# LABORATORY BIOSAFETY AND BIOSECURITY

**LAB 1**
**Medical Virology**
**4th grade**

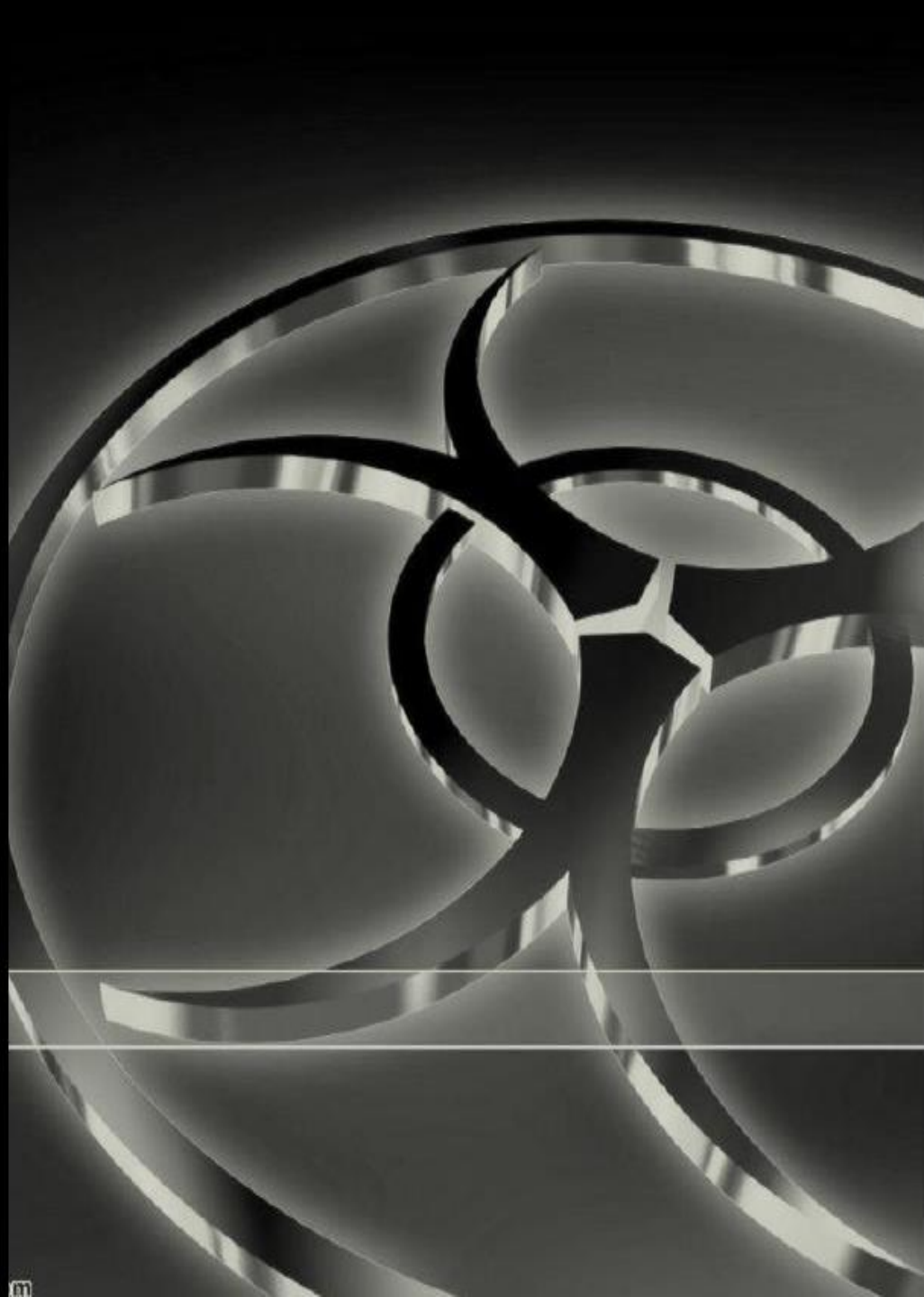
# BIOSAFETY: PREVENTING LAB-ACQUIRED INFECTIONS

- Bacteria
- Viruses
- Fungi
- Human blood, unfixed tissue
- Human cell lines
- Recombinant DNA

# BIOSAFETY

## Definition (WHO)

*"Laboratory biosafety – the containment principles, technologies and practices that are implemented to prevent the unintentional exposure to pathogens and toxins, or their accidental release."*



# BIOSECURITY

## Definition (WHO)

*"Laboratory biosecurity – the containment principles, technologies and practices that are implemented to prevent the intentional exposure to pathogens and toxins, or their intentional release."*

**Biosafety is to keep bad bugs from people**

**Biosecurity is to keep bad people from bugs**

# Biosafety & Biosecurity Synergy

- Raising awareness of risk
- Implementation of graded levels of protection based on risk management
- Registration of biological agents
- Waste management
- Monitoring and Audit
- Training
- etc

# STANDARD MICROBIOLOGICAL PRACTICES

NOT permitted in laboratories:

- Eating
- Drinking
- Smoking
- Handling contact lenses
- Pipetting by mouth
- Storing food and drink

# LABORATORIES DIVIDED ON BASIS OF NATURE OF MICROBES

- Labs divided into 4 biosafety levels; protective practices increase with each
- **Biosafety Level 1 labs** - work with least dangerous agents, require fewest precautions
- **Biosafety Level 4 labs -** have strictest methods because dealing with agents that are most dangerous to human health

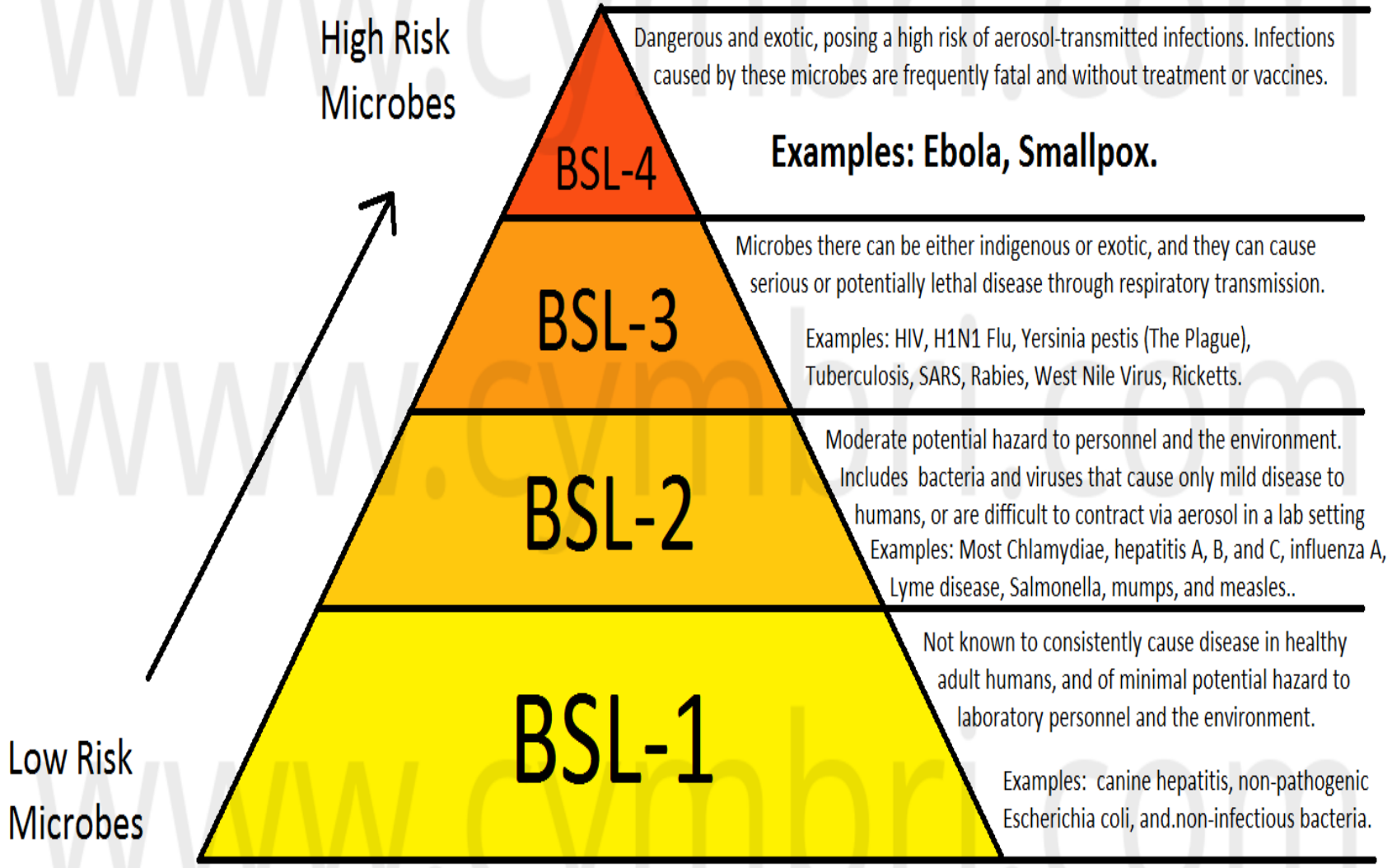
# BARRIERS - PRIMARY BARRIERS

- Primary barriers: physical barriers or personal protective equipment between lab worker and pathogen
- Gloves, masks, special breathing apparatus

# BARRIERS SECONDARY BARRIERS

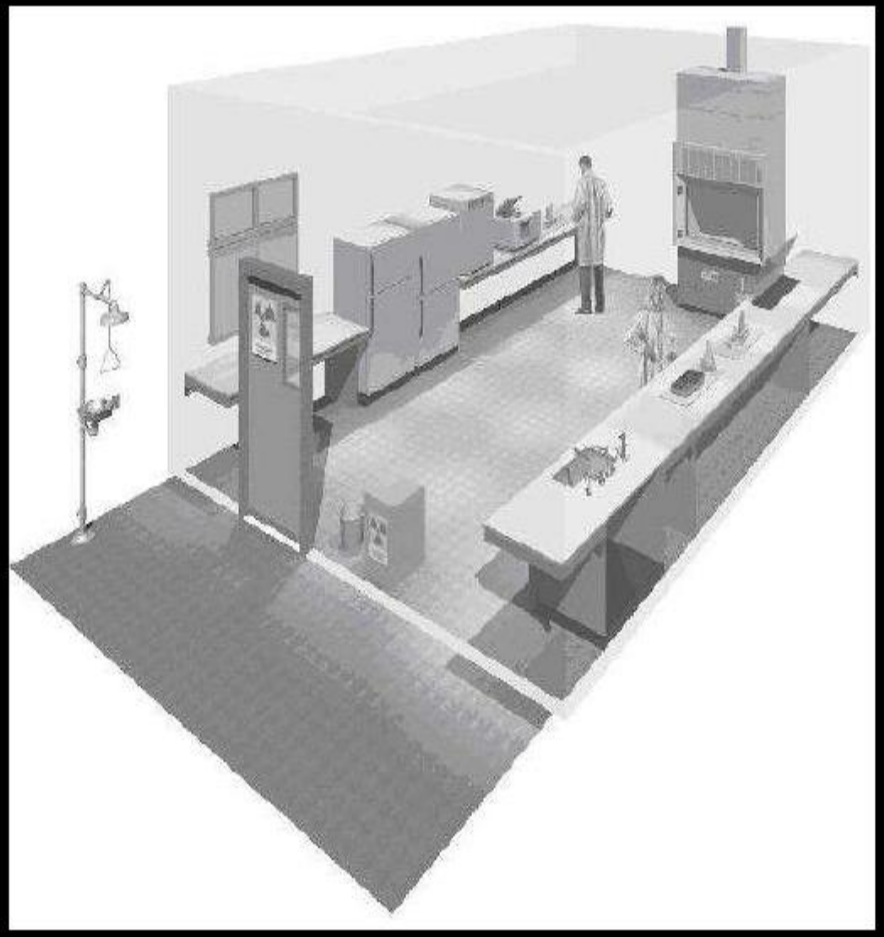
- Secondary barriers: structural aspects of the laboratory that make working environment safer against infection
- Sinks for handwashing, special containment areas, special air ventilation patterns

# CDC Biosafety Levels



# Levels of Containment

- **BL1** - microorganisms that don't consistently cause disease in healthy adults
- *E. coli* K12, *S. cerevisiae*, polyomavirus
  - Basic laboratory
  - Standard Microbiological Practices



# BIOSAFETY LEVEL 1

- labs have doors
- labs have sinks
- surfaces are easy to clean
- tables are water-resistant
- windows are screened

# BIOSAFETY LEVEL 1 (BSL-1)

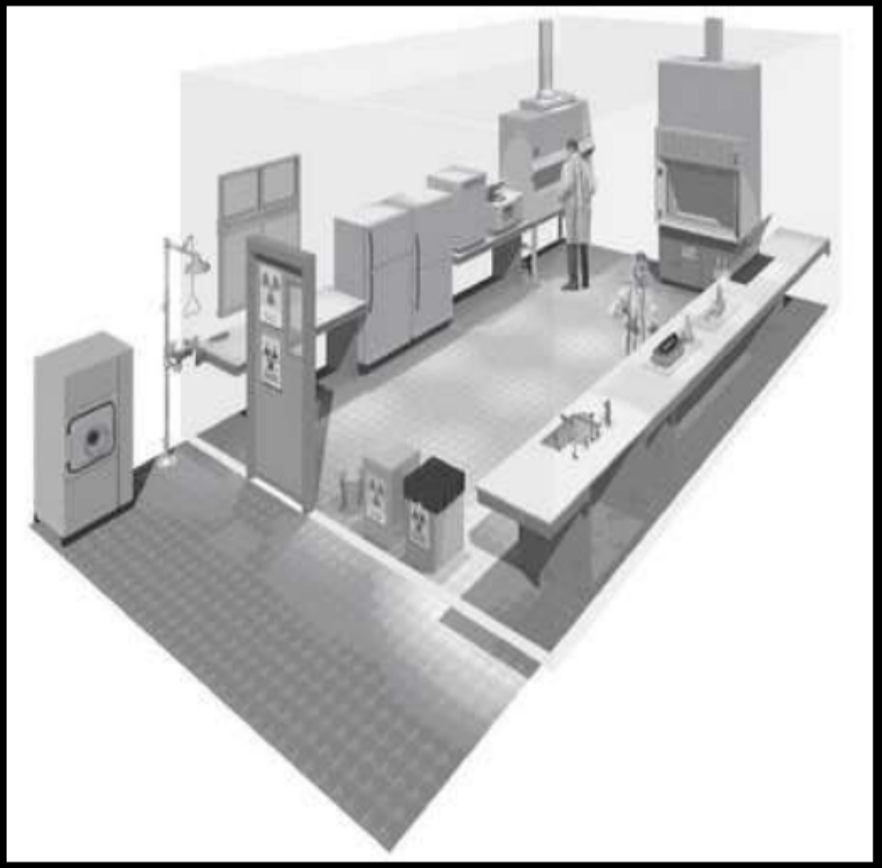
- Standard practices required:
  - frequent handwashing
  - door that can be kept closed when working;
  - limits on access to the lab space when working;
  - no smoking, eating, drinking, storage of food in laboratory;
  - care to minimize splashes and actions that may create aerosols (tiny droplets);
  - decontamination of work surfaces after every use after any spills;

# BIOSAFETY LEVEL 1 (BSL-1)

- Standard practices (continued):
  - decontamination of laboratory wastes;
  - use of mechanical pipettes only (no mouth pipetting);
  - "sharps" precautions, including special containers for disposing of needles and other sharp objects;
  - maintenance of insect/rodent control program;
  - use of personal protective equipment (lab coats, latex gloves, eye protection or face shields)
- **Open bench top sink for hand washing**

# Biosafety Level 2 (BSL-2)

- Agents associated with human disease
- Generally required for any human-derived blood, bodily fluids, tissues in which infectious agent may be unknown
  - Agents include measles virus, *Salmonella* species, pathogenic *Toxoplasma*, *Clostridium botulinum*, hepatitis B virus, herpesvirus



# BIOSAFETY LEVEL 2

All items listed in BSL1 – and:

- » eyewash station
- » restricted access when work is in progress
- » doors that lock
- » BSC as needed
- » air flows into the lab without recirculation to non-lab areas (recommended for new construction)

# BIOSAFETY LEVEL 2 (BSL-2)

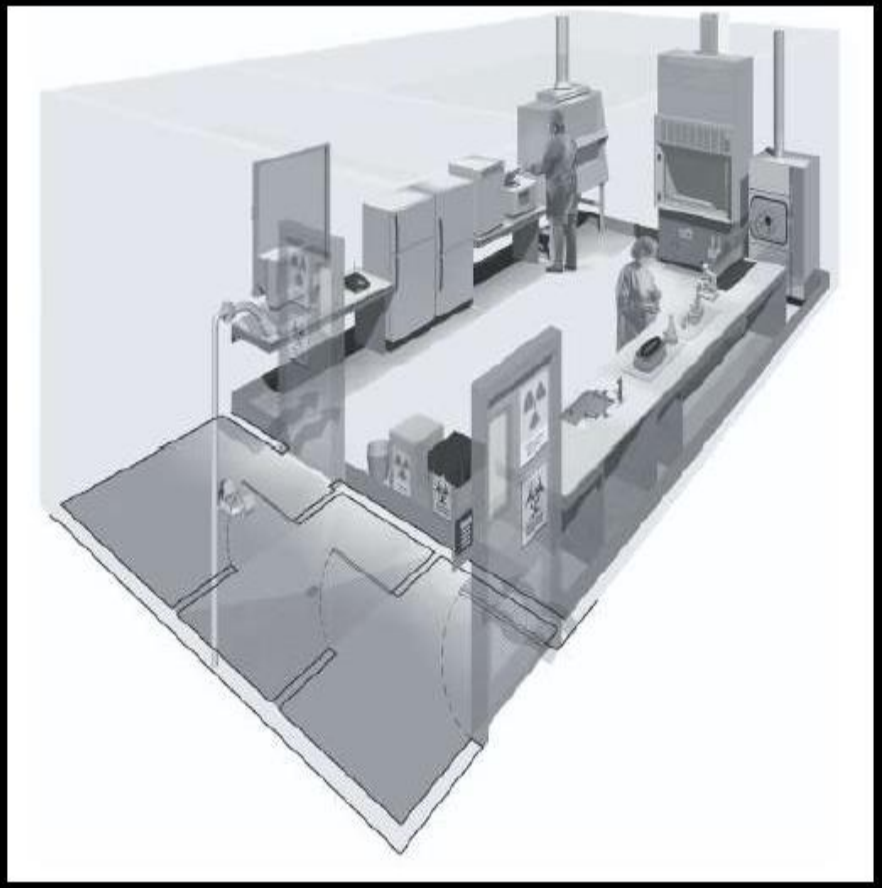
- Standard practices include BSL-1 plus:
  - policies to restrict access to lab;
  - biohazard warning signs posted outside lab;
  - surveillance of laboratory personnel with appropriate immunizations offered;
  - biosafety manual with definitions of needed waste decontamination or medical surveillance policies;
  - supervisory staff who have experience working with infectious agents and specific training for laboratory personnel in handling these agents

# BIOSAFETY LEVEL 2 (BSL-2)

- Primary barriers: biosafety cabinets or other approved containment devices
  - Personal protective equipment: lab coats, gloves, face protection as needed
  - Protective clothing removed when personnel leave laboratory area
  - Cabinets thoroughly decontaminated daily and monitored for radiation for personal protection
  - Secondary barriers: BSL-1 barriers plus autoclave for glassware

# Levels of Containment

- **BL3** - microorganisms that cause serious disease, transmitted by inhalation
  - *M. tuberculosis*, yellow fever virus, hantavirus, SARS Cov2
- Agents with potential for respiratory transmission, may cause serious and potentially lethal infection
- May be studied at BSL-2 for diagnosis



# BIOSAFETY LEVEL 3

All items listed in BSL2 – and:

- » access to an autoclave
- » separated building or isolated zone
- » double door entry
- » directional inward flow
- » single pass air
- » enclosures for aerosol generating equipment
- » walls, floors, and ceilings are H2O resistant

# Levels of Containment

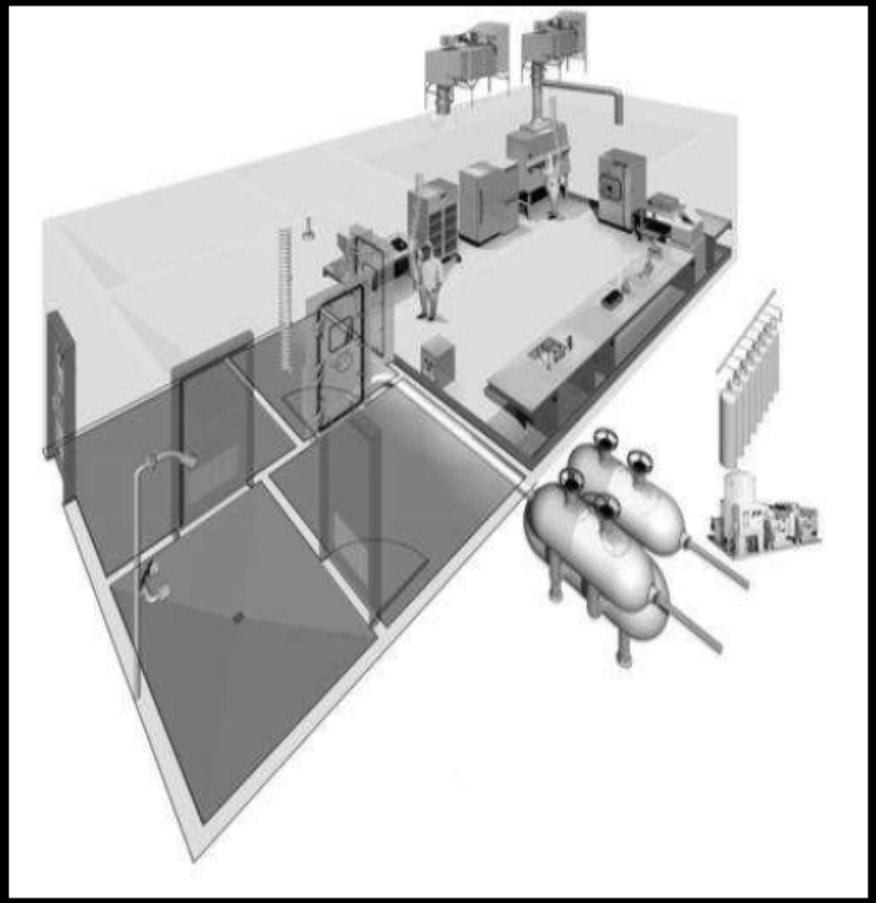
- **BL4** - microorganisms that cause lethal disease, with no known treatment or vaccine
  - ➔Ebola virus, Marburg virus
  - ➔Maximum containment lab; positive pressure ventilated suits (moon suits)

# BIOSAFETY LEVEL 4 (BSL-4)

- Dangerous and exotic agents with high risk of life threatening disease, aerosol-transmitted
- Related agents with unknown risk of transmission
- **Agents (all viruses) include Marburg virus, Ebola virus, viruses that cause Congo-Crimean hemorrhagic fever, Lassa fever**

# BIOSAFETY LEVEL 4 (BSL-4)

- Primary barriers:
  - Biosafety cabinets used at other biosafety levels
  - Full-body, air-supplied, positive pressure personnel suit
- Secondary barriers:
  - All physical barriers at BSL-3
  - isolated zone or a separate building;
  - dedicated supply and exhaust, vacuum, decontamination systems;
  - a recommended absence of windows (or sealed and resistant to breakage)

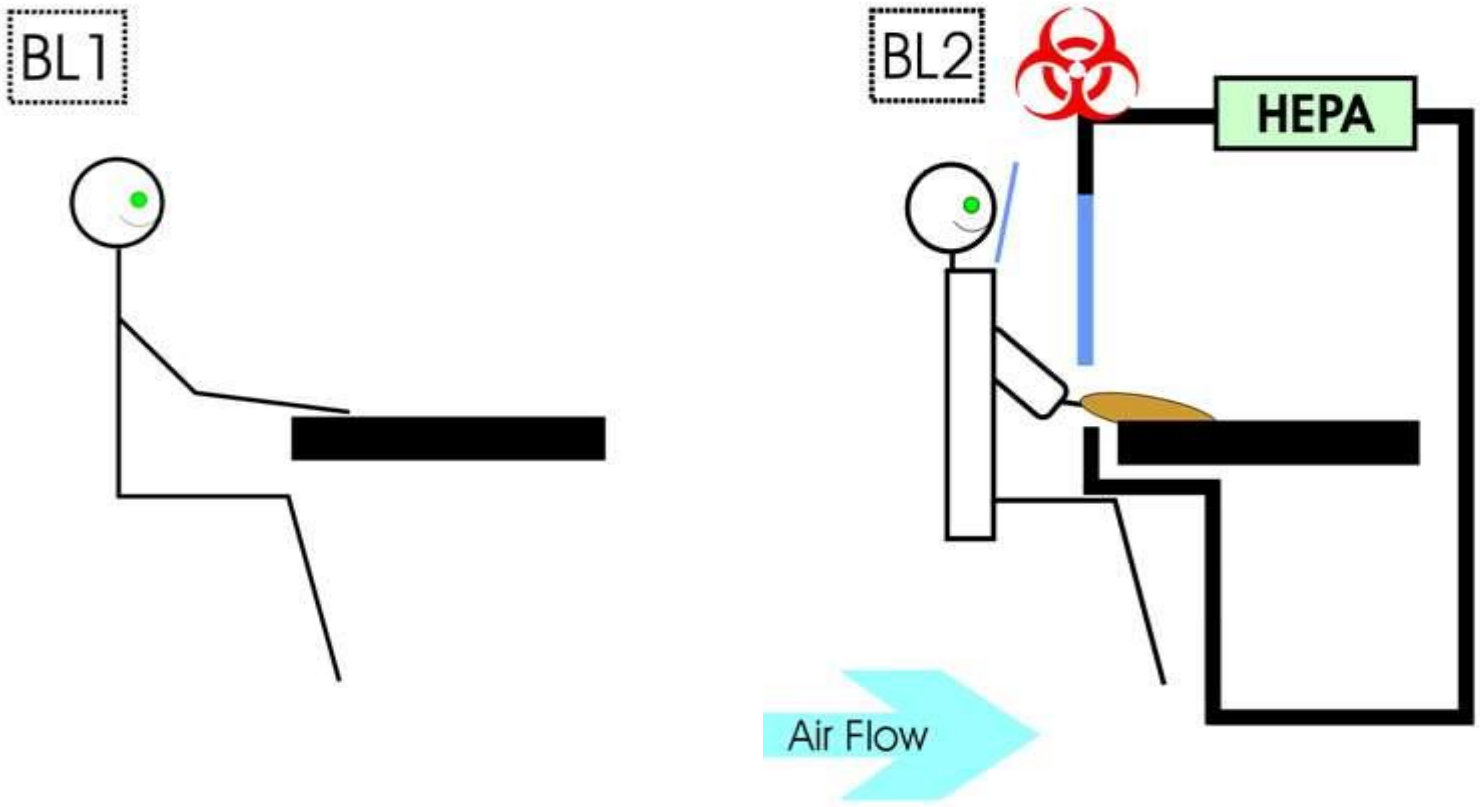


# BIOSAFETY LEVEL 4

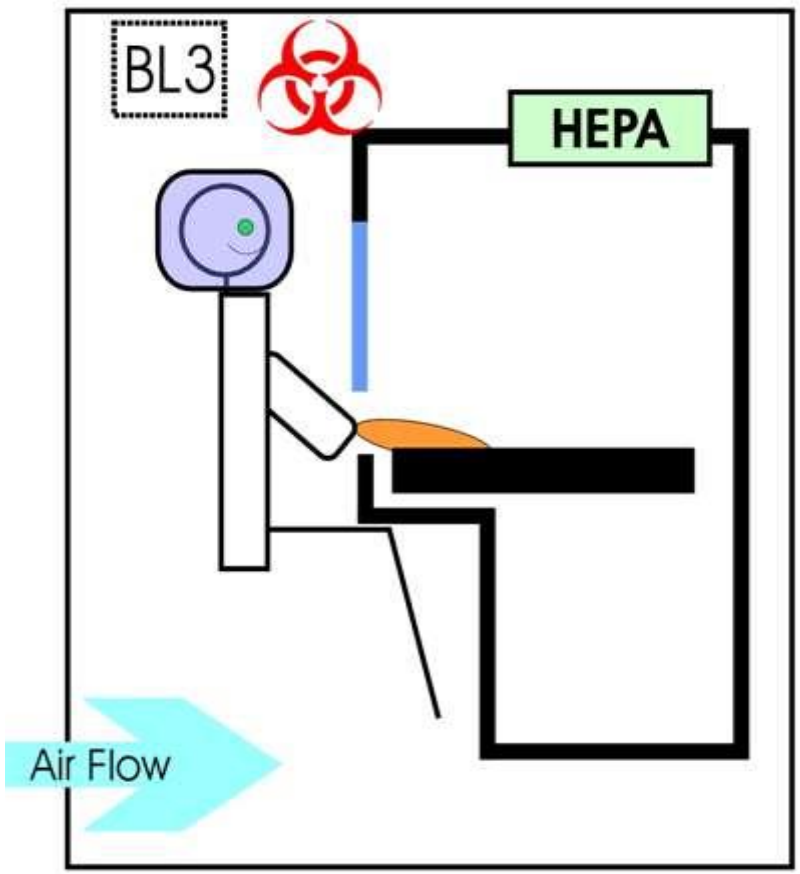
All items listed in BSL3 – and:

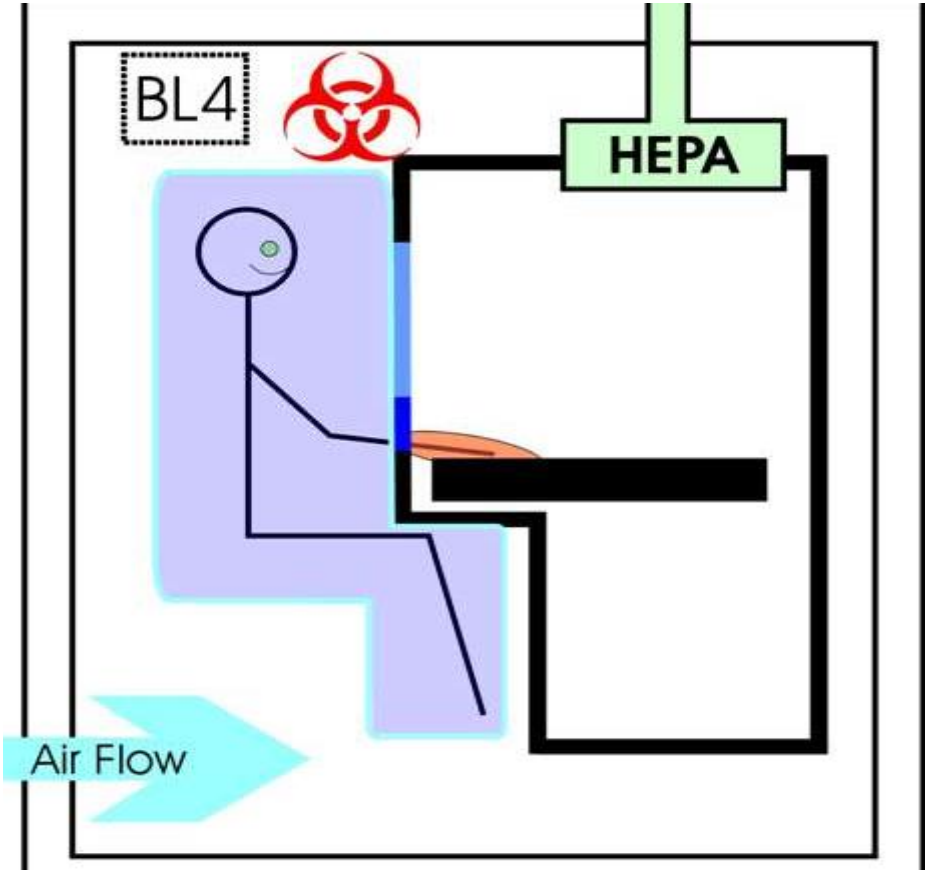
- » double door autoclaves
- » rooms are sealed
- » inner and outer doors are interlocked to prevent doors being opened at the same time
- » liquids are decontaminated
- » multi-level system redundancy

# BIOSAFETY LEVEL 1 AND LEVEL 2



# BIOSAFETY LEVEL 3 AND LEVEL 4



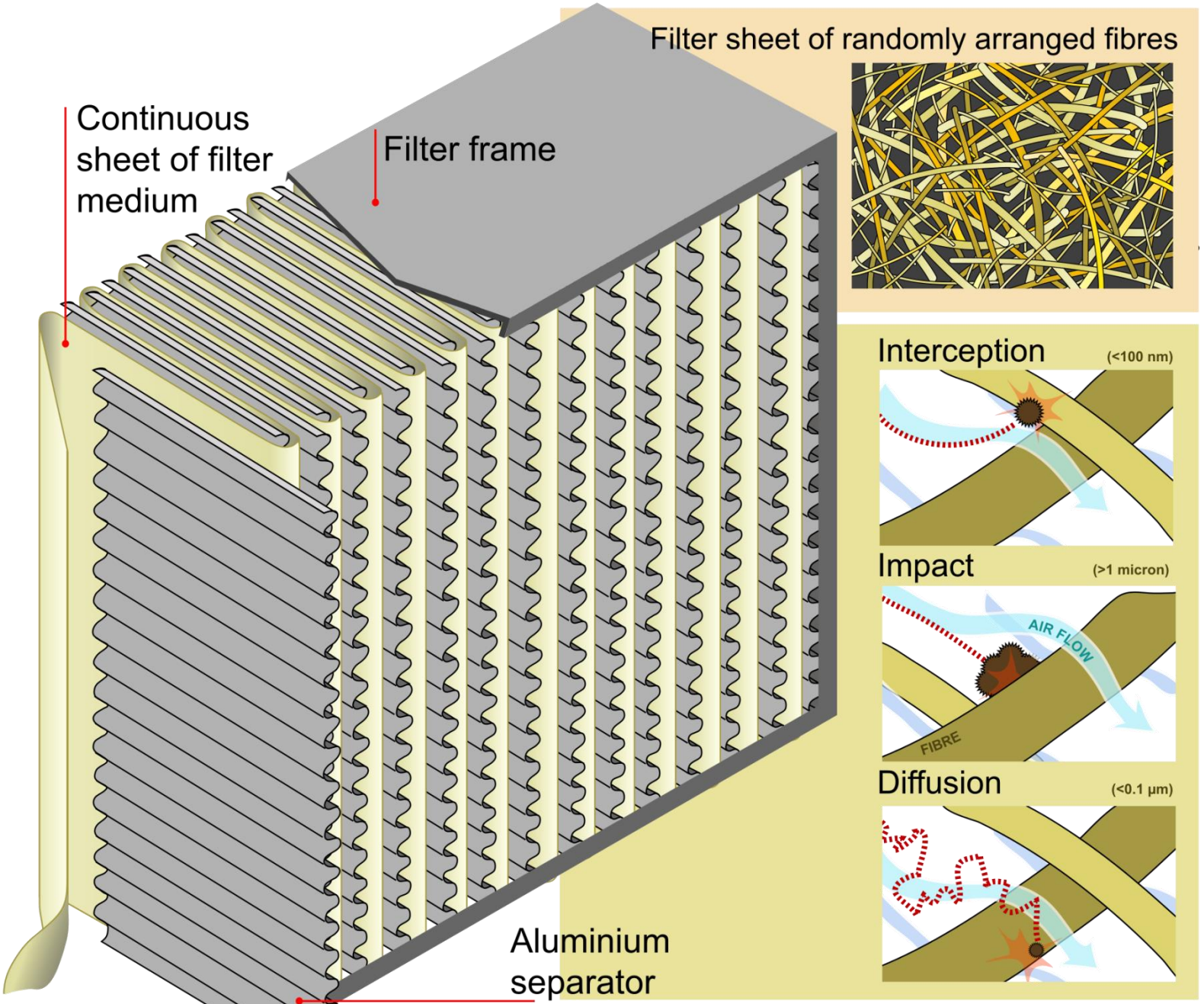



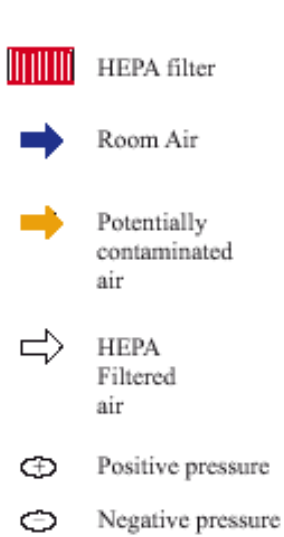
# BIOSAFETY CABINET

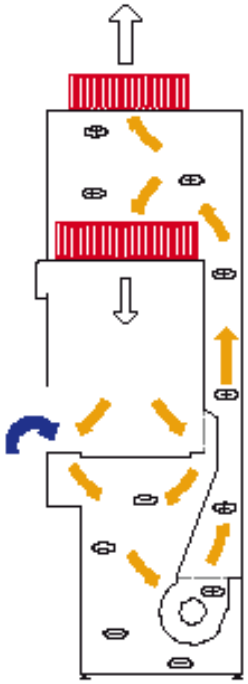
- Biosafety cabinets (BSCs) are primary means of containment, developed for working safely with infectious micro-organisms

- HEPA – High efficiency particulate air filter

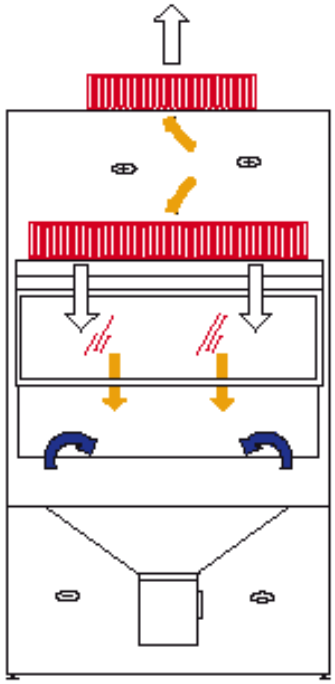
- It removes the most penetrating particle size (MPPS) of 0.3 µm with an efficiency of at least 99.97 %


Continuous sheet of filter medium
Filter frame
Filter sheet of randomly arranged fibres
Interception
(<100 nm)
Impact
(>1 micron)
AIR FLOW
FIBRE
Diffusion
(<0.1 µm)
Aluminium separator



Section View



Front View


Class II BSC

## REMEMBER:

The main purpose of a BSC is to **protect you and the environment** from exposure to biohazards while working with infectious agents

In addition, Class II and III BSCs will protect your research materials from airborne contaminants with the aid of HEPA supply filters

**Before using the cabinet:**

- Ensure BSC is certified
- Turn off UV lamp; turn on fluorescent lamp
- Disinfect work surfaces with appropriate disinfectant
- Place essential items inside cabinet
- Allow the blower to run for 5-10 min before work

**After using the cabinet:**

- Leave blower on at least 5 minutes to purge cabinet
- Remove and decontaminate equipment and materials
- Disinfect cabinet surfaces
- Turn off blower and fluorescent lamp, turn on UV lamp

# LABORATORY LOCATIONS

- BSL-1: high schools, community colleges, municipal drinking water treatment facilities
- BSL-2: local health departments, universities, state laboratories, private laboratories (hospitals, health care systems), industrial laboratories (clinical diagnostic companies)
- BSL-3: state health departments, universities, private companies, industry, federal government (NIH, CDC)
- BSL-4: only 15 facilities in the US
- 9 federal (CDC, NIH), 4 university (Georgia State University, University of Texas Medical Branch), 1 state, 1 private
- Renovations underway at several labs, new facilities proposed at additional sites