STERILISATION & DISINFECTION

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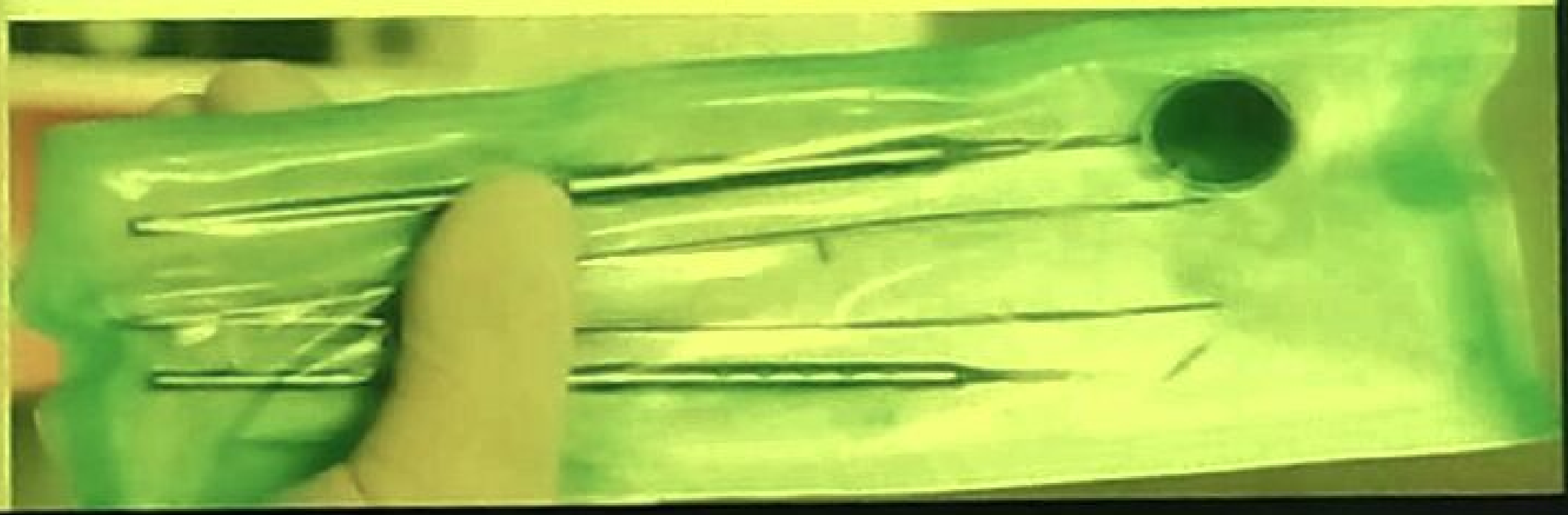
Learning Objectives

1. Differentiate between disinfection and sterilisation.
2. Explain the principles of sterilisation and disinfection
3. Explain different types of sterilisation
4. Explain different types of disinfection
5. Describe the facilities and equipment required for Sterlisation and disinfection

DEFINITION

STERILISATION

The process of freeing an article from microorganisms including their spores.



DISINFECTION:

Reducing the number of pathogenic microorganismsto the point where they no longer cause diseases.

- Antiseptic

  A product that destroys or inhibits the growth of microorganisms in or on living tissue.

- Aseptic

  Characterized by the absence of pathogenic microbes.

Decontamination- The treatment used to make equipment safe to handle.

Choice of Method

- Method to be used will depend on:
  - Device's intended use
  - Risk of infection
  - Degree of soilage
- Process must not damage the device

Methods of Sterilisation

Sterilisation by Heat

Factors influencing sterilization by heat:

- Temperature
- Time of exposure
- Number of vegetative microorganisms and spores present.
- The species/strain: spore forming ability
- Nature of the contaminated material

Methods of sterilization by dry heat

- **Hot air oven sterilizer**- for materials that can withstand high temperature but affected by contact with steam: laboratory glassware.

- **Flaming**- processed using a bunsen burner flame: innoculating wire loops
- **High vacuum Infra red sterilizer**: industrial

Dry Heat Sterilisation - 2

Advantages

- Can be used for powders, anhydrous oils
- Inexpensive
- No corrosive effect on instruments

Disadvantages

- High temperature damages some items
- Penetration of heat slow, uneven

Sterilization by moist heat

- Done using an autoclave.
- High temperature conditions attained by raising the pressure of steam in a pressure vessel.

Why autoclave?

To ensure endospores et al. are killed on things like surgical instruments.

Factors Influencing moist heat/steam Sterilisation

- Proper loading must occur
- All items in load must have contact with steam
- Items in load must be free from grease and oil

Heat Sterilization Monitoring - Types of Indicators

- **Mechanical**

Measure time, temperature, pressure

- **Chemical**

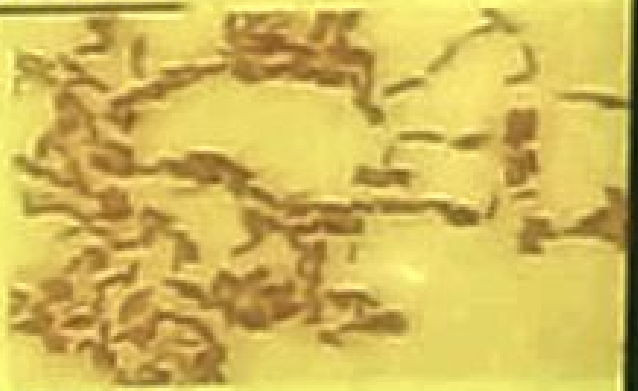
Change in color when physical parameter is reached

- **Biological (spore tests)**

Use biological spores to assess the sterilization process directly

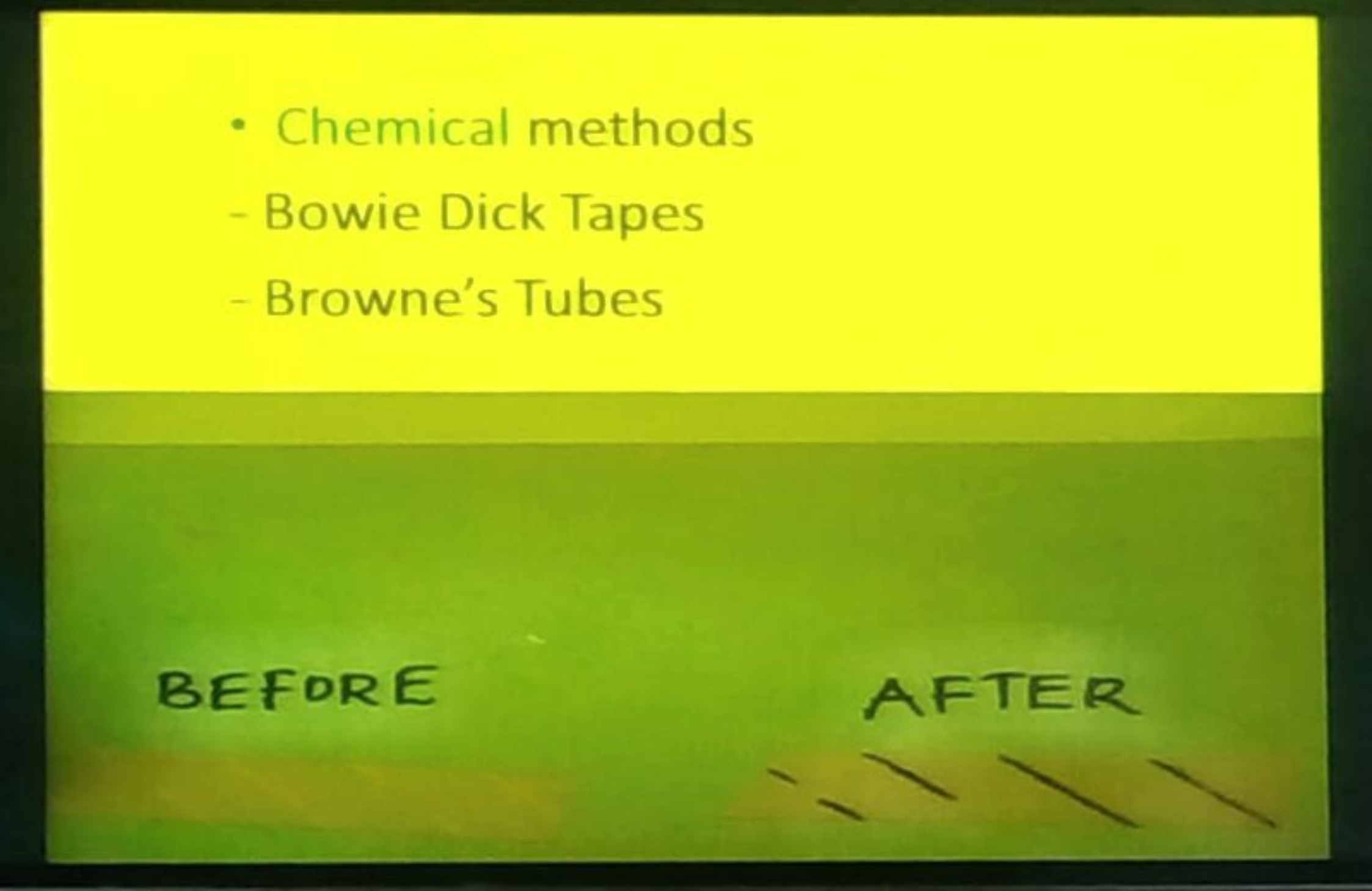
- Biological methods
  - Spores of *Bacillus stearothermophilus*
  - Spores of *Bacillus subtilis*

Bacillus stearothermophilus



- rod-shaped, gram positive bacteria
- Can grow within a temperature range of 35-70°c.
- The biological indicator contains spores of the organism on filter paper inside a vial.
- Growth of the spores on incubation after sterilization indicates that the sterilization process has not been met.

- Chemical methods
  - Bowie Dick Tapes
  - Browne's Tubes



Browne's tubes

- They are glass tubes that contain heat sensitive dyes.
- These change colour after sufficient time at the desired temperature.

Sterilization by Gaseous Processes

Ethylene Oxide (EO) Gas Sterilisation

- Used for heat or moisture sensitive items
- Highly penetrative, non- corrosive microbiocidal gas.
- Useful for sterilization of heat sensitive materials – plastics, surgical instruments
- Prevents normal cellular metabolism and replication

EO Sterilisation

Advantages

- Items not damaged by heat or moisture
- Not corrosive, not damaging to delicate instruments, scopes
- Permeates porous materials
- Dissipates from material

Disadvantages

- Cost
- Toxic properties of ethylene oxide
- Aeration required
- Longer process

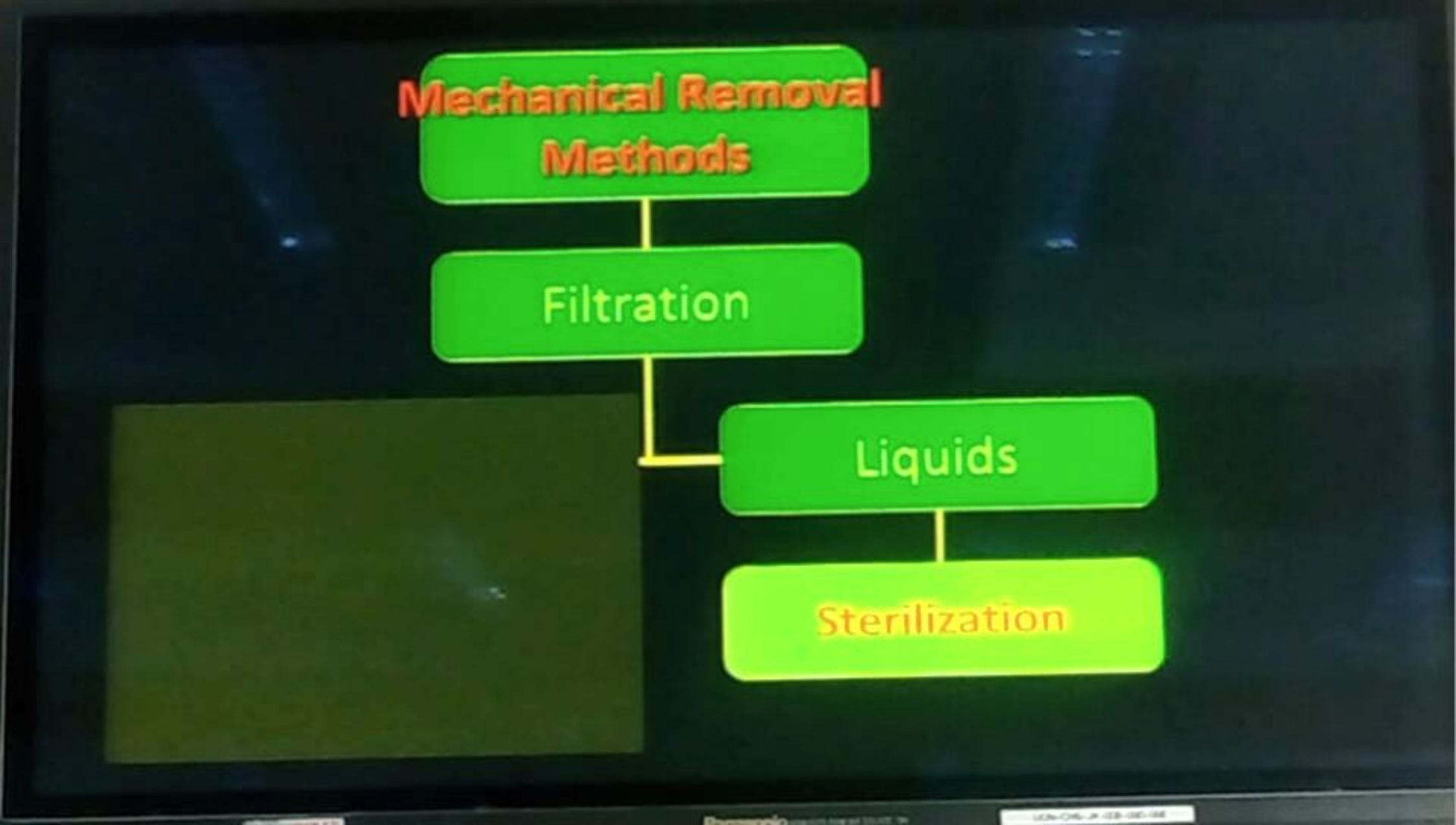
Other Gaseous Processes

Formaldehyde at low temperature– gives an effective sporicidal process.

Glutaraldehyde– more effective than formaldehyde. Both are used to sterilize respiratory therapy equipment.

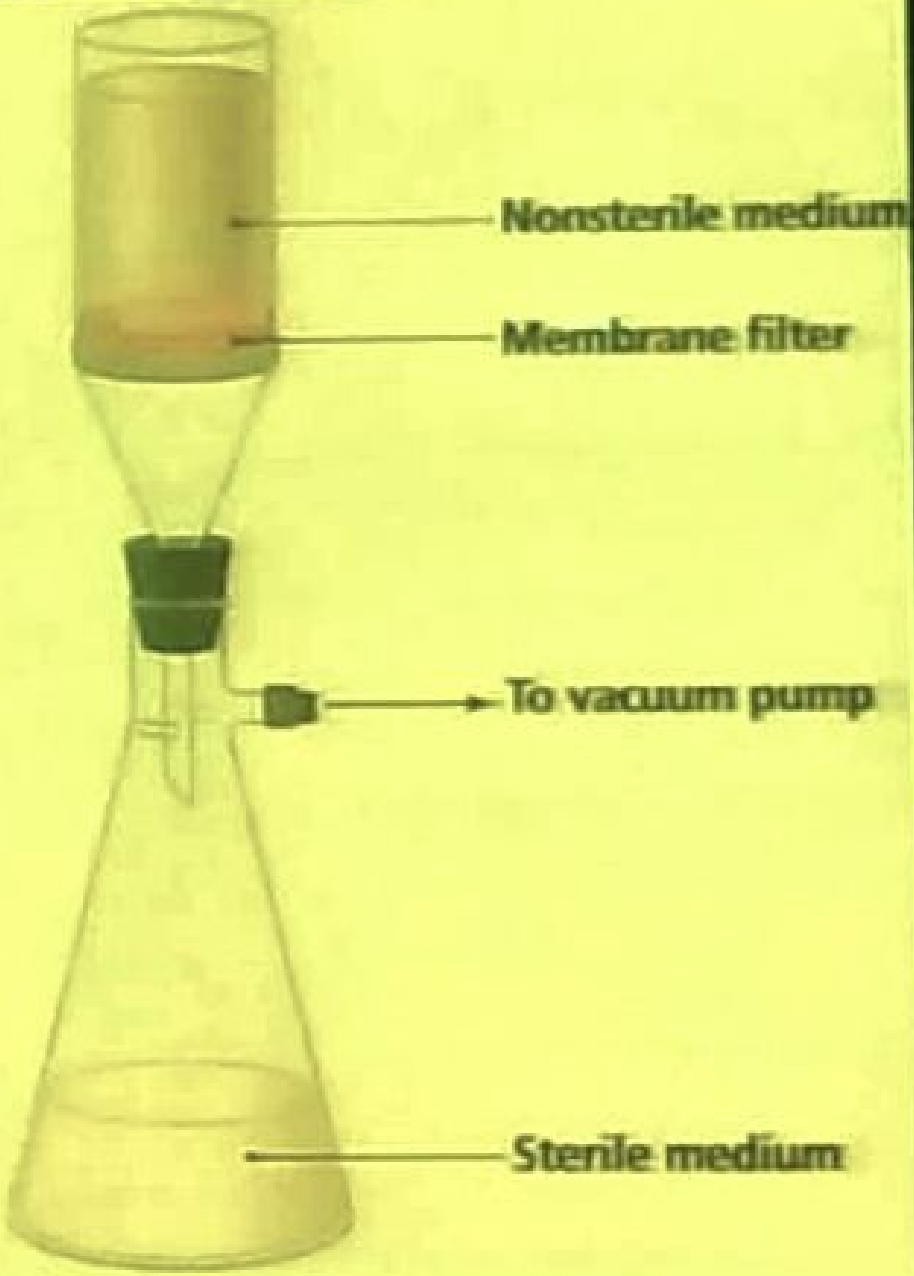
Sterilization by Ionizing Irradiation

- Includes X-rays, gamma rays, accelerated electrons.
- Ultra violet light, X-rays kill microorganisms by damaging DNA.
- Used to sterilize large amounts of prepackaged single use items eg catheters, plastic syringes.


Mechanical Removal Methods
Filtration
Liquids
Sterilization

Sterilization by Filtration

- Membrane filters eg the millipore filter made of nitrocellulose
- Filter of pore size 0.22um
- Useful in sterilizing fluids such as antibiotic solutions, blood products.



(a)

The Ideal Disinfectant

- Resistant to inactivation
- Broadly active (killing pathogens)

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- Resistant to inactivation
- Broadly active (killing pathogens)
- Not poisonous (or otherwise harmful)
- Penetrating (to pathogens)
- Not damaging to non-living materials
- Stable
- Easy to work with

DISINFECTION

-Disinfection can be by:

- moist heat
- ultraviolet radiation
- gases
- filtration
- chemical methods.

1. Disinfection by Moist Heat: steam at 73°c is used to disinfect thermolabile reusable equipment.

2. Disinfection by Ultraviolet Radiation:

- effective radiation of 240–280 nm can be produced by mercury lamps
- inhibits DNA replication
- treatment of air, water and surfaces of laboratory safety cabinets.

3. Disinfection by Gases:

- Formaldehyde gas: to disinfect complex heat sensitive equipment such as baby incubators, anaesthetic machines.

4. Disinfection by Filtration:

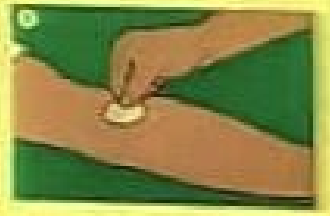
- A properly installed HEPA (high efficiency particulate air) filter achieves 99.997% arrestance to particles of 0.5um.
- operating theatres, ventilation systems, pharmaceutical clean rooms etc.

5. Disinfection by Chemicals:

- Alcohols
- Aldehydes
- Halogens
- Surface acting agents
- Oxidizing agents

Alcohols

- Intermediate-level disinfectants
- Denature proteins and disrupt cytoplasmic membranes
- Evaporate rapidly – both advantageous and disadvantageous
- Swabbing of skin with 70% ethanol prior to injection



Halogens

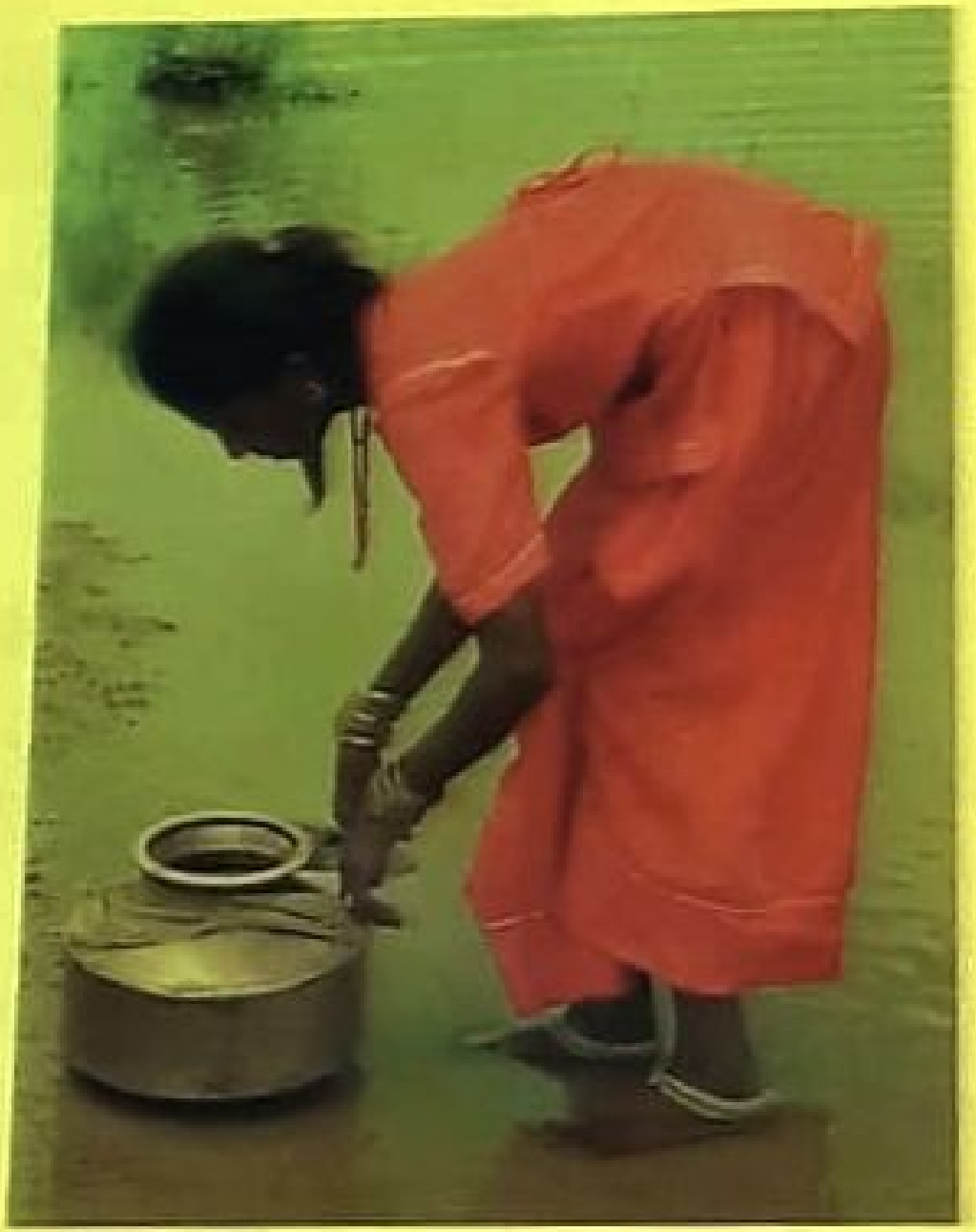
- Intermediate-level antimicrobial chemicals
- Believed that they damage enzymes via oxidation or by denaturing them
- Iodine tablets, iodophores (Betadine®), chlorine treatment of drinking water, bleach, chloramines in wound dressings, and bromine disinfection of hot tubs

Surfactants

- "Surface active" chemicals that reduce surface tension of solvents to make them more effective at dissolving solutes
- Soaps and detergents

Heavy Metals

- Low-level bacteriostatic and fungistatic agents
- 1% silver nitrate to prevent blindness caused by *N. gonorrhoeae*
- Thimerosal (mercury-containing compound) used to preserve vaccines…problems?
- Copper controls algal growth in reservoirs, fish tanks, swimming pools, and water storage tanks; interferes with chlorophyll



- Brass is an alloy of copper and zinc.
- Copper slowly leaches out of the metal.
- Indian tradition of storage of river water in brass containers as a way to prevent disease.
- The river water may have up to 1 million fecal bacteria per ml. That count could be reduced to undetectable by 2 days of storage in a brass container!

Oxidizing Agents

- Peroxides, ozone, and peracetic acid kill by oxidation of microbial enzymes
- High-level disinfectants and antiseptics
- Hydrogen peroxide can disinfect and sterilize surfaces of objects
- Ozone treatment of drinking water
- Peracetic acid – effective sporocide used to sterilize equipment

:CONCLUSION

- Cleaning, disinfection, and sterilisation are the backbone of infection prevention and control
- Proper cleaning essential before any disinfection or sterilisation process
- Failure to sterilise or disinfect reusable medical devices properly may spread infections
- The type and level of device decontamination depends upon the nature of the item and its intended use

Quiz

1. Decontamination results in an item that is safe for patient reuse. **True/False.**
2. Disinfection:
   a. Is used for items that will contact intact skin
   b. Involves chemical agents
   c. Reduces the numbers of microorganisms
   d. All of the above
3. The most reliable means of sterilisation is:
   a. Ethylene oxide
   b. Steam
   c. Dry heat
   d. Plasma