Biosafety is:
The application of knowledge, techniques and equipment to prevent personal, laboratory and environmental exposure to potentially infectious agents or other biohazards...

Who makes the rules and recommendations?

- CDC/NIH: Biosafety in Microbiological and Biomedical Laboratories (BMBL)
- NIH: Guidelines for recombinant DNA molecules
- MMWRA
- MIOSHA

BMBL = MSU’s Biosafety Manual

Examples of Biohazards

- Infectious agents
  - Human, animal and plant pathogens
- Toxins of biological origin
- Recombinant DNA
- Materials potentially containing infectious agents or biohazards
  - Blood, tissues, body fluids etc.
  - Waste, carcasses etc.

Biosafety

- Defines the containment conditions under which infectious agents or biohazards can be safely manipulated
- Containment conditions are also known as biosafety levels (BSLs)

Biosafety Level (BSL)

- 4 levels
  - BSL-1 least restrictive, BSL-4 most restrictive
- As the biosafety level increases, so does:
  - The procedural and facility requirements for working with the organism
  - The risk of the organism to humans, animals, plants and/or the environment
Human Biosafety Levels (BSLs)

- **BSL-4**: Maximum containment of high risk agents (Ebola, Marburg)
- **BSL-3**: Airborne hazard containment (M. tuberculosis)
- **BSL-2**: Containment of moderate risk non-airborne agents (HBV, Salmonella spp.)
- **BSL-1**: Low risk/no risk agents (E. coli K-12, ICHV, Saccharomyces cerevisiae)

Biosafety Control Measures

- Focus on reducing infection and contamination risks through the use of:
  - Administrative controls
  - Engineering controls & facility design
  - Work practices and procedures
- Combinations of these control measures are included in the 4 Biosafety levels

Biological Safety in Laboratory Settings

- [http://vimeo.com/4612859](http://vimeo.com/4612859)

Biosafety Level 1 (BSL-1)

- **Suitable for work with agents that are:**
  - Well-characterized
  - Not known to cause disease in healthy human adults
  - Minimal potential hazard to lab personnel and the environment
  - Example: Non-pathogenic *Escherichia coli*

BSL-1: Facilities

- Sink for hand washing
- Bench tops are impervious
- Sturdy, Non-fabric lab chairs
- Windows with fly screens
- Easily cleaned
BSL-1: Microbiological Practices

- Decontaminate cultures, stocks and regulated wastes after use
- Decontaminate work surfaces daily, after spills, or after tasks involving viable materials

Standard Laboratory Protocols

- Eating, drinking, smoking, applying cosmetics, and mouth pipetting are potential risk of contamination by accidental ingestion

BSL-2

- Engineering Controls
- PPE
- Sharps Management

Biosafety Level 2 (BSL-2)

Suitable for work involving agents that:
- Are associated with human disease that is rarely serious
- Preventive or therapeutic interventions are often available
- Are moderate potential hazard to personnel and the environment

BSL-2 Infectious Materials

At BSL-2, work is limited to infectious materials which are likely to be transmitted through:
- Ingestion
- Breaks in the skin
- Contact with the mucous membranes

Controlling Transmission at BSL-2

- Emphasis on sharps precautions
  - Ex. Do not re-cap sharps, use safer sharps devices, etc.
- Reducing contact with infectious materials
Administrative Controls at BSL-2

- Training
- Health-status entry requirements
- Biosafety Manual including project-specific procedures
- Reporting requirements for large spills and exposures

Engineering Controls

Engineering controls are equipment designed to isolate or eliminate the hazard. At BL-2:

- Eyewash/handwash facilities
- Sharps containers
- Autoclaves

More Engineering Controls...

- Centrifuges with safety features

Biological Safety Cabinet (BSC)

- Designed to provide personnel, environmental and product protection
- Uses High Efficiency Particulate Air (HEPA) filters

HEPA Filters

- Remove particles 0.3µm in diameter with an efficiency of 99.97%
- Borosilicate fibers, pleated to increase overall surface area
- Very sensitive material
  - Do not handle
  - Professional installation required
- NSF49 certification required annually and after BSC is moved

Biosafety Cabinets at BSL-2

Use a BSC when:

- Performing procedures that create infectious aerosols
- High concentrations of infectious materials are used
- Large volumes of infectious materials are used
Are aerosols created from pipet use?

Clean Bench (Laminar Flow Hood)

Clean benches protect the product, NOT the worker!

A clean bench is NOT a BSC!

Biological Safety Cabinet

BSC protects the product AND the worker!

Using Your BSC: The Do’s & Do Not’s...

- Purge BSC 3-5 minutes before use
- Wear gloves and lab coat
- Minimize movements that break the “air curtain”
- Use care with UV lights

Using Your BSC...

Using Your BSC...

- Use disinfectant-filled vacuum trap
- Item “C” In-line filter at vacuum supply
- Stabilize and contain flasks to prevent spillage

Work from “clean to dirty”
Using Your BSC: The Do’s & Do Not’s…

DO NOT:

• Block inlet grilles
• Use outside upright pipette collection containers

PPE - Selection

When used correctly, PPE will create a barrier between the hazard and the route of transmission.

• Is it designed for the hazards encountered?
• Is it designed so that it won’t hinder your ability to work?
• Disposable or reusable?
• Is it available in a range of sizes?

Disposable Glove Types

• Latex
  – Benefits: low-cost, form-fitting
  – Drawbacks: quality, allergens
• Nitrile
  – Benefits: no allergens, consistent quality
  – Drawbacks: moderate cost
• Vinyl
  – Benefits: no allergens
  – Drawbacks: loose-fit, limited tactility

Glove Use

• Prior to use, inspect for defects
• Change contaminated gloves as soon as feasible
• Limit contact with outer surfaces of gloves when removing
• Do not reuse gloves
• Wash hands after glove removal

Glove Use in common areas-Rules to remember

• Whenever possible, gloves must not be worn outside the laboratory, even if they are clean!
• When transporting samples to another part of the building, use a secondary container. If gloves must be worn, use the one glove method shown in the bottom picture.
• Do not reuse or wash disposable gloves or use them to touch clean surfaces (e.g. telephone, keyboard, or doorknobs).
• Note: If you need to carry materials to another floor, wear only one glove and use the ungloved hand to touch common use surfaces such as elevator buttons and door knobs.

The Universal Hygiene Tool: Handwashing

Handwashing is the best way to control the spread of infections & contamination in the workplace!
Eye Protection at BSL-2

Use splash goggles whenever there is a risk of splashing or spattering infectious fluids!

Basics of Disinfection

**Purpose:**
Reduction of microorganism below the level necessary to cause disease or cross-contamination

**How can this be achieved?**
Knowing the limitations of the product.

Selecting the “Right” Disinfectant

- Can the product effectively destroy the agent of concern?
- Dilution ratio?
- Contact time?
- Shelf-life? (both concentrate & solution)

Product Hazard Considerations

- Is the product compatible with surfaces to be treated? (corrosive?)
- What are the chemical exposure hazards to the user? (Refer to MSDS)
- Considered a pesticide by the EPA so must follow label instructions

Solid, Non-Sharps Biohazardous Waste

Waste items generated through lab process that are contaminated with potentially infectious material or r-DNA...

Storage:
- Biohazard bag in secondary container
- Lid required to prevent liquid release or other contamination issue (ie. insect entry)
Solid, Non-Sharps Biohazardous Waste

- Incorrect Solid Waste Storage:

Managing Liquid Biohazardous Waste

- Biohazardous waste must be stored in a leak-proof container labeled as a biohazard. Appropriate PPE should be worn when handling and disposing.

Managing Liquid Biohazardous Waste

- There are two different methods of decontamination that can be used:
  - Chemically disinfect the liquid waste using an appropriate disinfectant and following the manufacturer's specifications for use. The waste can then be disposed of down the sanitary sewer by way of the lab sink.
  - Autoclave the contaminated liquid waste and then dispose down the sanitary sewer by way of the lab sink.
- Safety Notice: Do not chemically disinfect AND autoclave the liquid waste. Autoclaving chemicals is hazardous and should not be done.

Liquid Biohazardous Waste

**Examples:**
- Cell line waste
- Bulk quantities of blood

**Treatment:**
- Chemical disinfection OR Autoclave

**Disposal:**
- Flush to sewer
- Use proper PPE!

Effective Waste Autoclaving

- Use autoclavable bag with heat indicator
- Use EHS - approved and certified autoclaves
- Follow EHSS posted parameters

Effective Waste Autoclaving

- Leave bag open during autoclaving
- Place bag in secondary container (open tray)
Treated Waste Bag Disposal

- Allow waste bag to cool
- Securely tie bag shut
- Place bag in a non-transparent black bag for regular disposal

Remember: NO ORANGE BAGS IN DUMPSTER!

Incorrect Solid Waste Examples

- Always use a secondary container to store and autoclave solid biohazardous waste.
- No orange biohazardous waste bags in the dumpster

Sharps Management

Sharps include all:
- Needles
- Syringes
- Scalpels

Sharps also include any item that is sharp enough to puncture the skin and is contaminated with potentially infectious material.

Handling Sharps Safely

- Organize tasks to limit sharps exposure
- Don’t bend or break sharps
- Don’t recap if feasible
- Do not handle sharps with 2 hands

Handling Sharps Safely

- Use disposables where feasible (i.e. scalpels, biopsy punches)
- Use safer sharps devices where feasible
- Dispose of sharps in proper containers immediately after use

Sharps Disposal

Use only containers designed for sharps disposal...

...For YOUR safety as well as the safety of others who handle waste!
Sharps Containers

• Don’t overfill the sharps container
• A sharps container must be permanently closed and disposed of through ORCBS when:
  – It is ¾ full, or
  – Within 90 days of “first use”

NOT a Sharps Container

• Coffee cans
• Reagent bottles
• “Sharpkeeper” boxes
• Any container NOT designed to be a sharps container

NOT a Sharps Waste

• Plastic pipettes
• Plastic pipette tips
• Mercury thermometers
• Tubes of blood

More Ways to Reduce Sharps Hazards

Substitute plastic for glass

Don’t touch broken glass

Biohazard Spill-Kit

• Disinfectant (i.e. bleach)
• Absorbent material (paper towels, absorbent powder)
• Waste containers (biohazard bags, sharps container)
• Gloves and goggles
• Mechanical tools (forceps, broom and dust pan)

Biohazard Spills - NO Sharps

1. Cover with paper towels
2. Spray spill with bleach solution from outside to in
3. “Wipe up” spill
4. Disinfect spill area with bleach solution
Biohazard Spills – WITH Sharps

1. Remove sharps
2. Cover spill with absorbent powder & pretreat with bleach solution
3. “Sweep up” spill
4. Disinfect surface with bleach

Questions

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