protection equipment selection prior to cleaning up any spilled material(s). If the laboratory personnel do not have the proper personal protective equipment, then contact B+labs Management.

3. Contain spilled material(s) using absorbent pads and/or socks. Paper towels must not be used for containment of spill nor will they be used for cleanup.

4. Clean up as recommended on the SDS.

6. Place cleanup material in a waste container and contact B+labs Management to dispose of the waste properly.

7. Wash area where spill has occurred with water several times making sure no residue was left behind.

8. All emergency equipment shall be decontaminated and stored.

9. All non-disposable personal protective equipment shall be decontaminated and stored.

10. All disposable personal protective equipment and clean up materials shall be disposed of as hazardous waste.

11. Always use extreme caution when cleaning up hazardous substances.

Report all spills involving the release of materials in quantities greater than 100 milliliters to B+labs Management. to file an Accident/Incident Report documented on Appendix B.

3.8 Hazard Assessment

A hazardous chemical means a chemical for which there is statistically significant evidence that acute or

chronic health effects may occur in exposed persons. An acute health effect is an adverse health effect characterized by severe symptoms that develop rapidly. A chronic health effect is an adverse health effect with symptoms that develop slowly over a relatively long period of time.

A hazard assessment must be completed to identify the physical and health hazards of chemicals used in the laboratory and to determine the risk of exposure to the body. A physical chemical hazard is a chemical that is proven to be a combustible liquid, flammable, a compressed gas, explosive, an organic peroxide, an oxidizer, pyrophoric, unstable or water reactive. A health hazard means a chemical for which there is statistically significant evidence that acute or chronic health effects may occur in exposed persons. Chemicals that are health hazards include carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes. (Appendix C)

A hazard assessment should include identifying the hazard type(s), the selection of appropriate PPE, laboratory personnel training, storage and handling requirements, control measures, signs and symptoms of an exposure, and spill and decontamination procedures.

3.9 Bonding and Grounding

Bonding and grounding of flammables is extremely important to reduce the risk of explosion and fire due to static electricity that builds up during the transfer of flammable liquids. Bonding prevents the generation of static electricity by minimizing the electrical potential between two objects, such as a dispensing drum and a safety can. Grounding minimizes the electrical potential between the containers and the ground. Bonding and grounding shall be used when transferring Class I flammable liquids, those with a flash point below 100°F (ethyl ether, benzene, xylene, acetone), in metal equipment in order to avoid static generated sparks.

3.10 Procedures for Prior Approval

Whenever there is a significant change in chemical amounts, new equipment, a situation where one must work alone, or highly hazardous chemicals or procedures, approval must be given by the Laboratory EHS Lead prior to starting the procedure. General safety considerations include:

- Experimental design
- Equipment design
- Workspace adequacy
- Development of an SOP (Standard Operating Procedure)
- Work preparedness
- Hazard assessment

3.11 Procedures for Particularly Hazardous Substances (Select Carcinogens, Reproductive Toxins, Highly Toxic Chemicals, and Chemicals of Unknown Toxicity)

The following procedures must be followed when performing laboratory work with particularly hazardous substances.

- These substances must be used and stored only in areas with restricted access.
- A designated area must be used for work with these materials. This area may be an entire laboratory, a glove box, an area of a laboratory, or a device such as a chemical fume hood. The designated area must be clearly posted with signs that;
    - Identify the hazards
    - Signify when the hazardous material is in use
    - Warn that no untrained personnel allowed in the work area
    - Clearly define the designated area
- Only the smallest amount of a chemical required by the procedure shall be used or stored.
- When possible only order the required amounts to avoid unnecessary decanting or weighing out of the material.
- Specific spill procedures for the hazardous materials must be developed and posted in the designated area.
- All laboratory personnel working with these chemicals shall be familiar with the hazards and proper procedures for an accidental release.
- General PPE to be worn at all times when working with these materials are safety glasses, gloves, long sleeve laboratory coats, and no open toed shoes.
- The designated work area shall always be decontaminated after each process, experiment, or when the work is completed.

- All waste products from the process shall be managed in a compatible container.

3.12 Chemical Substances Developed in the Laboratory

If the composition of a chemical substance produced for the laboratory's use is known, the Laboratory EHS Lead shall determine if it is a hazardous chemical. If the chemical is determined to be hazardous, the Laboratory Manager/Supervisor shall provide for appropriate training. If the chemical produced is a byproduct whose composition is not known, it shall be assumed that the substance is hazardous. If the chemical substance is produced for another user outside of the laboratory, the Laboratory EHS Lead of the tenant company shall comply with the Hazard Communication Standard (29 CFR 1910.1200,) including the requirements for preparation of SDS's and labeling.

4.0 Special Procedures for Handling Hazardous Chemicals

The Laboratory EHS Lead shall ensure that all laboratory personnel are aware of the locations, hazards, and appropriate control measures for work involving hazardous chemicals. In some cases, laboratory specific procedures may be required for working with highly hazardous materials. Review the SDS for specific handling and storage requirements of hazardous chemicals. Some specific hazards that may be present in various laboratories at BLABS are listed below.

4.1 Allergens and Sensitizers

A chemical allergy is an adverse reaction by the immune system to a chemical. Allergic reactions result from previous sensitization to a chemical or a structurally similar chemical. Once sensitization occurs, allergic reactions can result from exposure to extremely low doses of the chemical. Allergic reactions can be immediate, occurring a few minutes after an exposure. Anaphylactic shock is a severe immediate allergic reaction that can result in death if not treated quickly. Allergic reactions can also be delayed, taking hours or even days to develop. It is important to recognize that a delayed chemical allergy can occur even some time after the chemical has been removed. Examples of substances that may cause allergic reactions include diazomethane, formaldehyde, various isocyanates, benzylic and allylic halides, and certain phenol derivatives.

4.2 Asphyxiants

Asphyxiants are substances that interfere with the transport of an adequate supply of oxygen to the vital organs of the body. Simple asphyxiants are substances that displace oxygen from the air being

breathed to such an extent that adverse effects result. Acetylene, carbon dioxide, argon, helium, ethane, nitrogen, and methane are common asphyxiants. It is important to recognize that even chemically inert and biologically benign substances can be extremely dangerous under certain circumstances such as carbon monoxide.

4.3 Compressed Gas

Gas cylinders contain either compressed liquids or gases. Gas cylinders represent an insidious hazard, since puncture, heat, faulty valves, pressure or regulators may result in a rapid release of the entire contents. The following safety considerations should be implemented where applicable:

- The cylinder contents must be clearly identifiable.
- Handle cylinders carefully and do not roll, slide, or drop. Use a cart or hand truck to transport.
- Do not lift a cylinder by its cap.
- Secure all cylinders while in storage, transport, or use.
- Never tamper with cylinder valves, force connections, or use homemade adapters. Use only approved equipment. Never repair or alter cylinders, valves, or safety relief devices.
- Only use a regulator compatible with the cylinder contents.
- Close the cylinder valve when not in use.
- When empty, turn off the cylinder valve and label the cylinder as empty. Store separately from full cylinders.
- Store cylinders in a well-ventilated area away from ignition sources, heat, flames, and flammable chemicals.
- Keep the protective caps on the cylinders at all times except when the cylinders are in active use.
- Check for gas leaks using soapy water around the connections.
- Do not store flammable gas cylinders with oxidizers such as nitrous oxide or oxygen. They must be separated by a minimum of 20 ft. or a 5-foot fire wall.

4.4 Corrosive Chemicals

The Resource Conservation and Recovery Act (RCRA) defines a corrosive chemical as a liquid with a pH ≥12.5 or ≤2. Acids and bases can cause severe tissue damage depending on the corrosivity of the chemical. The primary means of protection from corrosive chemicals is the use of gloves, goggles, face

shields, aprons, lab coats, and other chemical resistant clothing. Exercise extreme caution when handling corrosive chemicals. The following safety considerations should be implemented where applicable:

- Transport acids and bases in a bottle carrier or cart. Do not handle by the neck alone; support the weight of the bottle from the bottom when handling or pouring.
- Do not store acid and bases with flammable liquids or oxidizing chemicals. Store perchloric acid by itself.
- Isolate corrosive chemicals from incompatible chemicals.
- Reference the chemical's SDS for proper handling, PPE, and storage requirements.
- If an acid or base comes in contact with your skin or clothing, thoroughly wash the affected areas utilizing the safety showers or eyewash units, and remove contaminated clothing.

4.5 Cryogenic Liquids

Cryogenic liquids are liquefied gases that are kept in their liquid state at very low temperatures and are associated with various hazards including: extreme cold, asphyxiation, explosion, cold contact burns, and toxicity. Laboratory personnel should be thoroughly trained on the hazards and the proper steps to avoid them. Training should include emergency procedures, operation of equipment, safety devices, appropriate engineering controls, knowledge of the properties of the materials used, and personal protective equipment required. Insulated gloves should always be worn when handling anything that comes into contact with cryogenic liquids or the vapors. Considerations must be made to prevent cryogenic material from contacting skin. Clothing such as a lab coat, pants, closed toed shoes, safety glasses, goggles, and face shields should be worn.

4.6 Flammable and Combustible Chemicals

Flammable chemicals are considered to be liquids with a flashpoint below 100 °F and solid materials that readily sustain combustion. Liquids with a flashpoint between 100 °F and 200 °F are generally classified as combustible; the same basic procedures should be applied when handling combustible liquids.

- Do not allow smoking or other sources of open flames in areas where flammable chemicals are used.
- Know the location of fire extinguishers, fire alarms, and emergency exits in the laboratory.
- Do not store flammable liquids in domestic-type refrigerators. Use only refrigerators rated for

flammables.

- Do not store flammables with oxidizing agents (e.g., nitric, perchloric, and sulfuric acids).
- Do not expose flammable liquids to potential sources of ignition such as electrical equipment, heat, burners, or open flames.
- To prevent accidental electrical charge, the use of bonding and grounding equipment should be used whenever applicable. The use of non-sparking tools can prevent an ignition source.
- Store flammable liquids in an approved fire rated flammable storage cabinet.
- Do not store flammable liquids on the floor, unless protected by secondary containment.
- Minimize the amount of flammable liquids that are in use, being stored, and that are generated as wastes. No more than 60 gallons of flammable liquids are to be stored in any single laboratory space.
- Storage of flammable liquids totaling greater than 10 gallons within a single laboratory space must be in an approved and labeled flammable storage cabinet.
- The Safety Data Sheet (SDS) shall be reviewed by the owner/user of the materials for additional safety requirements and precautions.

4.7 Hepatotoxins

Chemicals that are toxic to the liver are called hepatotoxins. The effects of hepatotoxins depend on the amount, point of entry and distribution speed of the toxin, and on the health of the person. Signs and symptoms include jaundice; liver enlargement. Examples of hepatotoxins include carbon tetrachloride and nitrosamines. Hepatotoxins should be stored in a tightly closed container in a cool, dry, well-ventilated area away from incompatible substances. Use adequate general or local exhaust ventilation (such as a chemical fume hood) to keep airborne concentrations below the permissible exposure limits.

4.8 Irritants

An irritant is a chemical, which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact. A wide variety of organic and inorganic chemicals are irritants; thus, skin contact with all laboratory chemicals should be avoided. Use a properly functioning chemical fume hood when handling irritants that can be inhaled. At minimum, safety glasses, lab coat, long pants, protective gloves, and closed toed shoes should be worn.

4.9 Nephrotoxin

Nephrotoxins are chemicals that inhibit damage or destroy the cells and/or tissues of the kidneys. Signs

and symptoms include edema; proteinuria. Examples of nephrotoxins include halogenated hydrocarbons, heavy metals, and uranium. Both acute and chronic exposure to certain organic chemicals can cause inflammation, injury or severe damage to the kidneys. Use proper engineering controls such as a fume hood to minimize exposure.

4.10 Neurotoxins

Neurotoxic chemicals can induce an adverse effect on the structure or function of the central and/or peripheral nervous system, which can be permanent or reversible. Neurotoxic chemicals may cause narcosis, slurred speech, decrease in motor functions, and staggered gait. Many neurotoxins are chronically toxic substances whose adverse effects are not immediately apparent. Examples include mercury and carbon disulfide.

4.11 Organic Peroxides

Organic peroxides are hazardous because of their extreme sensitivity to shock, sparks, heat, light, strong oxidizing and reducing agents, and other forms of detonation. Organic peroxides may cause fire, create explosion hazards, and may be toxic or corrosive. Some organic peroxides are dangerously reactive, decomposing very rapidly or explosively if they are exposed to only slight heat, friction, mechanical shock or contamination with incompatible materials. Precautions for handling peroxides should include the following:

- Limit the quantity of peroxides.
- Do not return unused peroxides to the container.
- Clean up all spills immediately. Solutions of peroxides can be absorbed using vermiculite or other absorbing material.
- Do not permit smoking, open flames, and other sources of heat near peroxides. Areas should be labeled that contain peroxides so that this hazard is evident.
- Avoid friction, grinding, and other forms of impact near peroxides, especially solid peroxides. Glass containers that have screw-cap lids or glass stoppers should not be used. Polyethylene bottles that have screw-cap lids may be used.
- Isolate from incompatible materials such as strong acids and bases, flammable and combustible liquids, and reducing agents.

4.12 Oxidizers

Oxidizers are chemicals other than a blasting agent or explosive as defined in § 1910.109(a), that initiates or promotes combustion in other materials, causing fire either of itself or through the release of oxygen or other gases. Examples include perchloric acid, potassium persulfate, and lead nitrate. Precautions for handling oxidizers should include the following:

- Minimize the number of oxidizers used and stored.
- Isolate from incompatible chemicals (e.g. organics, flammable, dehydrating agents, or reducing agents).
- Do not store oxidizers in wooden cabinets or on wooden shelves.
- Do not return unused material to the original container.
- Store in a tightly closed container and in a cool, dry, ventilated area.
- Perchloric acid may not be used in any fume hood except those specifically designed for perchloric acid use.

4.13 Pyrophoric Chemicals

Pyrophoric chemicals are extremely reactive toward oxygen and water and must never be exposed to the atmosphere. Examples include sodium hydride and magnesium. Exposure of these chemicals to the air could result in spontaneous combustion, which could cause serious burns or other injuries to the person handling the chemical or others in the immediate area. In addition, all combustible materials, including paper products, should not be allowed to come in contact with any pyrophorics at any time. Pyrophorics can be handled and stored safely as long as all exposure to atmospheric oxygen and moisture is avoided. Solids must be transferred under an inert atmosphere in an efficient glove box. Glass bottles of pyrophorics should not be handled or stored unprotected. The metal container shipped with each bottle should be retained as a protective container for each bottle for transporting and storage

4.14 Reproductive Toxins

Reproductive toxins are chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis). Reproductive toxins have adverse effects on various aspects of reproduction, including fertility, gestation, lactation, and general reproductive performance. Reproductive toxins can affect both men and women. Male reproductive toxins can in

some cases lead to sterility. Two well-known male reproductive toxins are ethylene dibromide and dibromochloropropane. When a pregnant woman is exposed to a chemical, generally the fetus is exposed as well because the placenta is an extremely poor barrier to chemicals.

4.15 Select Carcinogens

A carcinogen is a substance capable of causing cancer. Carcinogens are particularly insidious toxins because they may have no immediate apparent harmful effects. Carcinogens should be handled using prudent practices. A chemical is considered to be a carcinogen if:

- It has been evaluated by the International Agency for Research on Cancer (IARC), and found to be a carcinogen or potential carcinogen; or
- It is listed as a carcinogen or potential carcinogen in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or,
- It is regulated by OSHA as a carcinogen.

4.16 Toxic Chemicals

Toxic is defined by OSHA 29 CFR 1910.1200 as a chemical which falls into any of these three categories:

- A chemical that has a median lethal dose (LD50) of more than 50 milligrams per kilogram but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
- A chemical that has a median lethal dose (LD50) of more than 200 milligrams per kilogram but not more than 1,000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.
- A chemical that has a median lethal concentration (LC50) in air of more than 200 parts per million but not more than 2,000 parts per million by volume of gas or vapor, or more than two milligrams per liter but not more than 20 milligrams per liter of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

4.17 Unknown Chemicals

Unknown chemicals, or those for which complete physical and chemicals hazards are not known, must

be assumed to be hazardous and highly toxic. Appropriate PPE and engineering controls should be utilized.

4.18 Water-Reactive Chemicals

Water-reactive chemicals are likely to become spontaneously flammable or give off flammable or toxic gas when in contact with water. Examples include aluminum powder, barium, calcium hydride, and sodium borohydride. Protect from moisture and separate from incompatibles. Store these chemicals in accordance with manufacturer or applicable SDS requirements.

4.19 Controlled Substances

The use of controlled substances in the laboratory is subject to U.S. Drug Enforcement Administration (DEA) and Pennsylvania state regulations. A controlled substance is a drug or other substance, or immediate precursor, regulated by the DEA under schedules I-V. All controlled substances must be registered and licensed per all applicable governmental regulations.

5.0 Control Measures

For the laboratory use of OSHA regulated substances the Laboratory Manager/Supervisor shall assure that laboratory personnel exposure to such substances does not exceed the permissible exposure limits specified in 29 CFR 1910, subpart Z. To minimize laboratory personnel exposure to hazardous chemicals the following control measures for reducing chemical exposure should be implemented:

- Substitution of less hazardous chemicals or processes
- Engineering controls
- Administrative controls
- Personal protective equipment (PPE)

Substitution, engineering controls, administrative controls, and personal protective equipment (PPE) are basic principles used to control hazards and exposures. Before the proper control (s) can be selected, a hazard assessment of the process, activity, or material should be conducted.

5.1 Substitution

Every hazard assessment should first determine if the hazardous conditions can be prevented, e.g. substituting with a less hazardous chemical or process. Substitution is one of the most effective ways to eliminate or reduce exposures because it removes the hazard at the source.

5.2 Administrative Controls

Administrative controls are changes in work procedures such as written safety guidelines, rules, supervision, schedules, signs, labels, SDSs, and training to reduce employee exposure to hazardous chemicals.

5.2.1 Safety Data Sheets (SDS)

SDSs are documents created by the chemical manufacturer that describe the substance. Some information found on an SDS includes chemical and physical characteristics, handling requirements, storage and disposal information, and signs and symptoms of exposure. SDS's are required for all chemicals at B+labs and must remain on file with the tenant company for 30 years after employment. OSHA requires up to date SDS's that are readily available for each chemical. The Laboratory EHS Lead is responsible for maintaining SDS's in the lab for chemicals used and stored therein. For laboratories with multiple chemicals, an SDS binder or other means such as electronic files must be readily available to all emergency response personnel, regulatory inspectors, and everyone working with the hazardous chemicals. An inventory of all chemicals, SDSs and their quantities on site must be provided to B+labs Management. Laboratory personnel have a right to access any or all SDS's. If an SDS is not included in the shipment, the Laboratory EHS Lead or designee shall contact the chemical manufacturer in order to obtain the SDS for that chemical.

5.2.2 Signs and Labels

All hazardous materials, hazardous waste, and chemical storage areas shall be appropriately labeled indicating the hazards present and any other relevant regulatory requirements. All chemical containers must be labeled regardless of size and whether or not they are hazardous. Note: If a container is under the immediate control of the user, it does not require labeling. Labeling of all chemical containers assists emergency personnel and others in identifying what is and what is not hazardous should a spill occur, or other emergency situation arise. Original labels on chemical containers must not be removed or defaced. Labels must be in English and they must contain the complete name of the chemical and be traceable or easily linked to the appropriate SDS (chemical formulas are not allowed). The manufacturer's label is generally sufficient to meet OSHA labeling requirements and should be replaced only if it becomes damaged or illegible. All containers into which chemicals are transferred also need to be legibly labeled in English and include the name of the chemical and appropriate hazard warnings

(chemical formulas are not allowed). OSHA's Globally Harmonized System of labeling, including compliant pictograms, must be used on all containers. Refrigerators or freezers containing chemicals should be appropriately labeled, e.g. "chemicals only, no food or drink".

All laboratories shall be posted with signage addressing the hazards of the materials contained in the lab, requirements for personal protective equipment, and any special hazards located in the lab. Special hazards, such as the presence of bio-hazardous or radioactive materials, must be indicated with appropriate signage. Signage will be determined and posted by BLabs Management.

5.3 Engineering Controls

Engineering controls eliminate or reduce exposure to a chemical or physical hazard through the use of specifically engineered equipment or process design. Engineering controls include process change, substitution, isolation, ventilation, and source modification.

- **Process change** consists of changing a process to make it less hazardous (e.g., paint dipping in place of paint spraying).
- **Substitution** consists of substituting for a less hazardous material, equipment, or process (e.g., use of soap and water in place of solvents, use of automated instead of manually operating equipment).
- **Isolation** is applied when a barrier is inserted between a hazard and those who might be affected by that hazard. Separating personnel from hazardous operations, processes, equipment, or environments using a physical barrier or distance may provide the necessary isolation.
- **Ventilation** can be either local (direct air movement) or general (dilution of air contaminants) that exhausts or supplies air properly.
- **Source modification** consists of changing a hazard source to make it less hazardous (e.g., wetting dust particles or lowering the temperature of liquids to reduce off-gassing and vaporization).

5.4 Personal Protective Equipment (PPE)

Each tenant company occupying lab space at the BLABS is required to determine if PPE should be used to protect their employees. PPE should be used in conjunction with guards, engineering controls, and

administrative controls. PPE may be required to reduce exposure to hazards when engineering and administrative controls are not feasible or effective in reducing these exposures to acceptable levels. PPE should always be worn if there is a possibility that personal clothing could become contaminated with hazardous materials. Examples of PPE include; laboratory coats, aprons, jumpsuits, boots, shoe covers, safety glasses and gloves. Review SDS's to determine the necessary PPE to limit exposure. The kind of PPE needed depends on how the chemical enters the body. This is called route of exposure and is listed on the SDS. The four major routes of exposures are skin absorption, inhalation, ingestions, and injection.

5.4.1 Eye and Face Protection

Safety glasses with side shields that conform to ANSI standard Z87.1-1989 shall be required for work with hazardous chemicals. Ordinary prescription glasses with hardened lenses do not serve as safety glasses. If prescription safety glasses are needed, please contact employer for additional instructions. Although safety glasses can provide protection from injury from flying particles, they offer little protection against chemical splashes. Splash goggles should be worn if there is a splash hazard in any operation involving hazardous chemicals. Full face shields are worn in conjunction with either safety glasses or splash goggles. When there is a possibility of liquid splashes, both a face shield and splash goggles should be worn; this is especially important for work with highly corrosive liquids. Full-face shields with throat protection and safety glasses with side shields should be used when handling highly hazardous chemicals. If work in the laboratory could involve exposure to lasers, ultraviolet light, infrared light, or intense visible light, specialized eye protection should be worn. Safety glasses should be provided for visitors in the laboratory.

5.4.2 Hand Protection

When handling hazardous chemicals, laboratory personnel shall select and wear the appropriate gloves. No single glove can provide appropriate protection in every work situation. It is important to assess the hazards in each task and select a glove that provides the required protection. Below are general recommendations for glove selection and use:

- Similar gloves supplied by different manufacturers may not offer the same level of protection; therefore, the manufacturer's glove selection chart may need to be reviewed.

- Select gloves which are resistant to the chemicals you may be exposed to. Consult the relevant SDS which may recommend a particular glove material.
- Select gloves of the correct size and fitting; gloves that are too small are uncomfortable and may tear whereas larger gloves may interfere with dexterity.
- Before use, check gloves (even new ones) for physical damage such as tears and pin holes.
- When removing gloves, do so in a way that avoids the contaminated exterior contacting the skin.
- Wash hands after removing gloves.

Many factors affect the breakthrough times of gloves including: thickness of glove material, chemical concentration, amount of chemical that comes into contact with the glove, length of time the glove is exposed to the chemical, temperature at which the work is done, and possibility of abrasion or puncture. Glove selection guides are available from most manufacturers.

If chemicals do penetrate the glove material, they could be held in prolonged contact with the hand and cause more serious damage than in the absence of a proper glove. Gloves should be replaced immediately if they are contaminated or torn. The use of double gloves may be appropriate in situations involving chemicals of high or multiple hazards. Leather gloves are appropriate for handling broken glassware and inserting tubing into stoppers, where protection from chemicals is not needed. Reusable gloves should be decontaminated or washed appropriately before they are taken off and should be left in the laboratory and not be allowed to touch any uncontaminated objects in the laboratory or any other area. Gloves should be replaced periodically, depending on the frequency of use.

5.4.3 Lab Coats, Protective Suits & Aprons

Appropriate laboratory coats should be worn, buttoned, with the sleeves rolled down. Laboratory coats should be fully covering. Laboratory coats or laboratory aprons made of special materials are available for high-risk activities. Laboratory coats that have been used in the laboratory should be left there to minimize the possibility of spreading chemicals to eating and office areas, and they should be cleaned regularly. Rings, bracelets, watches, or other jewelry that could trap chemicals close to the skin, come in contact with electrical sources, or get caught in machinery should not be worn. Leather clothing or

accessories should not be worn in situations where chemicals could be absorbed in the leather and held close to the skin.

5.4.4 Laboratory Attire

When performing work with hazardous materials, laboratory personnel should cover all exposed parts of their body to prevent unnecessary chemical exposure. Tie long hair back, avoid loose clothing such as neckties and flowing sleeves, wear long pants or long skirt to cover the legs below the lab coat.

5.4.5 Foot Protection

Fully encapsulating, closed toed shoes should be worn in areas where hazardous chemicals are in use or mechanical work is being done. Clogs, perforated shoes, bare feet, sandals, and cloth shoes do not provide protection against chemicals. Shoe covers may be required for work with especially hazardous materials.

6.0 Equipment, Maintenance, and Inspections

6.1 Fume Hoods

The laboratory fume hood is the most common local exhaust method used in laboratories. When working with hazardous chemicals, the use of the fume hood is required at BLABS. A properly operating and correctly used fume hood will control vapors, dusts, and mists released from volatile liquids. Fume hoods can also protect from accidental spills. Fume hoods are inspected and certified annually under the direction of B+labs Management However, the Laboratory EHS Lead for ensuring that their fume hood(s) has an up to date certification and is functioning properly. Except when adjustments to the apparatus are being made, the hood should be kept closed, with vertical sashes down and horizontal sashes closed, to help prevent the spread of a fire, spill, or other hazards into the laboratory. Basic guidelines for operating a fume hood include the following:

- Confirm that the fume hood has been certified within the last year (label with date).
- Confirm that the chemical can be used in the fume hood.
- Conduct procedure at least six inches behind the plane of the sash.
- Never put your head inside a fume hood to check an experiment.
- Work with the sash at the lowest position possible to protect your face and body.
- Do not clutter the fume hood with bottles, chemicals, or equipment as it restricts airflow and

workspace.

- Immediately report any suspected fume hood malfunctions to the Lab and Safety Manager**.**
- Limit foot traffic behind while performing operations in the hood.

6.2 Glove Box

Glove boxes are usually small units that have multiple openings in which arm-length rubber gloves are mounted. The operator works inside the box by using these gloves. Glove boxes generally operate under negative pressure, so that any air leakage is into the box.

6.3 Safety Showers and Eyewash Stations

In case of an exposure to hazardous substances, a reliable, clean source of water must be available to rinse contaminants from the body. Safety showers are either located in the laboratory or in the hallway. Eyewash stations are located in the laboratory. Laboratory personnel must ensure that safety showers and eyewash stations are free from obstruction. Laboratory EHS Leads are responsible for ensuring all laboratory personnel are aware of the nearest safety shower and eyewash station location and how to use the device. B+labs Management is responsible for inspecting safety showers and eyewash stations.

6.4 Inspections

Tenants should conduct inspections on a regular frequency. B+labs reserves the right to conduct inspections at any time.

7.0 General Microbiology Safety Principles

7.1 Principles of Biosafety

Microbiology laboratories are special, often unique, work environments that may pose identifiable infectious disease risks to persons in or near them. Infections have been contracted in the laboratory throughout the history of microbiology.

Safe methods for managing infectious agents in the laboratory environment revolve around practices for containment of the agents, good laboratory practice and technique and facility design. Primary containment, the protection of personnel and the immediate laboratory environment from exposure to infectious agents is provided by good microbiological technique and the use of safety equipment. The use of

vaccines may also provide an increased level of personal protection. Secondary containment, the protection of the environment external to the laboratory from exposure to infectious materials, is provided by a combination of facility design and operational practices.

7.2 Biological Risk Assessment

Risk assessment is an important responsibility for laboratory directors. Risk assessment is a process used to identify the hazardous characteristics of a known infectious or potentially infectious agent or material, the activities that can result in a person's exposure to an agent, the likelihood that such exposure will cause a Laboratory Acquired Infection (LAI), and the probable consequences of such an infection. The information identified by risk assessment will provide a guide for the selection of appropriate biosafety levels and microbiological practices, safety equipment, and facility safeguards that can prevent LAIs.

Laboratory directors should use risk assessment to alert their staffs to the hazards of working with infectious agents and to the need for developing proficiency in the use of selected safe practices and containment equipment. Successful control of hazards in the laboratory also protects persons not directly associated with the laboratory, such as other occupants of the same building, and the public.

The primary factors to consider in risk assessment and selection of precautions fall into two broad categories: agent hazards and laboratory procedure hazards. In addition, the capability of the laboratory staff to control hazards must be considered. This capability will depend on the training, technical proficiency, and good habits of all members of the laboratory, and the operational integrity of containment equipment and facility safeguards.

The agent summary statements contained in BMBL identify the primary agent and procedure hazards for specific pathogens and recommend precautions for their control.

7.3 Hazardous Characteristics of an Agent

The principal hazardous characteristics of an agent are its capability to infect and cause disease in a susceptible human or animal host, its virulence as measured by the severity of disease, and the

availability of preventive measures and effective treatments for the disease. The World Health Organization (WHO) has recommended an agent risk group classification for laboratory use that describes four general risk groups based on these principal characteristics and the route of transmission of the natural disease.

Table 1: Classification of Infectious Microorganisms by Risk Group

Risk Group Classification	NIH Guidelines for Research involving Recombinant DNA Molecules 2002[2]	World Health Organization Laboratory Biosafety Manual 3rd Edition 2004[1]
Risk Group 1	Agents not associated with disease in healthy adult humans.	(No or low individual and community risk) A microorganism unlikely to cause human or animal disease.
Risk Group 2	Agents associated with human disease that is rarely serious and for which preventive or therapeutic interventions are *often* available.	(Moderate individual risk; low community risk) A pathogen that can cause human or animal disease but is unlikely to be a serious hazard to laboratory workers, the community, livestock or the environment. Laboratory exposures may cause serious infection, but effective treatment and preventive measures are available and the risk of spread of infection is limited.
Risk Group 3	Agents associated with serious or lethal human disease for which preventive or therapeutic interventions may be available (high individual risk but low community risk).	(High individual risk; low community risk) A pathogen that usually causes serious human or animal disease but does not ordinarily spread from one infected individual to another. Effective treatment and preventive measures are available.
Risk Group 4	Agents 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).	(High individual and community risk) A pathogen that usually causes serious human or animal disease and can be readily transmitted from one individual to another, directly or indirectly. Effective treatment and preventive measures are not usually available.[3]

The *NIH Guidelines* are the key reference in assessing risk and establishing an appropriate biosafety level for work involving recombinant DNA molecules. The purpose of the *NIH Guidelines* is to promote the

safe conduct of research involving recombinant DNA. The *NIH Guidelines* explicitly address experiments that involve introduction of recombinant DNA into Risk Groups 2, 3, and 4 agents, and experiments in which the DNA from Risk Groups 2, 3, and 4 agents is cloned into nonpathogenic prokaryotic or lower eukaryotic host-vector systems. Compliance with the *NIH Guidelines* is mandatory for investigators conducting recombinant DNA research funded by the NIH or performed at, or sponsored by, any public or private entity that receives any NIH funding for recombinant DNA research. Many other institutions have adopted these guidelines as the best current practice.

The National Institutes of Health (NIH) and the Centers for Disease Control (CDC) have published a set of instructions for work with infectious organisms entitled "*Biosafety in Microbiological and Biomedical Laboratories"* (HHS Publication # CDC 93-8395). Four biosafety levels (BL) are recommended.

It is B_+labs policy that all laboratories adhere to NIH and CDC guidelines for work with potentially infectious materials.

7.4 Laboratory Practice and Technique

The most important element of containment is strict adherence to standard microbiological practices and techniques. Persons working with infectious agents or potentially infected materials must be aware of the potential hazards and must be trained and proficient in the practices and techniques required for handling such material safely. Each Laboratory Manager/Supervisor is responsible for providing for the training of their laboratory personnel.

Each laboratory using bio-hazardous materials must develop specific instructions and procedures that identify the hazards that may be encountered, and the practices and procedures designed to minimize or eliminate risks. Employees should be trained on the hazards and the required practices and procedures. Laboratory Managers/Supervisors are responsible for the enforcement of proper practices and techniques in their laboratories, and laboratory personnel are responsible to follow the established rules.

7.5 Safety Equipment (Primary Barriers)

Safety equipment includes biological safety cabinets (BSCs or Tissue Culture Hoods), enclosed containers, and other engineering controls designed to remove or minimize exposure to hazardous biological agents.

The biological safety cabinet is the principal device used to provide containment of infectious splashes or aerosols generated by many microbiological procedures.

Safety equipment (required in all laboratories) also includes personal protective equipment such as safety glasses, laboratory coats, gloves, goggles, etc. Personal protective equipment is used in addition to biological safety cabinets and other devices that contain the agents or materials being worked with.

7.6 Facility Design (Secondary Barriers)

The design of the facility is important in providing a barrier to protect persons working inside and outside of the laboratory within the facility, and to protect the community from infectious materials that may be accidentally released from the facility.

The exposure risks for laboratory work at the B_+labs are typically Biosafety Level 1 or Biosafety Level 2. This means that direct contact with the agents or inadvertent contact through contaminated work environments must be avoided. Secondary barriers include the separation of laboratory work from public access, availability of decontamination facilities (autoclave) and hand washing facilities.

As the risk for aerosol transmission increases, (Biosafety Level 3 and 4), higher levels of primary containment and multiple secondary barriers become necessary to prevent infectious agents from escaping into the environment.

7. 5 Biosafety Levels

7.7.1 Biosafety Level 1 (BL1)

Safety equipment and facilities are appropriate for facilities in which work is done with defined and characterized strains of viable microorganisms not known to cause disease in healthy adult humans. Bacillus subtilis, Naegleria gruberi, and infectious canine hepatitis virus are representative of those agents meeting these criteria. Many agents not ordinarily associated with disease processes in humans are, however, opportunistic pathogens and may cause infection in the young, the aged, and immunodeficient or immunosuppressed individuals. Vaccine strains which have undergone multiple in vivo passages should not be considered avirulent simply because they are vaccine strains.

Biosafety Level 1 represents a basic level of containment that relies on standard microbiological practices with no special primary or secondary barriers recommended, other than a sink for hand washing.

7.7.2 Biosafety Level 2 (BL2)

Safety equipment and facilities are appropriate for clinical, diagnostic, teaching, research and other facilities in which work is done with the broad spectrum of indigenous moderate-risk agents present in the community and associated with human disease of varying severity. With good microbiological techniques, these agents can be used safely in activities conducted on the open bench, provided the potential for producing splashes or aerosols is low. Hepatitis B virus, the salmonellae, and Toxoplasma spp. are representative of microorganisms assigned to this containment level. Biosafety Level 2 is appropriate when work is done with any human-derived blood, body fluids, or tissues where the presence of an infectious agent may be unknown.

(Laboratory personnel working with human-derived materials should refer to the Exposure Control Plan for specific OSHA-required precautions).

Primary hazards to personnel working with these agents relate to accidental percutaneous or mucous membrane exposures, or ingestion of infectious materials. Extreme precaution with contaminated needles or sharp instruments must be emphasized. Even though organisms routinely manipulated at BL2 are not known to be transmissible by the aerosol route, procedures with aerosol or high splash potential that may increase the risk of such personnel exposure must be conducted in primary containment equipment, or devices such as a BSC or safety centrifuge cups. Other primary barriers should be used as appropriate, such as splash shields, face protection, gowns, and gloves.

Secondary barriers such as hand washing and waste decontamination facilities must be available to reduce potential environmental contamination.

7.7.3 Biosafety Level 3 And 4 (BL3 and BL4)

Safety equipment and facilities are appropriate for work that is done with agents that may cause serious or lethal infection and for which there may or may not be available vaccine or therapy. Autoinoculation, ingestion and exposure to infectious aerosols are the primary exposure concerns.

Biosafety Level 3 work requires controlled laboratory access, with all work conducted in biological safety cabinets or gas tight cabinets, and special ventilation systems. The Biosafety Level 4 facility itself is generally a separate building or completely isolated zone with complex, specialized ventilation and waste management systems to prevent release of viable agents to the environment.

BIOSAFETY LEVEL 3 AND 4 ACTIVITIES ARE NOT PERMITTED TO BE CONDUCTED AT B+labs AT THIS TIME

7.8 Clinical Specimens

Typically, the infectious nature of clinical material is unknown, and specimens may be submitted with a broad request for microbiological examination for multiple agents. It is the responsibility of the Laboratory Manager/Supervisor to establish standard procedures in the laboratory that realistically address the issue of the infective hazard of clinical specimens.

Except in extraordinary circumstances, the initial processing of clinical specimens and identification of isolates can be done safely at Biosafety Level 2, the recommended level for work with bloodborne pathogens such as Hepatitis B virus and HIV. The containment elements described in Biosafety Level 2 are consistent with the Occupational Exposure to Bloodborne Pathogens Standard from the Occupational Safety and Health Administration (OSHA) that requires the use of specific precautions with all clinical specimens of blood or other potentially infectious material (Universal Precautions).

Biosafety Level 2 recommendations and OSHA requirements focus on the prevention of percutaneous and mucous membrane exposures to clinical material. Primary barriers such as the biological safety cabinet (Class II) should be used when performing procedures that might cause splashing, spraying, or splattering of

droplets. The biological safety cabinet should also be used for the initial processing of clinical specimens when the nature of the test requested or other information is suggestive that an agent readily transmissible by infectious aerosols is likely to be present (e.g., M. tuberculosis), or when the use of a biological safety cabinet (Class II) is indicated to protect the integrity of the specimen.

Standard written procedures that address the potential hazards and the required precautions to be implemented will be established for all laboratory functions and procedures.

7.9 Importation and Shipment of Etiological Specimens

The importation of etiologic agents and vectors of human diseases is subject to the requirements of the Public Health Service Foreign Quarantine regulations. Companion regulations of the Public Health Service and the Department of Transportation specify packaging, labeling, and shipping requirements for etiologic agents and diagnostic specimens shipped in interstate commerce.

The U. S. Department of Agriculture regulates the importation and interstate shipment of animal pathogens and prohibits the importation, possession, or use of certain exotic animal disease agents that pose a serious disease threat to domestic livestock and poultry.

7.10 Universal Precautions

Work Practices that minimize exposure

Standard (UNIVERSAL) PRECAUTIONS

NO Eating, smoking, applying cosmetics, lip balm, handling contact lenses in the laboratory

NO Food in the Laboratory

NO Mouth Pipetting

Wash Hands - Whenever gloves are changed and when leaving the lab

Personal Protective Equipment – Take it off before leaving the lab

Sharps Use and Disposal – Discard hypodermic needles directly into sharps containers. Don't remove them from a syringe.

Minimize – splashing, spraying and generation of aerosols

Biological Safety Cabinet – Use for all operations (homogenizing, sonicating, blending) that can generate aerosols

7.11 General Work Practices Check List

BIOSAFETY LEVEL 1

- ❑ Wash hands after handling infectious agents and after taking off gloves.
- ❑ Decontaminate work surfaces daily and after spills.
- ❑ No eating, drinking or smoking in the laboratory.
- ❑ No mouth pipetting.
- ❑ Avoid using hypodermic needles.
- ❑ Use procedures that minimize aerosol formation.
- ❑ Wear safety glasses, a laboratory coat and gloves. Use other protective equipment as recommended.
- ❑ Decontaminate all biological waste. Use containers provided.
- ❑ Control insect and rodent infestation.

BIOSAFETY LEVEL 2

In addition to BL 1 requirements:

- ❑ Use biological safety cabinet to contain aerosol producing procedures. The use of centrifuges with sealed heads or safety cups is preferred.
- ❑ Use a face shield or goggles in addition to safety glasses if splashing is possible.
- ❑ Leave lab coat and protective equipment in the lab when you leave. Change gloves frequently.
- ❑ Ensure that bio-hazardous wastes are decontaminated. Use containers provided.
- ❑ Keep immunocompromised people out of the lab.
- ❑ All laboratory staff must be trained on laboratory safety rules and procedures. Schedule training sessions at least annually.
- ❑ Consider immunization for the agents being used such as Hepatitis.
- ❑ Use leak-proof containers when transporting infectious materials.

7.12 Physical Containment Check List

BIOSAFETY LEVEL 1

- ❑ Sink for washing hands.
- ❑ Floor, countertops, walls designed for easy cleaning.
- ❑ Screens on windows (if they open).
- ❑ Spaces between walls and equipment must be accessible for cleaning

BIOSAFETY LEVEL 2

In addition to BL 1 requirements:

- ❑ Universal Biohazard sign on door to laboratory
- ❑ Door sign listing the organisms in use and the name and telephone number (24 hours) of the Laboratory Manager/Supervisor. The sign should also indicate any special requirements for entering the laboratory.
- ❑ Use biological safety cabinet (class II) for operations that may generate an aerosol.
- ❑ Eye wash capable of 15 minutes of continuous flushing.
- ❑ "Exposure Control Plan" for the laboratory
- ❑ Method for decontaminating potentially infectious wastes. (Autoclave, chemical disinfectants or commercial disposal company)

7.13 Biohazard Spill Cleanup Procedures

Each laboratory containing bio-hazardous materials should have a spill decontamination kit. The kit should contain appropriate inactivating agent(s), absorbent material, biological waste bags, and personnel

protective equipment. It is the responsibility of the Laboratory Manager / Supervisor to ensure that these items are readily available and stocked at all times. The following procedures are provided as a guideline to bio-hazardous spill cleanup. The Laboratory Manager / Supervisor must also develop appropriate containment, inactivation and spill cleanup procedures for the specific biological materials to be used in the laboratory. In laboratories using Class 2 agents that are infectious by aerosol transmission, laboratory personnel may wish to be fitted with a HEPA filtered respirator. If a spill contains Class 2 or greater material, or if the spill is considered too large or too dangerous for laboratory personnel to safely clean up, secure the area--including the whole lab--and call the Lab and Safety Manager immediately for assistance. Check yourself and your clothing for potential contamination. Remove all contaminated clothing and place it in a bag for decontamination. Contaminated body areas must be washed immediately with soap and water, use an emergency shower.

7.13.1 Inside the Biosafety Cabinet (BSC)

- Wait at least five minutes to allow the BSC to contain aerosols.
- Wear lab coat, safety glasses and gloves during cleanup.
- Allow cabinet to run during cleanup.
- Apply 70% ethanol or effective disinfectant and allow a minimum of 20 minutes contact time.
- Wipe up spillage with disposable disinfectant-soaked paper towel.
- Wipe the walls, work surface and any equipment in the cabinet with a disinfectant-soaked paper towel.
- Discard contaminated disposable materials using appropriate bio-hazardous waste disposal procedures (e.g., autoclave).
- Place contaminated reusable items in biohazard bags, autoclavable pans with lids or wrap in newspaper before autoclaving and cleanup.
- Expose non-autoclavable materials to disinfectant (20-minute contact time) before removal from the BSC.
- Remove protective clothing used during cleanup and place in a biohazard bag for autoclaving.
- Run cabinet 10 minutes after cleanup before resuming work or turning cabinet off.

7.13.2 Spills in the Lab, but Outside the BSC

- Clear area of all personnel. Wait at least 15 minutes for aerosol to settle before entering spill area.
- During the 15 minute wait, call the Lab and Safety Manager if the material requires BL2 or greater containment.
- Remove any contaminated clothing and place it in a biohazard bag to be autoclaved.
- Put on a disposable gown, safety glasses and gloves. You may want to wear two pairs of gloves. (*If the spill requires the use of a respirator **do not** attempt to initiate the clean-up and call the Lab and Safety Manager for assistance in the spill clean-up.)*
- Initiate cleanup with disinfectant as follows:

1. Place dry paper towel on spill (to absorb liquids); then layer a second set of disinfectant soaked paper towels over the spill.
2. Encircle the spill with additional disinfectant being careful to minimize aerosolization while assuring adequate contact.
3. Decontaminate all items within spill the area.
4. Allow a minimum of 20 minutes contact time to ensure germicidal action of disinfectant. Note that a long contact time may be necessary for some agents.
5. Wipe equipment with appropriate disinfectant.
6. Discard contaminated disposable materials using appropriate biohazardous waste disposal procedures (e.g., autoclave).
7. Disinfect reusable items.

7.13.3 Inside a Centrifuge

- Clear area of all personnel.
- Wait 30 minutes for aerosol to settle before attempting to clean up spill.
- Wear a lab coat, safety glasses and gloves during cleanup.
- Remove rotors and buckets to nearest biological safety cabinet for cleanup.
- Thoroughly disinfect inside of centrifuge.
- Discard contaminated disposable materials using appropriate bio-hazardous waste

disposal procedures (e.g. autoclave).

7.13.4 Outside the Lab, In Transit

Transport labeled bio-hazardous material in an unbreakable, well-sealed primary container placed inside a second unbreakable, lidded container (cooler, plastic pan or pail) labeled with the biohazard symbol. Should a spill occur in a public area:

- Do not attempt to clean it up without appropriate personal protective equipment.
- Secure the area, keeping all people well clear of the spill.
- Call the Scientific Facility Manager to assist in cleanup.
- Standby during spill response and cleanup activity and provide assistance only as requested or as necessary.

8.0 Bloodborne Pathogen Exposure Control Plan

This plan establishes the Bloodborne Pathogen Exposure Control Plan for B+labs tenant companies as required by the OSHA Bloodborne Pathogen Standard (29 CFR 1910.1030). Each tenant company is responsible to implement this plan, and to review the OSHA standard for particular requirements which are applicable to their situation. This Exposure Control Plan must be reviewed at least annually by B+labs and by tenant companies' Laboratory Managers/Supervisors, and updated when necessary. See Appendix E for a sample of an exposure control plan.

8.1 Exposure Determination

OSHA requires each employer to perform an exposure determination to identify which employees (or other personnel) may be exposed to blood or other potentially infectious materials during the course of their work. The exposure determination is made without regard to the use of personal protective equipment (i.e. personnel are considered to be exposed even if they wear personal protective equipment). This exposure determination is required to list all job classifications in which employees (or other personnel) may be expected to incur such occupational exposure, regardless of frequency. Job classifications considered to have exposure to blood or other potentially infectious material include (*list all jobs that will have exposure to bloodborne pathogens*):

- Microbiology Laboratory Personnel

  Lab and Safety Manager

In addition, OSHA requires a listing of job classifications in which some employees (or other personnel) may have occupational exposure. Since not all the employees (or other personnel) in these categories would be expected to incur exposure to blood or other potentially infectious materials, tasks or procedures that would cause these employees (or other personnel) to have occupational exposure are also required to be listed in order to clearly understand which employees (or other personnel) in these categories are considered to have occupational exposure.

The job classifications and associated tasks for these categories are as follows (*list all jobs with potential exposure*):

JOB CLASSIFICATION	TASK/PROCEDURES
Lab Personnel	Removal of bio-hazardous waste and cleanup of biohazard spills.
B_+labs Facilities Personnel	Repairs/Maintenance in lab spaces or to lab equipment.
Outside Contractors	Repairs/Maintenance in lab spaces or to lab equipment.

8.2 Compliance Methods

Standard (Universal) precautions will be observed at B_+labs in order to prevent contact with blood or other potentially infectious materials. All blood or other potentially infectious material will be considered infectious regardless of the perceived status of the source individual.

Engineering and work practice controls will be utilized to eliminate or minimize exposure to laboratory personnel at this facility. Where occupational exposure remains after institution of these controls, personal protective equipment shall also be utilized. At BLABS the following engineering controls will be utilized:

- Sharps containers. Where sharps are stored, handled or reasonably anticipated to be encountered, sharps containers must be used. Sharps containers must be closable, puncture resistant, leak-proof on the sides and bottom and properly marked
- Mechanical hand-pipetting devices
- Biosafety cabinets for procedures that may generate aerosols

The above controls will be examined and maintained on a regular schedule. They will be reviewed weekly during regular lab safety inspections.

Hand washing facilities are also available at all times to the laboratory personnel who incur exposure to blood or other potentially infectious materials. (OSHA requires that these facilities be readily accessible after incurring exposure). At BLABS hand washing facilities are located in the laboratory areas.

After removal of personal protective gloves, laboratory personnel shall wash hands and any other potentially contaminated skin area **IMMEDIATELY**, or as soon as feasibly possible with soap and water.

If laboratory personnel incur exposure to their skin or mucous membranes, then those areas shall be washed or flushed with water **IMMEDIATELY**, or as soon as feasibly possible following contact.

8.3 Needles

Contaminated needles and other contaminated sharps will not be bent, recapped, removed, sheared or purposely broken unless using a device specifically designed for this purpose.

8.4 Containers for Non-Reusable Sharps

Contaminated sharps that are not reusable are to be placed immediately, or as soon as possible, after use into an appropriate sharps container.

Sharps containers are located in the laboratories and are puncture resistant, labeled with a biohazard label, and are leak proof.

8.5 Work Area Restrictions

No eating, drinking, applying cosmetics or lip balm, smoking, or handling of contact lenses in laboratory areas where blood or other potentially infectious material is located. Food and beverages are not to be kept in refrigerators, freezers, shelves, cabinets, or on counter tops or bench tops where blood or other potentially infectious materials are present.

Mouth pipetting/suctioning of blood or other potentially infectious materials is expressly prohibited.

All procedures will be conducted in a manner that will minimize splashing, spraying, splattering, and generation of droplets of blood or other potentially infectious materials.

8.6 Specimens

Specimens of blood or other potentially infectious materials will be placed in a container that prevents leakage during the collection, handling, processing, storage, and transport of the specimens.

The container(s) used for this purpose will be labeled or color-coded in accordance with the requirements of the OSHA standard.

Any specimens that could puncture a primary container will be placed within a secondary container that is puncture resistant. If outside contamination of any primary container occurs, the primary container shall be placed within a secondary container that prevents leakage during the handling, processing, storage, transport, or shipping of the specimen.

8.7 Contaminated Equipment

Equipment, which has become contaminated with blood or other potentially infectious materials, shall be examined prior to servicing or shipping and shall be decontaminated as necessary.

8.8 Personal Protective Equipment

All personal protective equipment used at B+labs will be provided by tenant companies without cost to their employees. Personal protective equipment will be chosen based on the anticipated exposure to blood or other potentially infectious materials. The protective equipment will be considered appropriate only if it does not permit blood or other potentially infectious materials to pass through or reach the laboratory personnel's clothing, skin, eyes, mouth, or other mucous membranes under normal conditions of use and for the duration of time which the protective equipment will be used.

B+labs will provide a basic lab coat to all laboratory personnel.

The following PPE is to be provided by each tenant company to its laboratory personnel:

- Safety glasses with side shields
- Goggles
- Face shields
- Gloves (surgical, nitrile, etc.)
- Additional disposable laboratory coats

All garments, which are penetrated by blood, shall be removed **IMMEDIATELY** or as soon as feasibly possible. All personal protective equipment must be removed prior to leaving the laboratory work area.

Gloves shall be worn where it is reasonably anticipated that laboratory personnel will have hand contact with blood, other potentially infectious materials, non-intact skin, or mucous membranes. Gloves will be available from the Laboratory Manager / Supervisor.

Disposable gloves are not to be washed or decontaminated for re-use and are to be replaced as soon as practical when they become contaminated or **IMMEDIATELY** if they are torn, punctured, or when their ability to function as a barrier is compromised. Utility gloves may be decontaminated for re-use provided that the integrity of the glove is not compromised. Utility gloves will be discarded if they are cracked, peelings, torn, punctured, or exhibit other signs of deterioration or when their ability to function as a barrier is compromised.

Surgical masks in combination with eye protection devices, such as goggles or glasses with solid state shield, or chin length face shields, are required to be worn whenever splashes, spray, splatter, or droplets of blood or other potentially infectious materials may be generated and eye, nose, or mouth contamination can reasonably be anticipated. Appropriate protective clothing such as lab coats, gowns, aprons, clinic jackets, or similar outer garments must also be used.

Each laboratory space shall be cleaned and decontaminated by laboratory personnel at the end of each day. Decontamination will be accomplished using such a bleach solution or an EPA registered disinfectant.

All contaminated work surfaces shall be decontaminated after completion of procedures and immediately, or as soon as feasibly possible, after any spillage of blood or other potentially infectious materials, as well as at the end of the work shift if the surface may have become contaminated since the last cleaning.

All bins, pails, cans and similar receptacles which may contain biohazardous material shall be inspected and decontaminated at least weekly.

Any broken glassware that may be contaminated must not be picked up directly by hand. Use a dustpan and broom, tongs or other method.

8.9 Regulated Waste Disposal

All contaminated sharps shall be discarded as soon as feasibly possible in sharps containers which are located in the laboratory areas.

Regulated biohazard waste other than sharps shall be placed in appropriate biohazard bags in labeled containers. Such containers are located in the laboratory areas and waste rooms.

8.10 Hepatitis B Vaccine

Each tenant company shall offer its laboratory personnel the Hepatitis B vaccine, at no cost to their employee. The vaccine will be offered within 10 working days of their initial assignment to work involving the potential for occupational exposure to blood or other potentially infectious materials unless the employee has previously had the vaccine. Employees may wish to submit to antibody testing which shows the employee to have sufficient immunity. Employees who decline the Hepatitis B vaccine will sign an appropriate waiver. Employees who initially decline the vaccine but who later wish to have it may then have the vaccine provided at no cost. See Appendix F

8.11 Accidental Exposure and Follow-Up

When laboratory personnel incur an exposure incident (needle stick, laceration, etc.); it should be reported immediately to their Laboratory Manager/Supervisor, their employer, and the Lab and Safety Manager. All laboratory personnel who incur an exposure incident will be offered, by their employer, post-exposure evaluation and follow-up in accordance with the OSHA standard. This follow-up must include the following:

- Documentation of the route of exposure and the circumstances related to the incident.
- If possible, the status of the source for HIV/HBV infectivity.
- The exposed laboratory personnel will be offered the option of having their blood collected for testing of HIV/HBV serological status. The blood sample will be preserved for up to 90 days to allow the exposed laboratory personnel to decide if the blood should be tested for HIV serological status. However, if the exposed laboratory personnel decide prior to that time that testing will or will not be conducted then the appropriate action can be taken, and the blood sample discarded.
- The exposed laboratory personnel will be offered post exposure prophylaxis in accordance with the current recommendations of the U.S. Public Health Service.
- The exposed laboratory personnel will be given appropriate counseling concerning precautions to take during the period after the exposure incident. The exposed laboratory personnel will also be given information on what potential illnesses to be alert for and to report any related experiences to appropriate persons.

8.12 Employer Interaction with Health Care Professionals

A written opinion may be provided to an employer from that employer's occupational health care provider in the following instances: 1) when its laboratory personnel receive Hepatitis B vaccination. 2) Whenever its laboratory personnel is sent to a health care professional following an exposure incident.

Health care professionals shall be instructed by the employer to limit their opinions to 1) whether the Hepatitis B vaccine is indicated and if its laboratory personnel have received the vaccine, or whether an evaluation is recommended following an incident. 2) The fact that the laboratory personnel have been informed of the results of the evaluation, and 3) The fact that the laboratory personnel have been told about any medical conditions resulting from exposure to blood or other potentially infectious materials. (Note that the written opinion to the laboratory personnel's employer is not to reference any personal medical information).

8.13 Training

Training for all laboratory personnel will be conducted prior to initial assignment to tasks where occupational exposure to bloodborne pathogens may occur. Trainings will be updated on an annual basis. Training for laboratory personnel will include but limited to:

- The OSHA standard for Bloodborne Pathogens
- Epidemiology and symptomatology of bloodborne diseases
- Modes of transmission of bloodborne pathogens
- The Exposure Control Plan (i.e. points of the plan, lines of responsibility, how the plan will be implemented, etc.)
- Procedures which might cause exposure to blood or other potentially infectious materials at.
- Control methods (including universal precautions) which will be used to control exposure to blood or other potentially infectious materials
- Personal protective equipment available and who should be contacted concerning acquisition
- Post Exposure evaluation and follow-up

- Signs and Labels used
- Hepatitis B vaccine program
- All laboratory personnel considered “occupationally exposed” will receive initial and annual refresher training

9.0 Laboratory Safety Information and Training

9.1 Information

The EHS Lead will provide the following information to laboratory personnel prior to working with any chemical or biological substance:

- The availability and location of the Safety Manual.
- SDS’s for all hazardous chemicals the laboratory personnel will use.
- Standard Operating Procedures (SOPs) for all of the operations the laboratory personnel will conduct.
- A description and use of the hazard labeling system.
- Additional information on the hazards, safe handling, storage and disposal of hazardous chemicals can be obtained from the Scientific Facilities Manager, Prudent Practices in the Laboratory, OSHA website, NIOSH website, and the chemical manufacturers.

9.2 Training

All laboratory personnel working in a laboratory shall be trained to the contents of the EHS Manual and all applicable SOP’s that are pertinent to a procedure, experiment, or task. Training shall include but is not limited to:

- Provisions of the EHS Manual.
- Hazards in the laboratory.
- OSHA regulated substances or recommended exposure limits.
- Signs and symptoms associated with exposures to hazardous chemicals.
- Safe handling, storage, and disposal of hazardous chemicals.
- How to read an SDS.
- The selection and use of PPE.

9.3 Frequency of Training

Training shall be provided for laboratory personnel by the EHS Lead prior to starting work in the laboratory, before each new possible hazard exposure, before use on new or altered equipment, and on changes to SOP's or the EHS Manual. Refresher training is required annually.

9.4 Recordkeeping

The EHS Lead is responsible for establishing and maintaining records for their laboratory personnel's training, for environmental monitoring, and for all other compliance records.

10.0 Medical Examinations and Consultations

Each tenant company shall provide its laboratory personnel who work with hazardous chemicals the opportunity for medical attention and follow-up by a competent physician if they show signs and symptoms of exposure.

10.1 Medical Surveillance

Laboratory personnel shall be provided an opportunity by their employer to receive an appropriate medical examination performed by a licensed physician at a reasonable time and free of cost under the following circumstances.

- At any time, laboratory personnel believe they have been significantly exposed to hazardous materials.
- Whenever laboratory personnel develop signs or symptoms associated with a hazardous chemical to which they may have been exposed in the laboratory.
- If an event takes place in the work area such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure.
- Where exposure monitoring reveals an exposure level routinely above the action level for an OSHA regulated substance.

10.2 Information Provided to the Physician

The EHS Lead shall provide the following information to the physician:

- The identity of the hazardous chemical(s) to which the laboratory personnel may have been exposed and its SDS;

- A description of the conditions under which the exposure occurred including quantitative exposure data, if available; and
- A description of the signs and symptoms of exposure laboratory personnel are experiencing, if any.

10.3 Physician's Written Opinion

The laboratory personnel's employer shall obtain a written opinion from the examining physician which shall include the following:

- Recommendation for further medical follow-up.
- The results of the medical examination and any associated tests.
- Any medical condition which may be revealed in the course of the examination which may place the laboratory personnel at increased risk as a result of exposure to a hazardous workplace.
- A statement that the laboratory personnel has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.
- The written opinion shall not reveal specific findings of diagnoses unrelated to occupational exposure.

B+labs EHS Manual Acknowledgment Form

By signing this form, I acknowledge that I have received a copy of B+labs EHS Manual. I understand that it contains important information about the Facility safety policies, that I am expected to read the Manual and familiarize myself with its contents, and that the policies in the Manual apply to me. I understand that nothing in the Manual constitutes a contract or promise of continued employment and that B+labs may change the policies in the Manual at any time. I have read and understood the materials and have had the opportunity to ask relevant questions pertaining to the material.

Employee's Signature/Date _____

Employee's Name (Print) _____

APPENDIX B – Hazard Assessment and Communication Standard

HIV and HBV Research Laboratories and Production Facilities

These facilities will follow all policies and procedures outlined in the EHS Manual. The Manual has been developed and approved by B+labs tenant. A copy of this manual is located in each of the HIV, HBV and other biological research laboratories and online at _____. If you would like a copy of this manual please contact the Lab and Safety Manager.

Hepatitis B Vaccination

Names of vaccinated individuals in your area:

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

Names of individuals who declined vaccination:

Post-Exposure Evaluation and Follow-up

When an incident occurs, it should be immediately reported to the employee's supervisor and/or PI. An incident report should be initiated and delivered within 24hrs to the Lab and Safety Manager. Refer to the Safety

Manual for reporting procedures and form.

Supervisors must offer post-exposure evaluation and follow-up. Follow-up will include the following:

♦ Documentation of route of exposure and circumstances related to the incident

♦ Identification and status of the source individual. If consent is given the source individual will be tested.

♦ HIV test results of source individual will be made available only if negative

♦ Employees will be offered blood tests for HIV, HBV, HCV and HIV serological agents.

♦ Employees will be offered post-exposure prophylaxis

♦ Counseling will be given to employee(s) on precautions after the exposure, potential illnesses and reporting procedures

Communication of Hazards to Employees

Training

Training content will cover the following topics

♦ An explanation of the OSHA Bloodborne Pathogen Standard 29 CFR 1910.1030

♦ The Exposure Control Plan for Clinical Practice Groups

♦ Standard Precautions

♦ Work Practice Methods

♦ Engineering Controls

♦ Management of regulated waste such as sharps and infectious waste

♦ Epidemiology and symptomology of Hepatitis B, C and HIV

♦ Modes of transmission of HBV, HCV and HIV

♦ Review of procedures which may result in exposure to potentially infectious materials

♦ Use of Personal Protective Equipment

♦ *An explanation of labels and signs used*

♦ The BLABS Hepatitis B Vaccine Program

♦ Post-exposure evaluation and follow-up procedures

Frequency of Training

New Hire – All new employees will be trained on the contents of the bloodborne pathogen standard 29cfr1910.1030 and information specific to their individual work areas. Training is coordinated through the Lab and Safety Manager.

Annual – Refresher training will be provided to all employees. This training session will review items covered in the initial new hire training but will also include changes in regulations and any new policies adapted by the BLABS.

Labels

♦ Labels must be present on all doors leading to areas containing potentially contaminated materials (i.e. laboratory doors).

♦ Labels must be placed on all vessels or containers containing bio-waste or other potentially contaminated materials, including transport containers, refrigerators, freezers, centrifuge, etc.

♦ Labels must be placed on all containers used for holding red Bio-waste bags.

♦ Labels must be placed on all sharps containers.

Example Laboratory Hazard Analysis

Name of process:

Chemical name / CAS #:

Identify (if any) environmental conditions (temperature, pressure, anaerobic, etc.):

Describe general procedure:

List physical/health hazards & assoc. engineering controls:

Administrative practices (including storage and waste procedures, OMS requirements):

Personal protective equipment (PPE):

List additional training required for this laboratory hazard analysis:

Additional comments:
