

Biosafety Levels (BSL-1 to BSL-4)

Understanding Laboratory Safety & Containment

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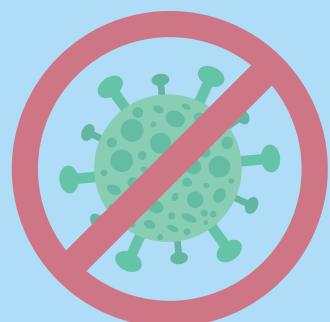
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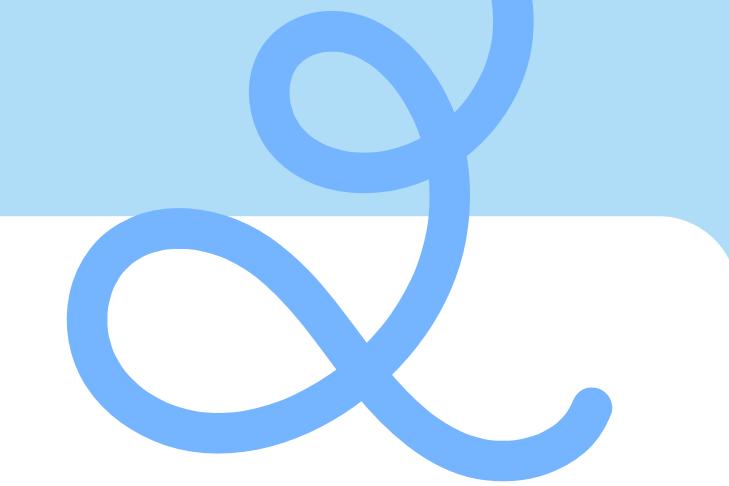
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Introduction to Biosafety

- Biosafety refers to the precautions and practices used to prevent exposure to harmful biological agents in laboratories.
- It is divided into four biosafety levels (BSL-1 → BSL-4) depending on:
 - The type of microorganisms handled
 - The risk of infection
 - The required equipment and training

Note: Higher level = more protection, control, and training.



1-



BSL-1: Basic Safety Laboratory



Definition:

Deals with agents that cannot cause disease in healthy humans.



Equipment

- Lab coat, gloves, mask, goggles, closed-toe shoes



Hygiene

- Wash hands regularly
- Handle sharps and samples carefully
- Prevent contamination



Before working

- Be trained, vaccinated, and aware of surroundings



Emergency

- Handle spills or needle injuries immediately

BSL-2: Moderate Safety Laboratory

Definition :

Deals with agents that cannot cause disease in healthy humans.

Standard Practices:

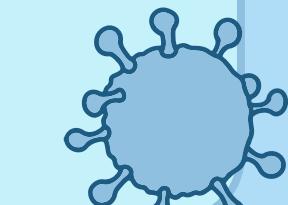
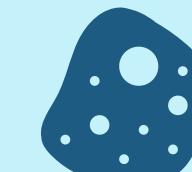
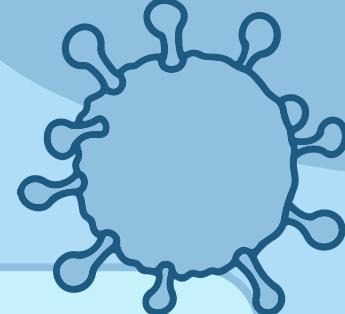
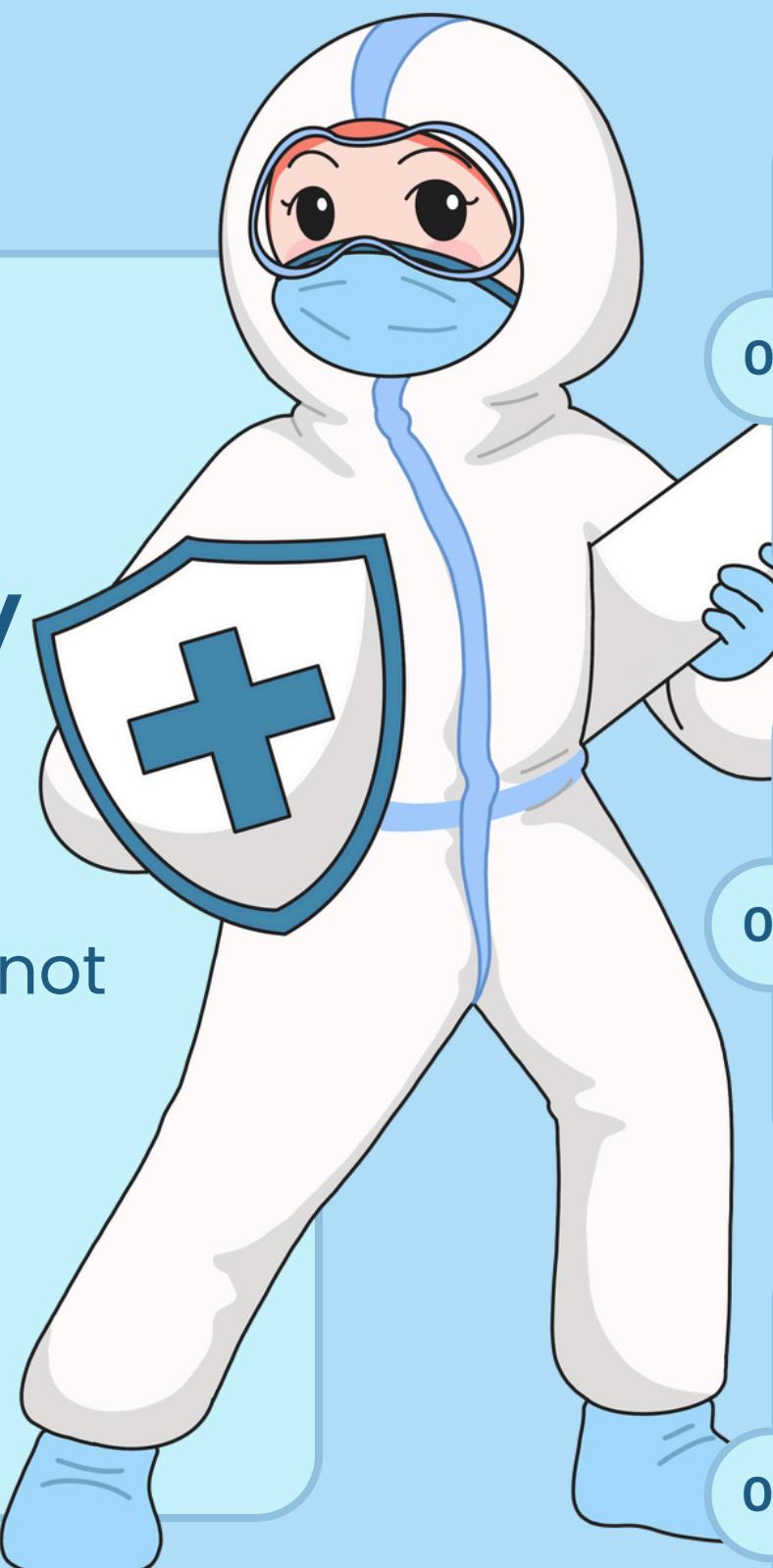
- Limited access
- No mouth pipetting
- Wash hands often
- Sharp management
- No eating or drinking

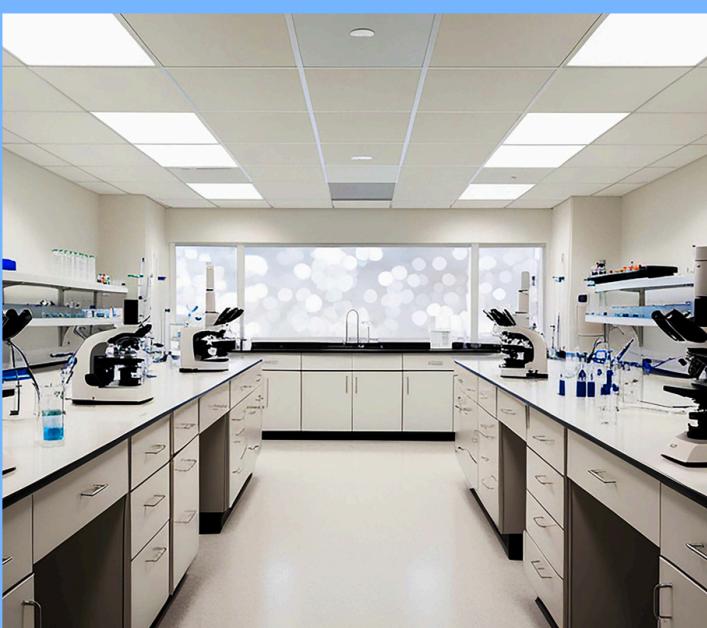
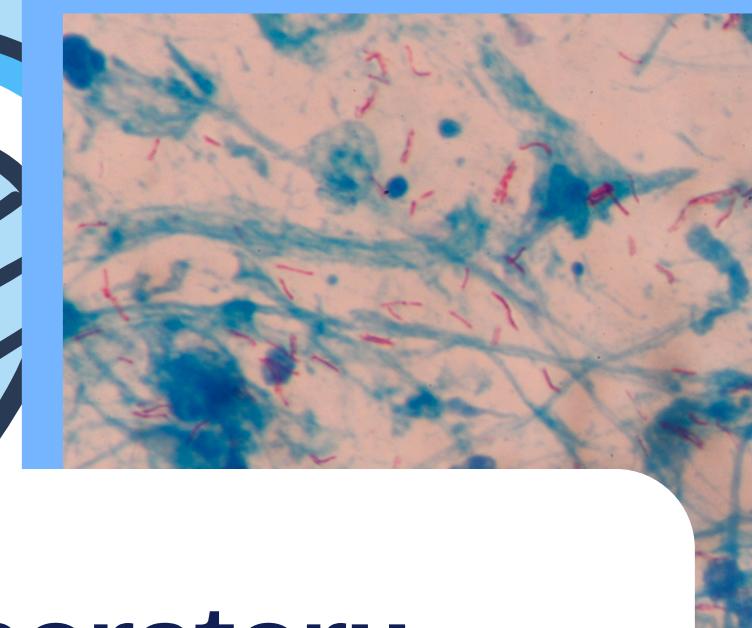
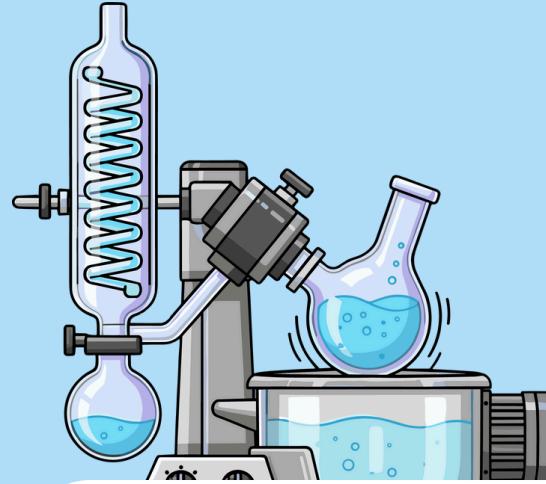
Special Practices:

- Biosafety training
- Biohazard signs with agent info & contact numbers
- Medical surveillance and immunizations

Safety Equipment:

- Biological Safety Cabinet (BSC)
- Personal protective equipment (PPE)



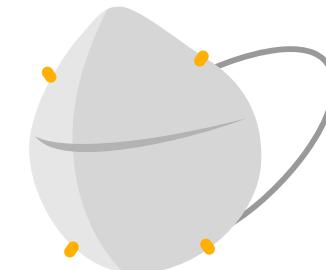


BSL-3: High Safety Laboratory

Definition :

Handles microorganisms that can cause serious or sometimes fatal diseases, often transmitted through the air.

(e.g., *Mycobacterium tuberculosis*, SARS-CoV-2, Yellow fever virus)



Design & Features

- Negative air pressure (air flows in, not out)
- Special ventilation with HEPA filters
- All work done inside Biological Safety Cabinet (BSC)



Note: Effective treatments or vaccines are usually available, but infections can still be dangerous.

Personnel

- Trained and authorized only
- Must wear N95 masks or respirators, face shields, and protective clothing



Accidents

- If a spill occurs, the area is locked and disinfected immediately



BSL-4: Maximum Safety Laboratory

Definition:

The highest biosafety level — for extremely dangerous and exotic pathogens that have **no known treatment or vaccine**.

(e.g., Ebola, Marburg, Lassa viruses)



Location & Design

- Completely isolated; often in a separate facility
- Independent power and ventilation systems



Protective Equipment

- Positive-pressure full-body suits with their own air supply
- Multiple airlocks and chemical showers for entry and exit



Safety Measures

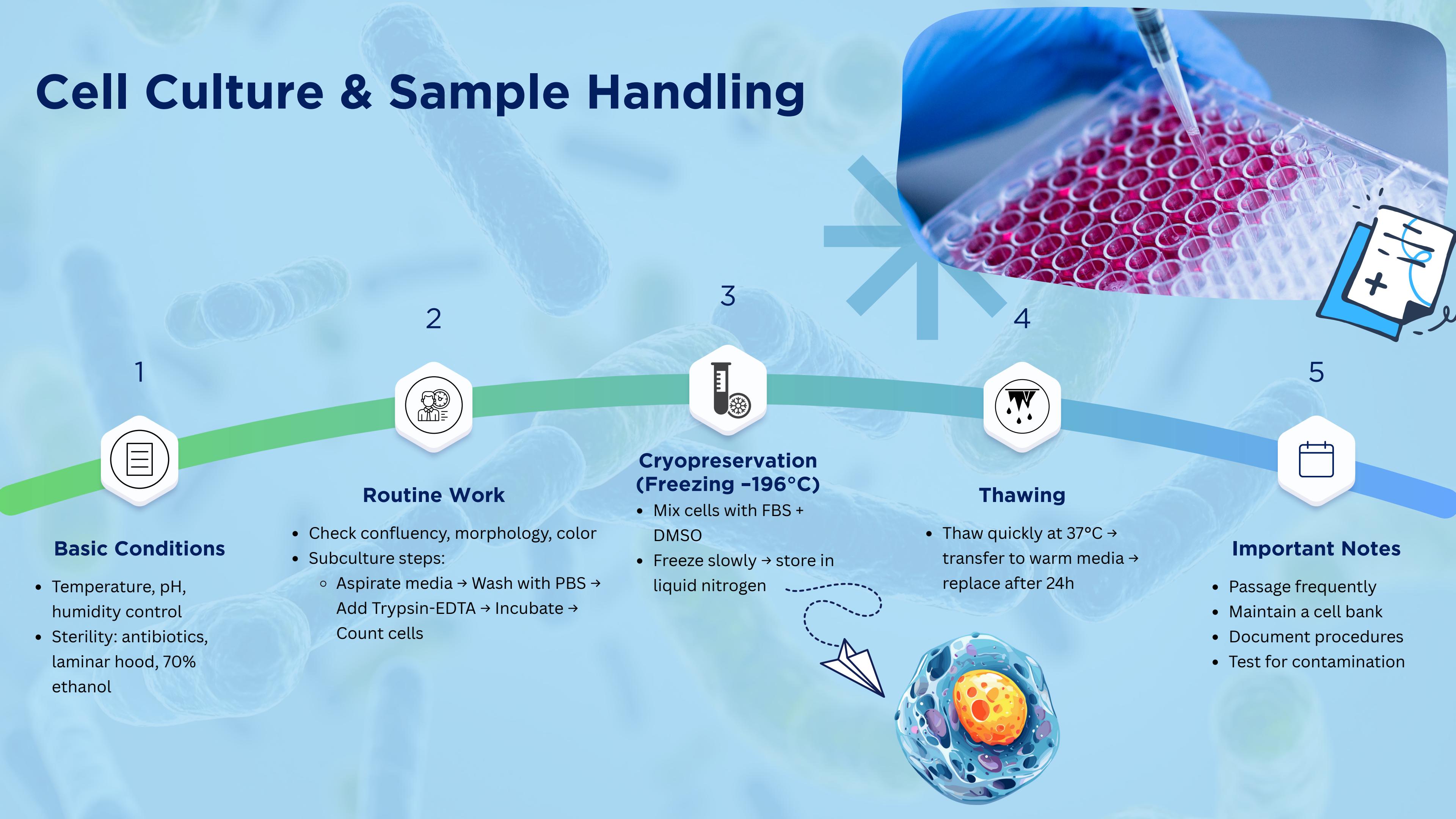
- Waste materials are sterilized before disposal
- Only highly trained personnel allowed
- Automatic doors, alarms, and backup systems for full containment



Famous Labs

- CDC (USA), Wuhan Institute of Virology (China)

Cell Culture & Sample Handling



Conclusion

Biosafety levels protect scientists, communities, and the environment.

Each level adds more control, training, and equipment as risk increases.

Safe labs = Safe research = Healthy world 





The End