VIRAL LABORATORY INSTRUMENTS AND SAFETY CABINETS

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Practical Medical Virology and MA 403

Summer Term

First week

12/08/2024

Outline

- Viral laboratory instruments
- Biosafety levels
- Biosafety cabinets

Objectives

- To learn about viral laboratory instruments
- To learn about biosafety levels and differentiate between them
- To learn about biosafety cabinets and differentiate between them

Instruments

Instruments which are used in virology lab are the followings

1. **Autoclave**
2. **Refrigerator or laboratory freezer**
3. **Microscope**
4. **Centrifuge**
5. **Cytocentrifuge**
6. **Oven**
7. **Filtering unit**
8. **Cryostat**
9. **Incubators**
10. **PCR machine**
11. **Plate reader**
12. **Electrophoresis equipment**
13. **The single and multichannel micropipettes**
14. **Biosafety cabinets**

Autoclave

Autoclave is a device depends on a steam sterilization; viruses, bacteria and fungal spores are killed at 121 ^{o}C within 15-20 min and 1.5 bar of pressure of autoclave.

Pressure Cooker Type

Common Laboratory Autoclave

Vertical Autoclave

Horizontal Autoclave

Large Automatic Hospital Autoclave

Refrigerator or laboratory freezer, microscope and centrifuge

Refrigerator: Laboratory freezer

The primary function of a laboratory refrigerator is to maintain a defined, internal storage temperature (typically in the +1°C to +15°C range or -10 to -80) in order to provide secure storage and protection of temperature-sensitive products, samples, specimens, chemicals, drugs, solutions, and other substances.

Microscopes are essential for observing viruses and infected cells.

- Electron microscopes (TEM and SEM) are often used for high-resolution imaging of viruses.

Centrifuge is a device that uses centrifugal force to separate various components of a fluid.

- **Normal centrifuge** (ordinary centrifuge)
- **Ultra-centrifuge**: it is used at high speeds 45000-60000 rpm
- **Micro centrifuge**: used for spinning liquid samples as low as 2 ml or even less at high speeds

Cytocentrifuge

Cytocentrifuge: sometimes referred to as a **cytospin**, is a specialized centrifuge used to concentrate cells in fluid specimens onto a microscope slide so that they can be stained and examined.

- The method can be used on many different types of specimens, including fine needle aspirates, cerebrospinal fluid, serous and synovial fluid, and urine.

Oven

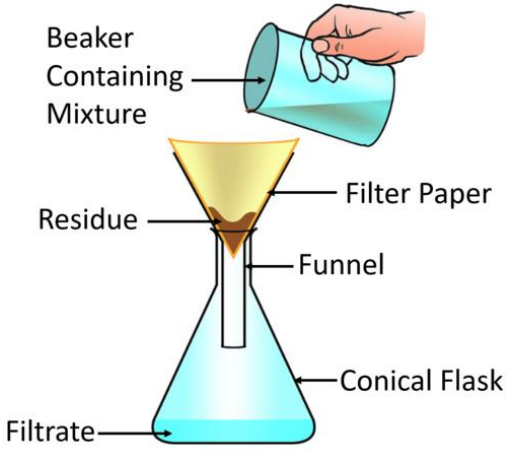
Dry heat (oven): It is done in a special instrument (dry oven), which is heated electrically to a temperature of 160 ^{o}C for 1-2 hrs.

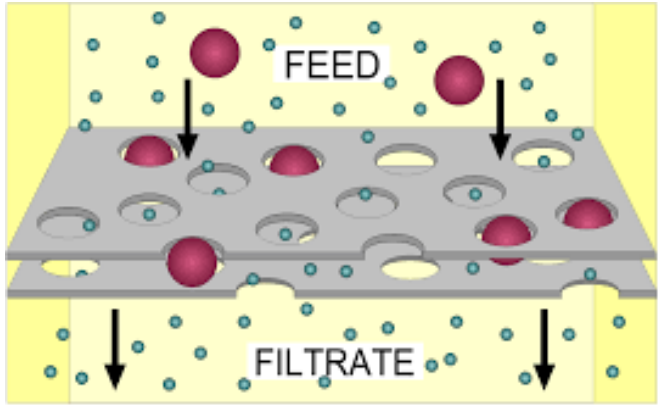
- Ovens are used to sterilize items.
- Sterilization is defined as the killing or removal of all microorganisms, including bacterial spores.

Filtering unit

In virology, **filtration** refers to a laboratory technique and process used to separate and purify viral particles from other components in a sample, such as cell debris, proteins, nucleic acids, and other contaminants.

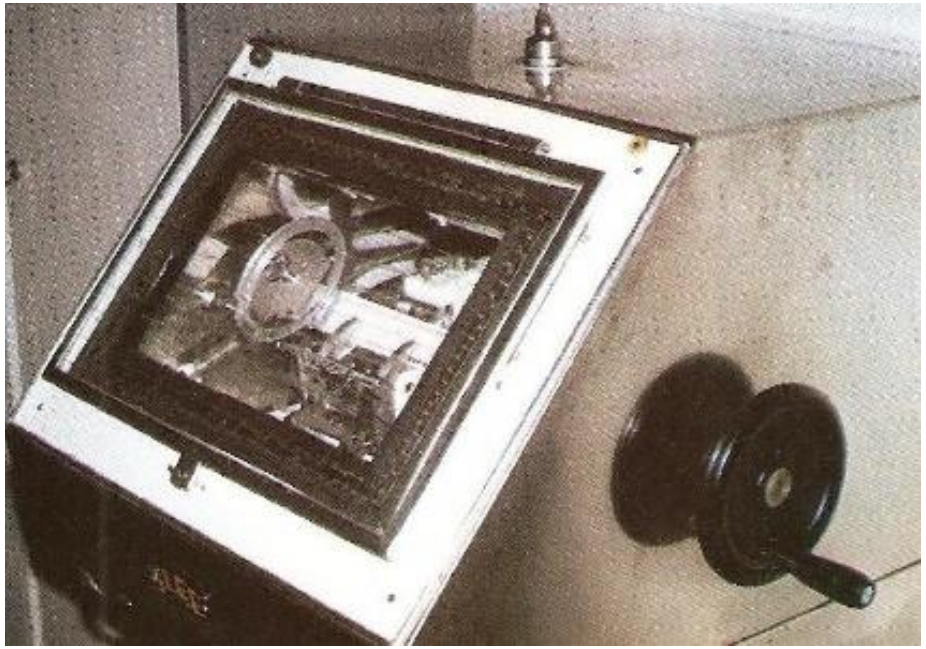
- Solid particles that cannot pass through the filter medium are described as **oversize** and the fluid that passes through is called the **filtrate**.





Refrigerated microtome (Cryostat)

Cryostat is a microtome machine for cutting tissue at low temperatures (typically around −15 to −30°C). it is used to make sections. The frozen piece of tissue is placed on the chuck of the refrigerated microtome and cut into sections of the desired thickness



Incubator, PCR machine, plate reader and electrophoresis equipment

Incubators: Incubators maintain controlled temperature and humidity conditions for the growth and propagation of viruses in cell cultures.

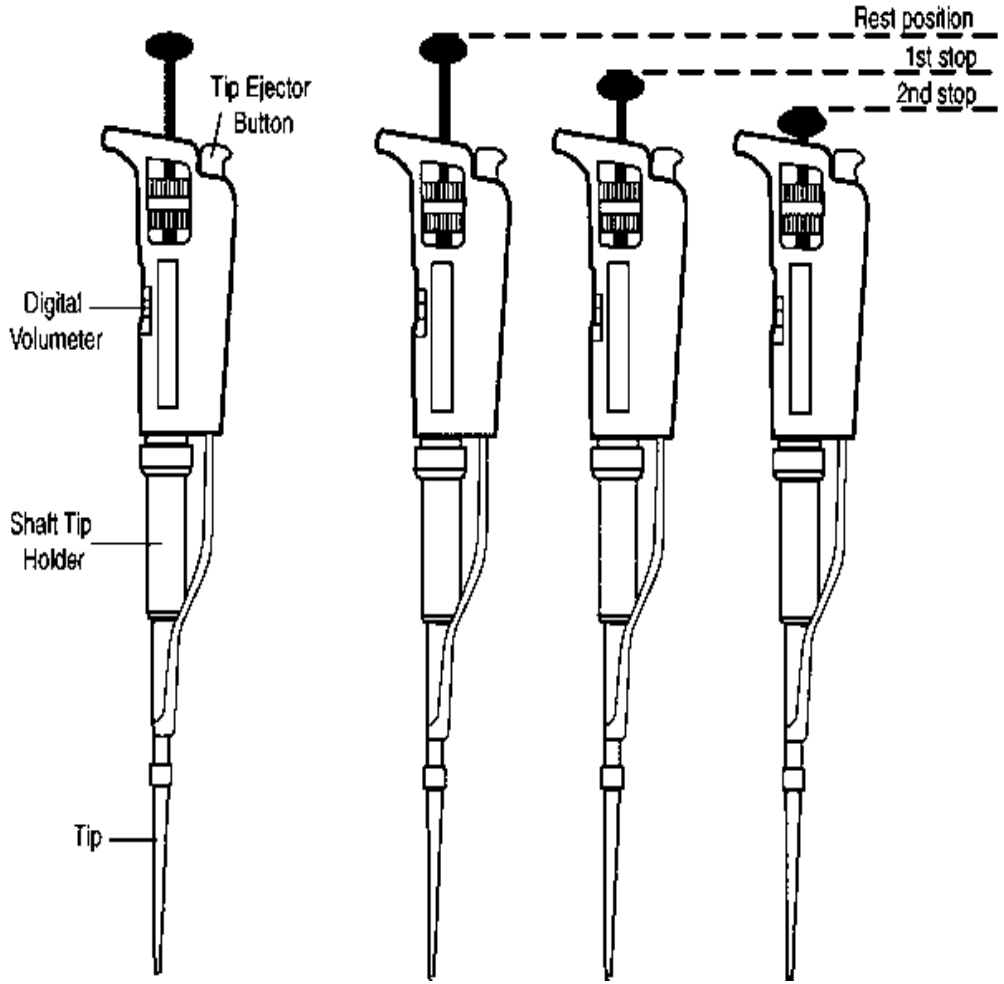
PCR Machines: Polymerase Chain Reaction (PCR) machines are used for amplifying viral genetic material, which is essential for virus detection, quantification, and characterization.

Plate readers are used to perform various assays, such as enzyme-linked immunosorbent assays (ELISAs) for virus detection and quantification.

Electrophoresis equipment: Gel electrophoresis is used to separate and analyze viral nucleic acids and proteins based on their size and charge.

The single and multichannel micropipettes

Micropipettes is a precision laboratory instrument used for accurately measuring and transferring small volumes of liquid.



Instructions for pipetting liquids using a micropipette

Micropipettes have 3 positions:

a) Rest position
b) First stop
c) Second stop

The single and multichannel micropipettes

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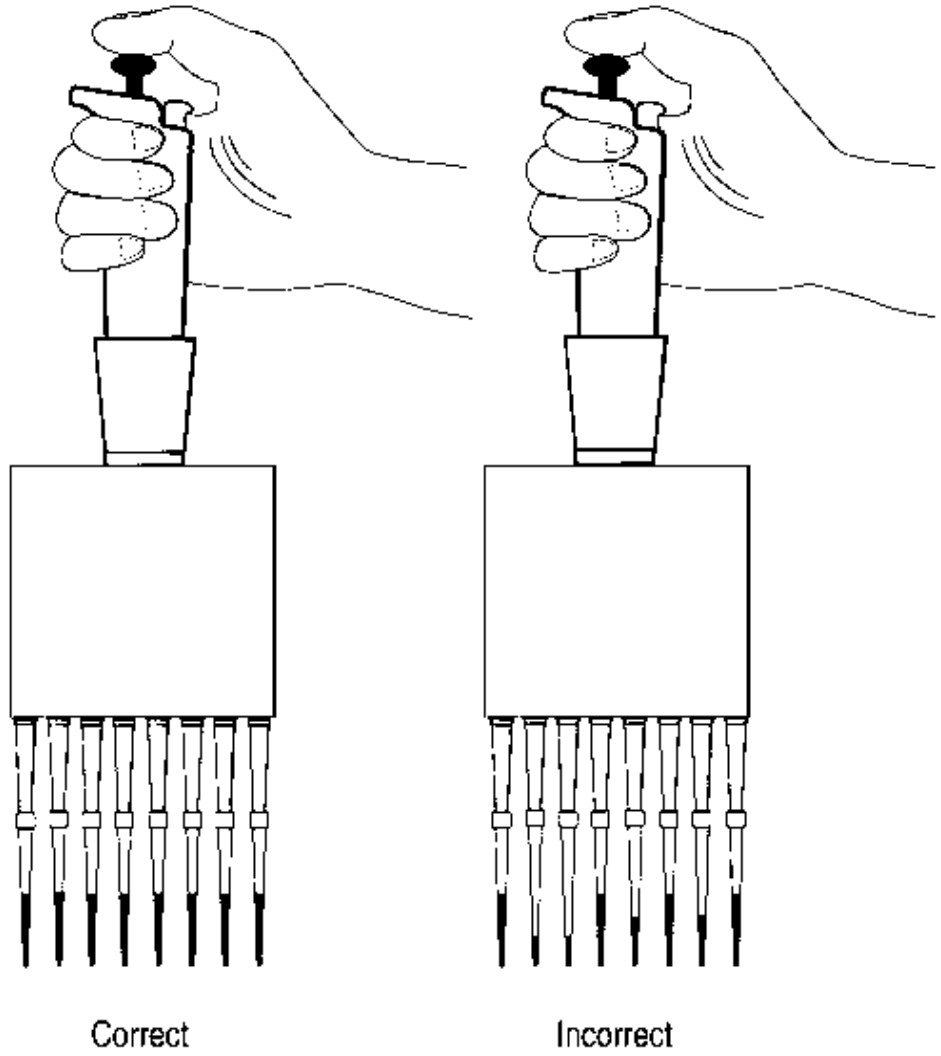


Safety manual

Every laboratory should have a safety manual.

A list of some of the safety issues to be addressed in a laboratory safety manual

1. Fire safety
2. First aid
3. Safe use of laboratory glassware
4. Safety with handling boiling liquids
5. Cleaning up spills and broken glass
6. Decontamination of benches and waste
7. Recycling of infected materials for example, needles and syringes
8. Safe use of chemicals

Biosafety levels

Biosafety levels (BSL) are a set of laboratory containment and safety measures designed to protect laboratory personnel, the environment, and the community when working with potentially hazardous biological materials.

- Once risk is assessed then the appropriate BSL is determined.
- The levels of containment range from the lowest biosafety level 1 (BSL-1) to the highest at level 4 (BSL-4), which includes:

1. **BSL-1**
2. **BSL-2**
3. **BSL-3**
4. **BSL-4**

Biosafety levels

BSL-1 laboratories are used for basic research and teaching activities involving well-characterized and low-risk agents that are not known to cause disease in healthy humans.

BSL-2 laboratories are used for handling agents that pose a moderate risk to personnel and the environment. These agents may cause diseases in humans but have available treatments or vaccines.

BSL-3 laboratories are used for work with agents that can cause severe or potentially lethal diseases in humans, such as tuberculosis, anthrax, and severe acute respiratory syndrome coronavirus (SARS-CoV).

BSL-4 laboratories are the highest level of containment and are used for work with the most dangerous agents, including Ebola virus, Marburg virus, and other highly contagious and deadly pathogens.

Biosafety cabinets

A biosafety cabinet (BSC), also known as a biological safety cabinet or microbiological safety cabinet, is a specialized piece of laboratory equipment designed to provide a controlled and safe working environment for handling hazardous biological materials, including bacteria, viruses, and fungi.

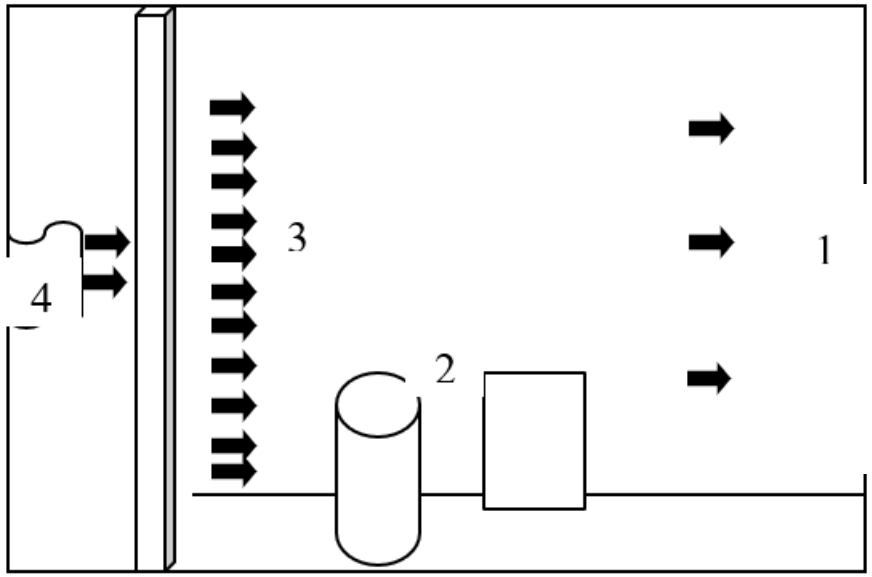
- Biosafety cabinets are essential in research, clinical, and diagnostic laboratories to protect

1. Laboratory workers
2. The environment
3. The integrity of the experiments

Types of biosafety cabinets

1. **Laminar flow clean air cabinet Class I:** This protects the work against microbial contamination by a laminar flow of sterile air.

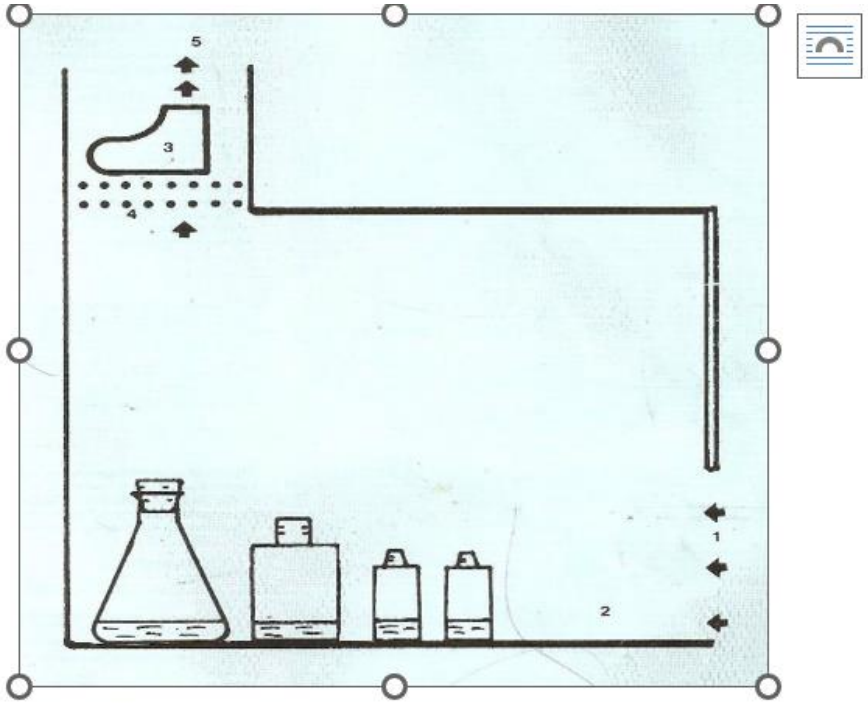
- This type of cabinet is suitable for making media and handling of non-infected tissue cultures. It is not suitable for infectious work as personnel are exposed to the exhaust air.



1- Open front and exhaust air
2- Working space
3- Hepafilter and laminar flow
4- Fan

Types of biosafety cabinets

2. Class II microbiological safety cabinet: This protects the worker. Air is drawn from the room, with the air steam away from the worker thus protecting him against infection. The incoming air is not sterile and may contaminate the work. The exhausted air is filtered to protect the environment.

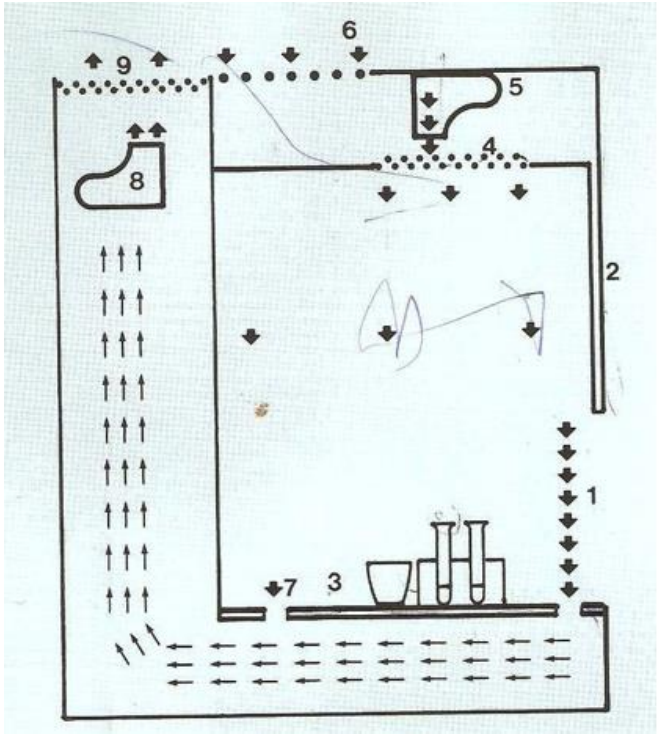


1- Open front with inward airflow
2- Working space
3- Exhaust fan
4- Exhaust hepafilter
5- Sterile exhaust air

Types of biosafety cabinets

Types of biosafety cabinets

3. Class III microbiological safety cabinet: This protects both the work and the worker. Incoming and exhaust air is filtered. The open front is protected by an air current, which acts as a curtain.

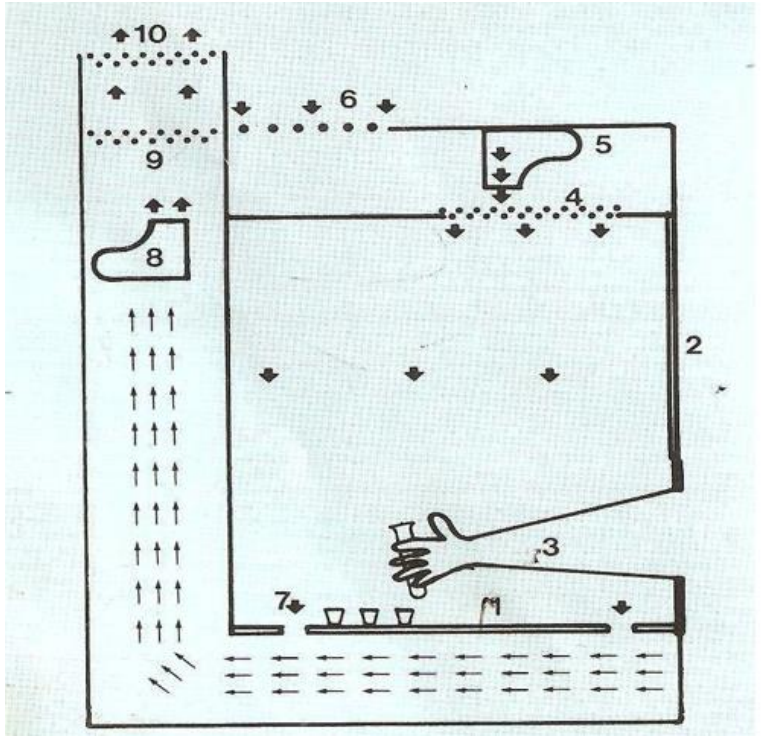


1- Open front with air curtain
2- Window
3-Working space
4- Inlet with hepafilter
5- Inlet fan
6- Air inlet with prefilter
7- Air vents in the bottom
8- Exhaust fan
9- Exhaust hepafilter

Types of biosafety cabinets

Types of biosafety cabinets

4. Class IV bacteriological safety cabinet: This type gives maximal protection for the test, the worker, and the environment. Regular inspection of the filter and the fan motors is necessary for maintaining the maximal safety level.



1- Working space
2- Window
3-Gloves, making the cabinet front totally closed
4- Air inlet with prefilter
5- Air inlet fan
6- Air inlet prefilter
7- Air vents to the duct in the bottom
8- Exhaust fan
9 and 10- A double set of hepafilters in the exhaust

References (in APA style)

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