

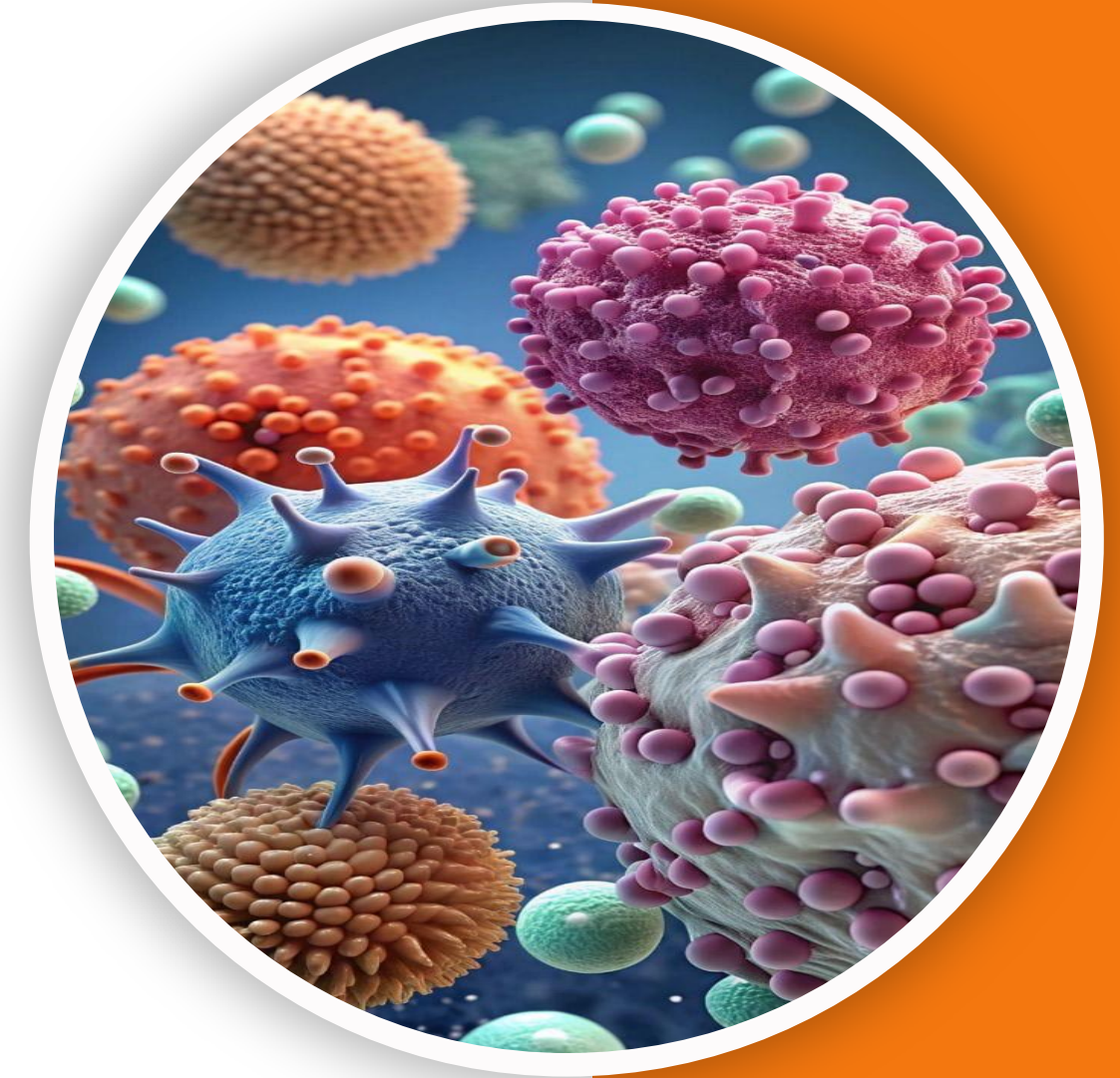
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لجائ

Microbiology | Lecture 8

Starilization & Disinfection pt.1



Written by : Leen Abukhalaf
Lujain alqadi

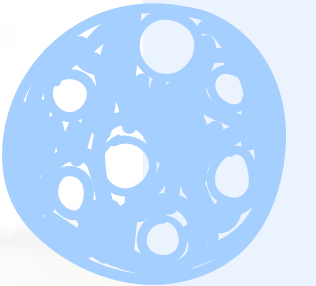
Reviewed by : NST



Lecture 6 Part-I

Sterilization & Disinfection

التطهير و التعقيم



Objectives

Sterilization& Disinfection (Definitions)

Sterilization

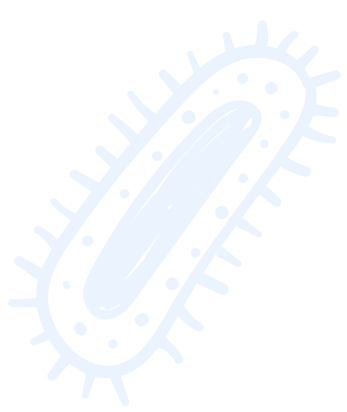
Disinfection

Antiseptics

Germicide

Cleaning

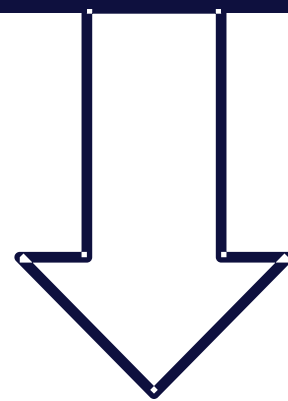
Decontamination



Sterilization & Disinfection

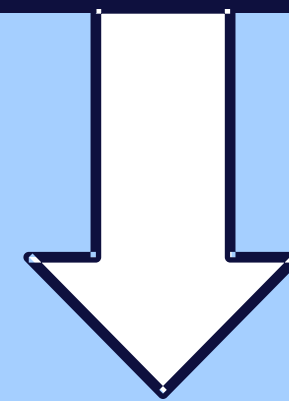
Fight bacteria

Inside the body



Antibiotics

Outside the body



Sterilization & Disinfection

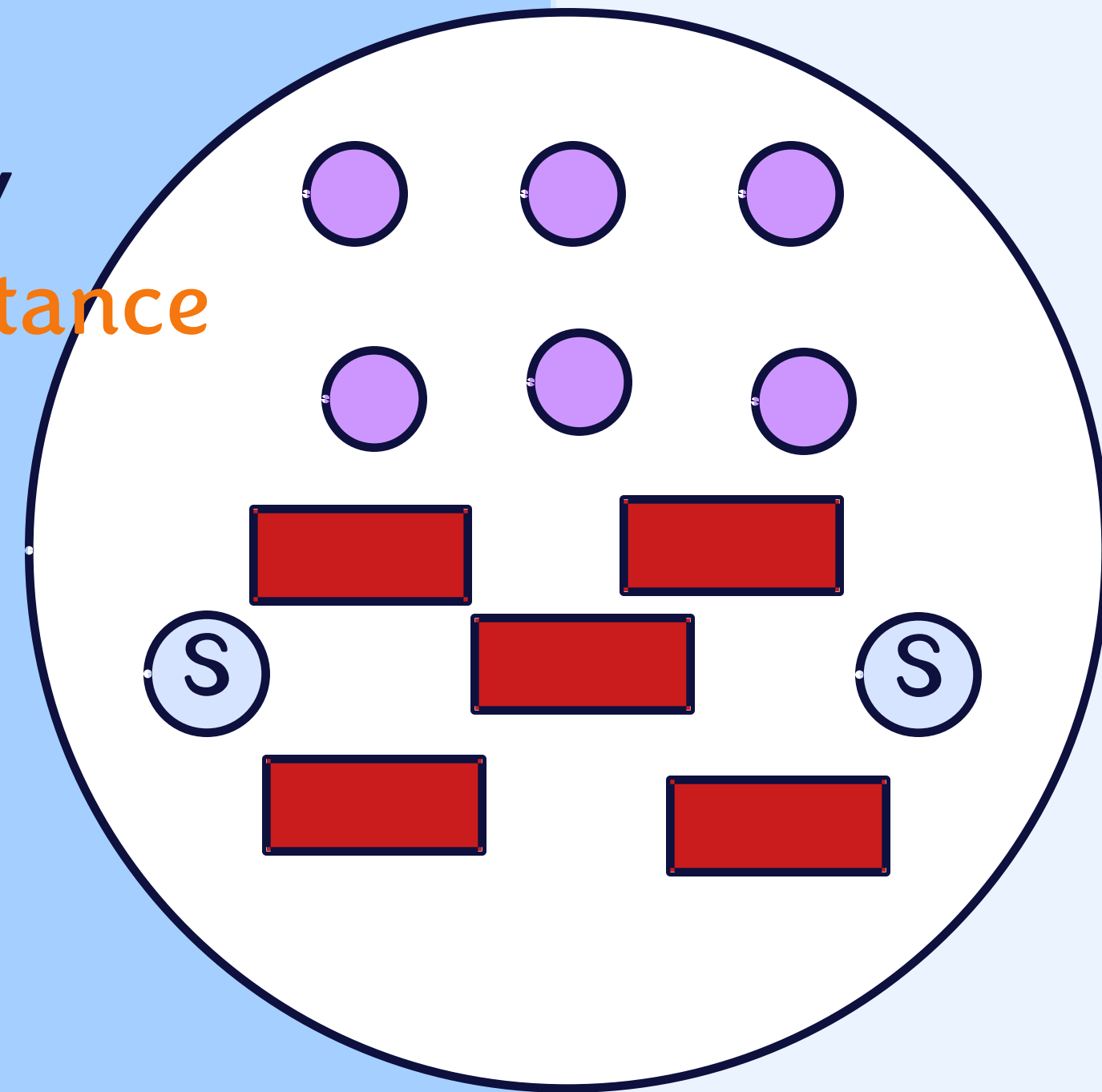


Sterilization



Removal or killing of all forms of living microorganisms including bacterial spores by physical or chemical methods.

Spores forming and non-spores forming
A resistance phase



Sterilization

Absolute term

**Killing *or* removing All
Microorganisms**



Sterilization

Need for what
Surgical instruments



Sterilization

Some of them are invasive ,
so it had to be fully sterilized
because they are entering
our body and we don't want
any type of contamination

Syringes



Gloves



catheter

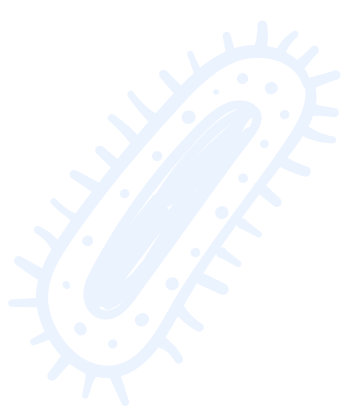


Culture media

We need to culture bacteria for identification , to see the suitable antibiotic for the patient.

As we are searching for the causative pathogen ; so it has to be sterilized then used ; as it is a good medium for bacterial growth so it should be sterilized so there is no contamination.





Sterilization

```
graph TD; A[Sterilization] --> B[Physical methods]; A --> C[Chemical methods]; B --> D[Heat]; B --> E[Radiation]; B --> F[Filtration]; C --> G[Gaseous]; C --> H[Liquids];
```

Physical methods

Heat

Radiation

Filtration

Chemical methods

Gaseous

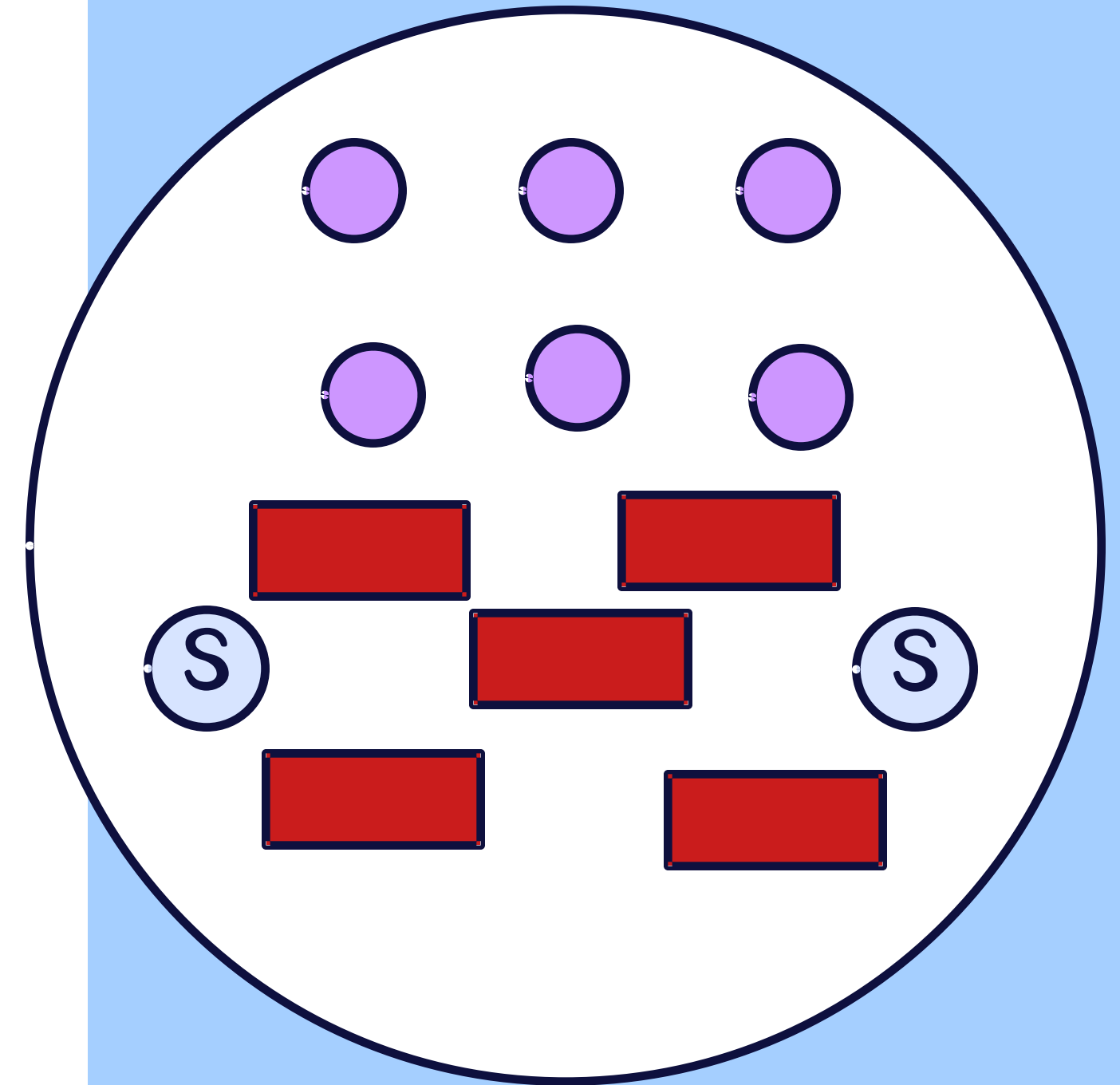
Liquids

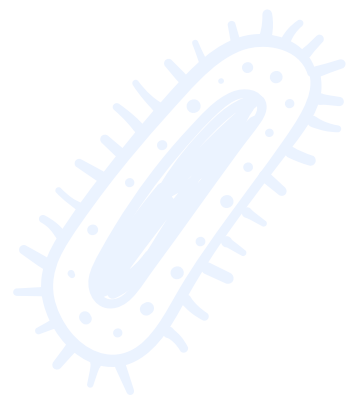


Disinfection

Removal of most (if not all) pathogenic organisms except bacterial spore by physical or chemical methods.

Disinfection kills most bacteria but cannot eliminate resistant forms such as spores. Therefore, it only reduces the microbial load to a level that cannot cause infection, since infection typically requires a high number of microorganisms.





Disinfection

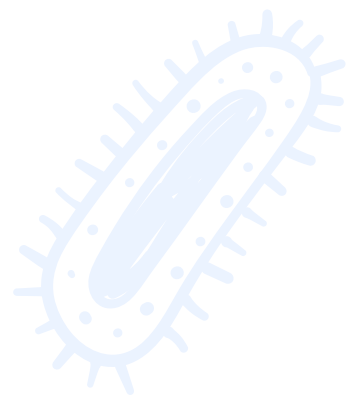
- **Disinfectants**

Chemical substances that used to achieve disinfection

TOXIC

**And we need to take
caution**





Disinfection

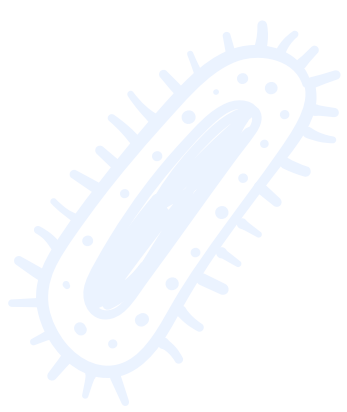
- Disinfectants may be:–

A) High level disinfectant → Nearly equivalent for the sterilization process

B) Intermediate level disinfectant

C) Low level disinfectant





Disinfection

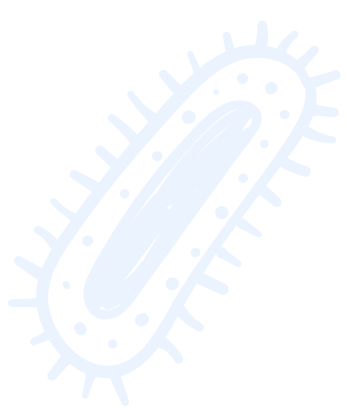
A) High level disinfectant

Kill all microbes EXCEPT Large number of bacterial Spore.

e.g. H_2O_2 For contact lens

- If there were only a low number of spores it will kill them all (close to sterilization)





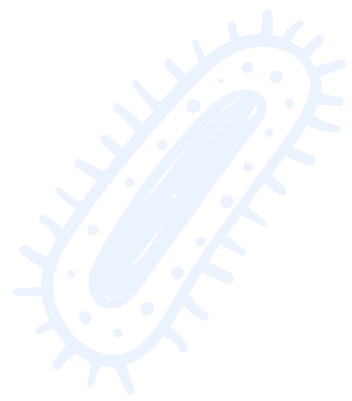
Disinfection

B) Intermediate level disinfectant

Kill all microbes EXCEPT Bacterial Spore.

e.g. alcohol





Disinfection

C) Low level disinfectant

Kill MOST vegetative Bacteria EXCEPT

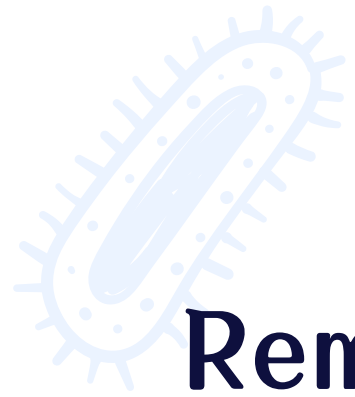
Mycobacterium tuberculosis

Can be used as an
indicator for
disinfectants :

Present: low level

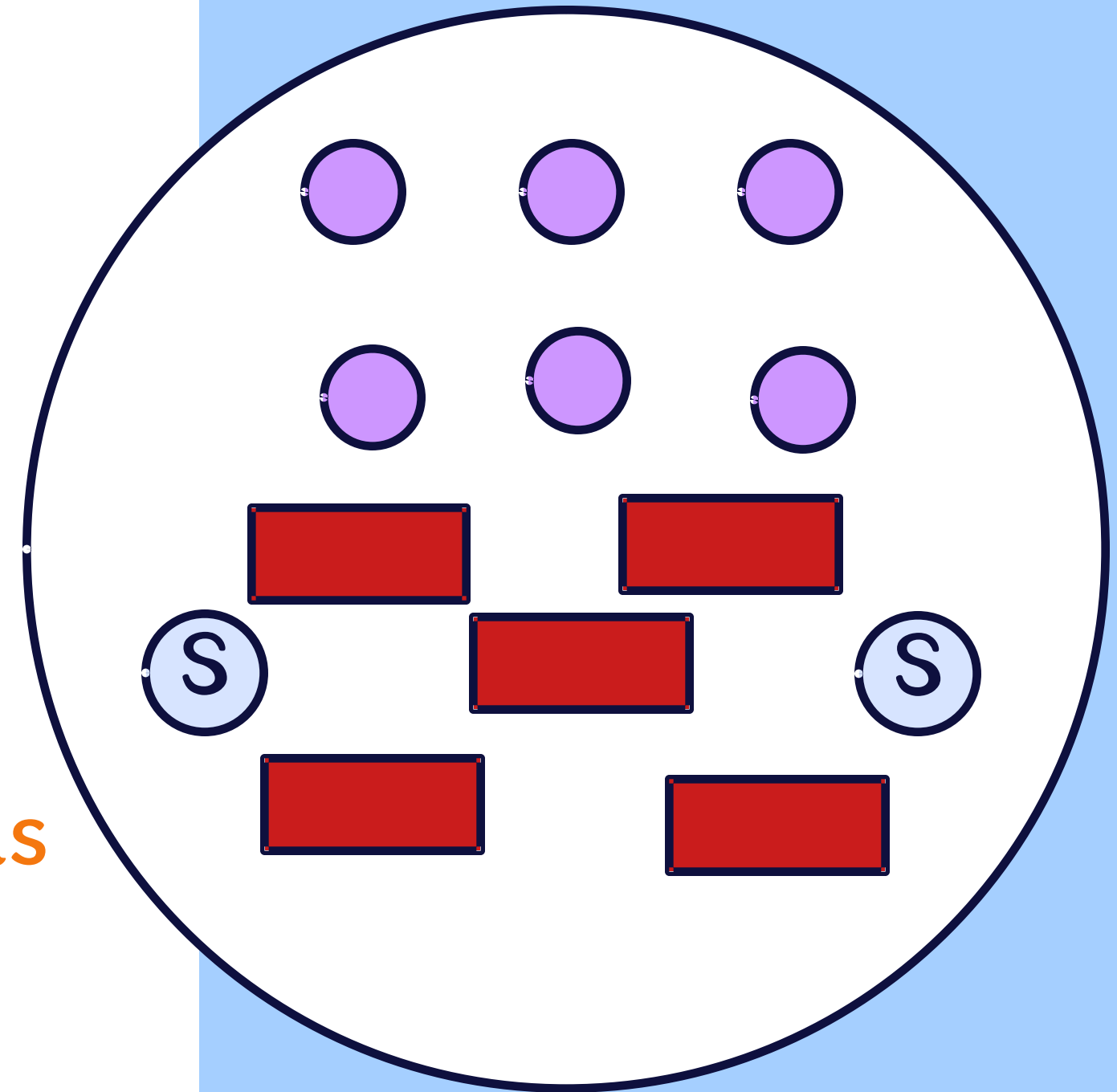
Not present: high level
or medium level

Antiseptics



Removal most (if not all)
microbes Except bacterial
spore.

Non-TOXIC



Same definition as disinfection but the only difference that it's where it's used, as antiseptics can be used **on living tissues** unlike disinfectant that are only used on surfaces



Germicide

Naming is accordingl what it kills and the mechanism

Agent destroy microorganism

Virucide

Kills viruses

Bactericide

Kills bacteria

Fungicide

Kills fungi



Germicide

Agent destroy microorganism and can act as

Disinfectant = with spores toxic

Antiseptic = with spores nontoxic

Sterilant. = 100% without spores



Germicide

Disinfection = Process

Disinfectant = Substance / Chemical

We call the Germicide as
Disinfectant, when it
achieves disinfection



Germicide

Antiseptic

**We call the Germicide an
Antiseptic, when it is non-toxic achieves
disinfection**



Germicide

Sterilant

Chemical germicide that achieves
sterilization



Cleaning

Removal of foreign material from medical devices by water & soap

Precede disinfection & sterilization

A Mechanical method, that is considered a pre-request **before** disinfection and sterilization to remove what can be seen with the naked eye.

For Ex : an instrument full of blood and mucus should be cleaned first.



Decontamination

Reduction of organisms to a level which items are safe to handle

Include:–

- Cleaning If only with soap and water
- Disinfection Killed microbes except spores
- Sterilization Killed microbes including spores



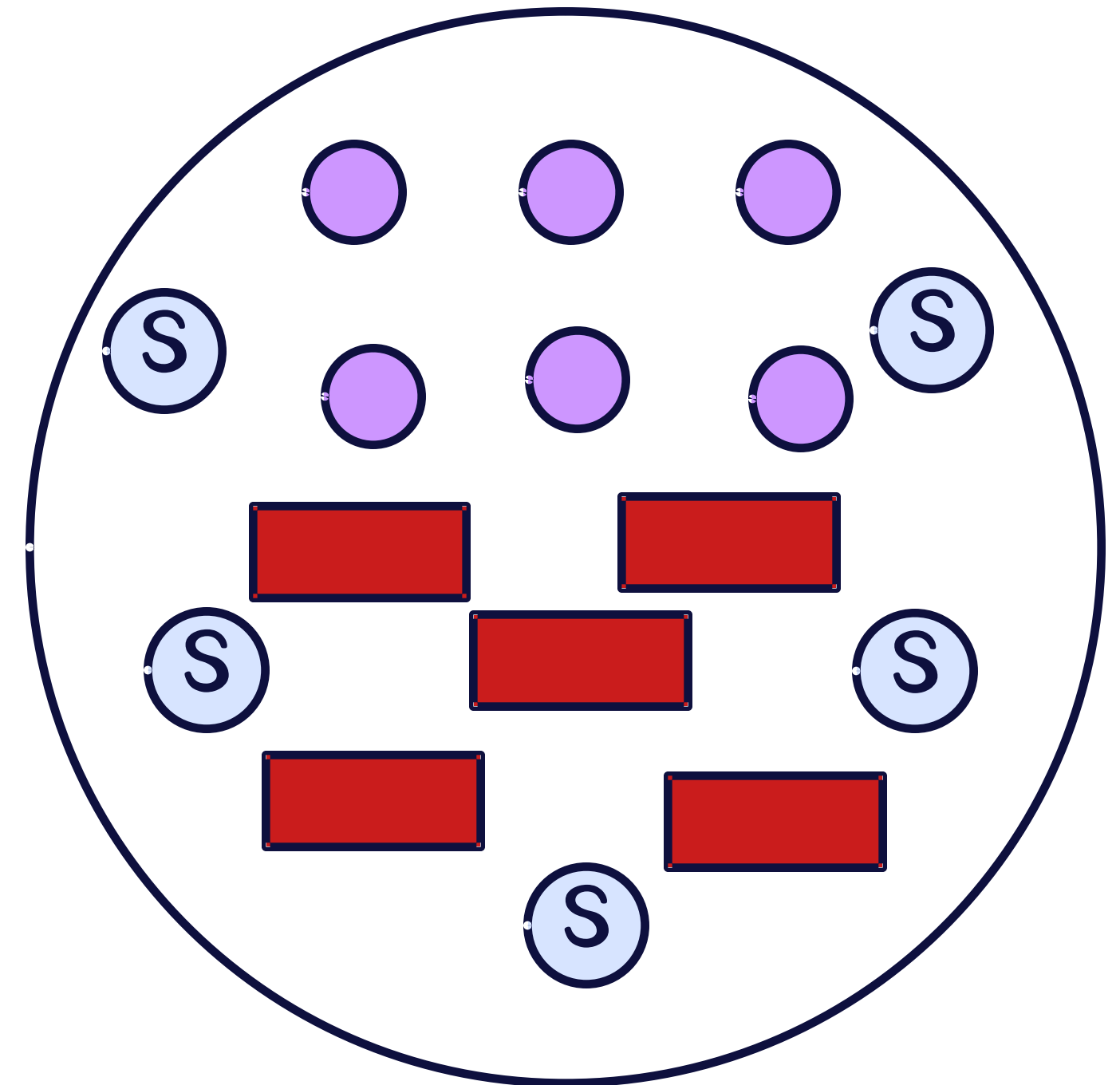
Objectives

Physical methods for disinfection

- | | | |
|-------------------|-----------------|---|
| Moist heat | 3 levels | <ul style="list-style-type: none">➤ Lower than 100 degrees➤ At 100 degrees➤ More than 100 degrees |
| Radiation | | <p>This is not considered disinfection method, but is a sterilization method</p> |

Disinfection

Removal most (if not all) pathogenic
organisms except bacterial spore



Disinfection

```
graph TD; A[Disinfection] --> B[Physical]; A --> C[Chemical]; B --> D["1) Moist Heat"]; B --> E["2) Radiation"]; C --> F["(Disinfectant)"];
```

Physical

1) Moist Heat

2) Radiation

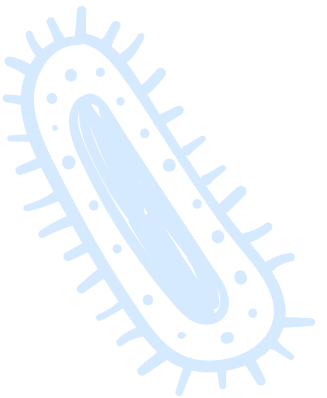
Chemical

(Disinfectant)

Physical methods for disinfection

Moist heat

I) Moist heat below 100°C (Pasteurization)



I) Moist heat below 100°C

- Pasteurization

At 63°C for 30 min.

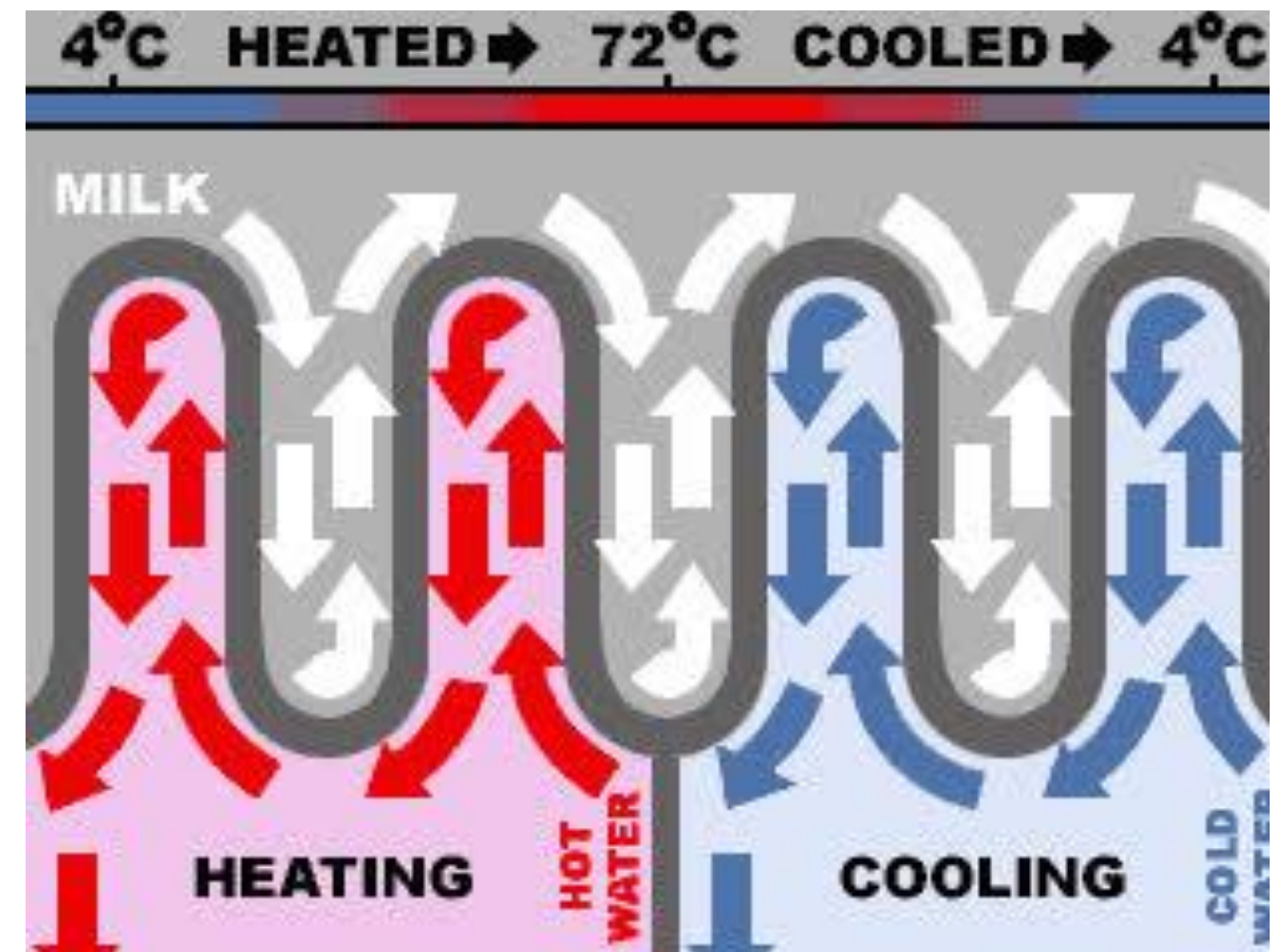
Temperature and duration are Related inversely

At 72°C for 20 sec.

Heat

Cooling

After heating there should be an immediate cooling, so it doesn't become a good medium for heat loving bacteria to grow

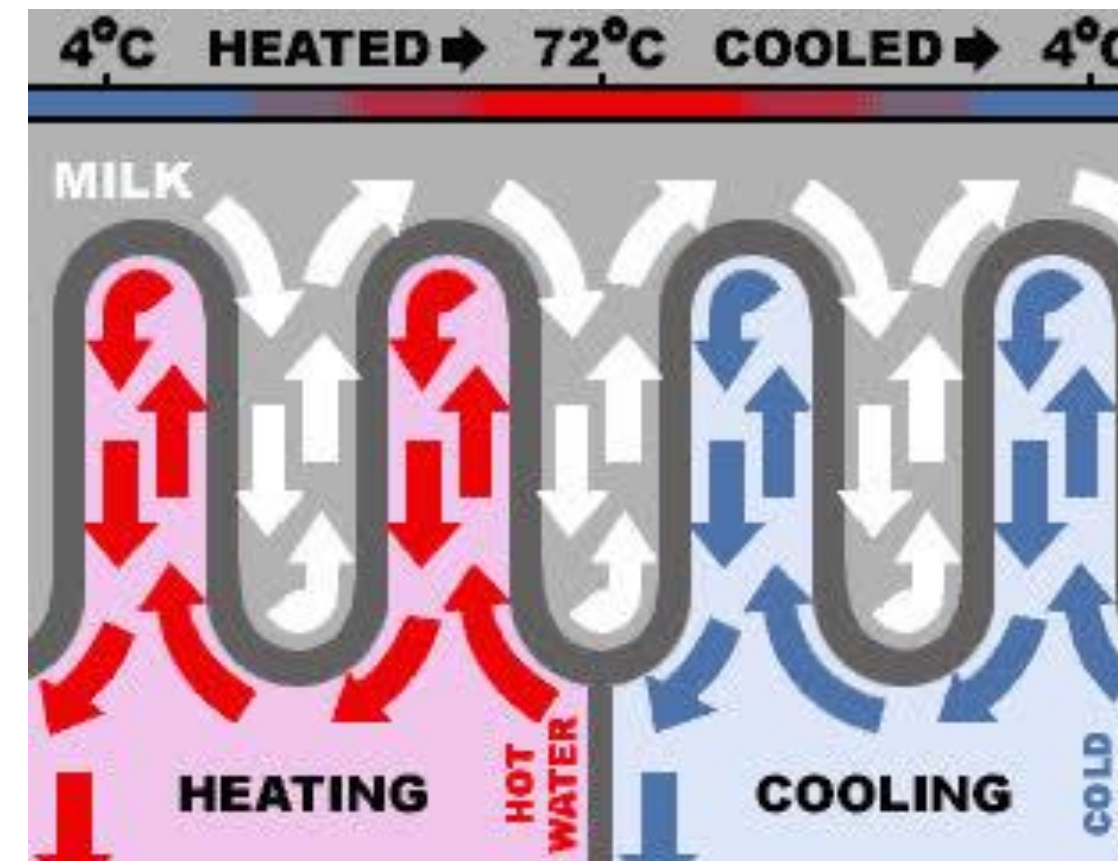


I) Moist heat below 100°C

- Pasteurization

Not sterilizing, Kills

- *M. Tuberculosis*
- *B. abortus*
- *Salmonella*
- *C. burnetti*



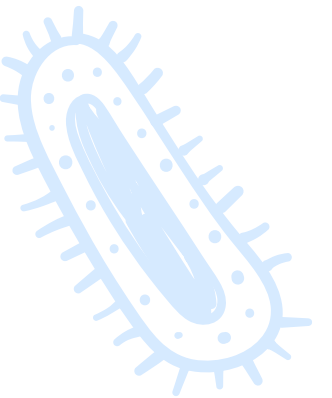
Factories used this method in the old days with milk and juice, but they found it is inefficient as they stay safe for a short while and then gets contaminated. Now they use autoclaving

Physical methods for disinfection

1) Moist heat

2) Moist heat at 100°C

(Boiling)



I) Moist heat at 100°C

- Boiling (100°C) for 20 min.
- Kill all vegetative bacteria
- In emergency



I) Moist heat at 100°C

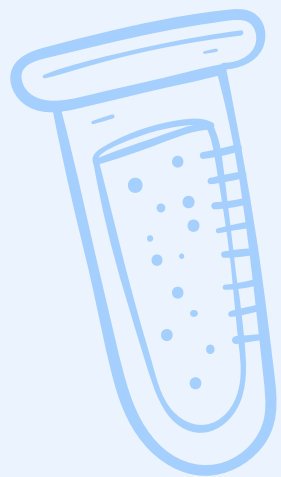
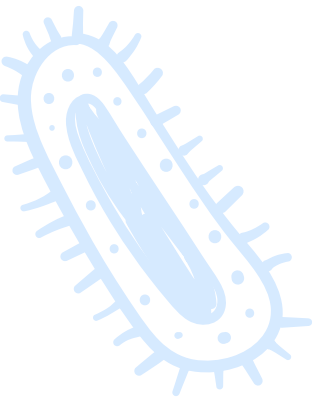
- **Boiling (100°C) for 20 min.**
Time starts counting from the moment we reach a 100 degree
- **Glass Syringes**
- **Surgical instruments**
Used along with hot air oven and autoclave



Physical methods for disinfection

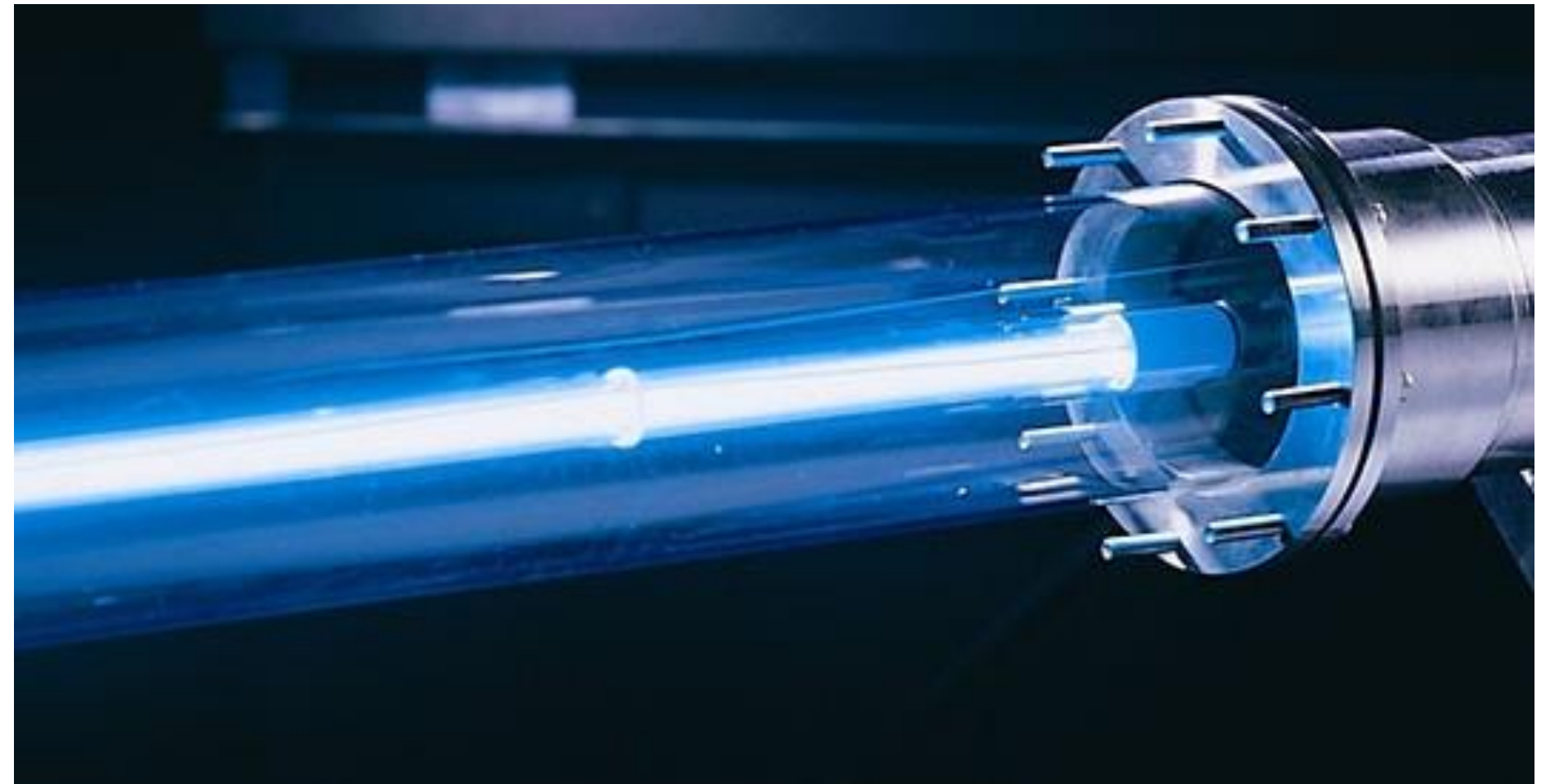
Radiation

Ultraviolet rays



Radiation

- **Ultraviolet rays**
 - **Artificially by mercury lamps**



Radiation

- Ultraviolet rays
 - Bactericidal
- Disadvantage
- Carcinogen

That's why everyone should leave the room while the lamp is turned on



Radiation

- Ultraviolet rays
- Operation room
- Drug filling cubicles
- Safety cabinets
For Ex : In culturing



Radiation

- Ultraviolet rays
- Surface disinfectant

Because it has

- Low penetration



Objectives

Chemical agents for disinfection

Low level disinfectants

Intermediate level disinfectants

High level disinfectants

Chemical agents for disinfection &Antiseptics

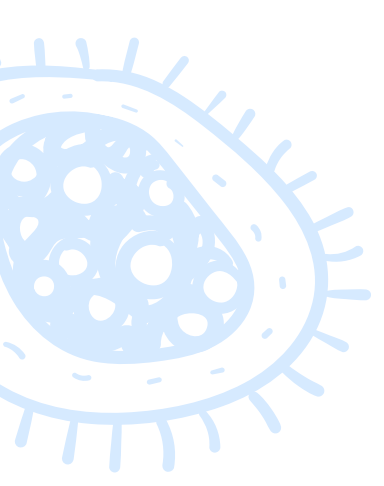
Why there is resistant to
antibiotics and usually no
resistant for chemical
disinfectants ?



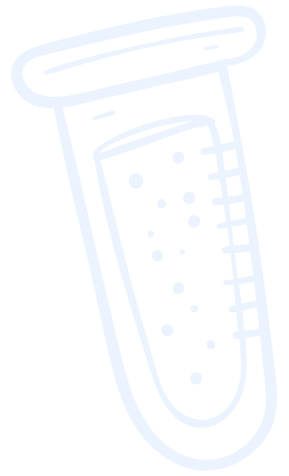
Chemical agents for disinfection &Antiseptics

Because Chemical disinfectants have a combination action

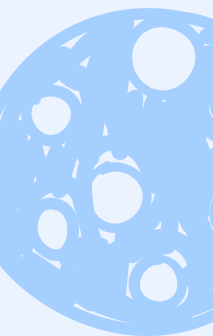
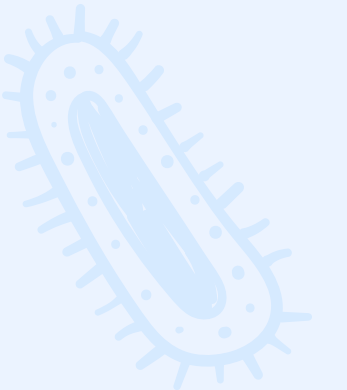
- Oxidation
- Denaturation
- Breaks DNA
- Cell membrane & cell wall damage



Chemical agents for disinfection & Antiseptics



I) Low level disinfectants

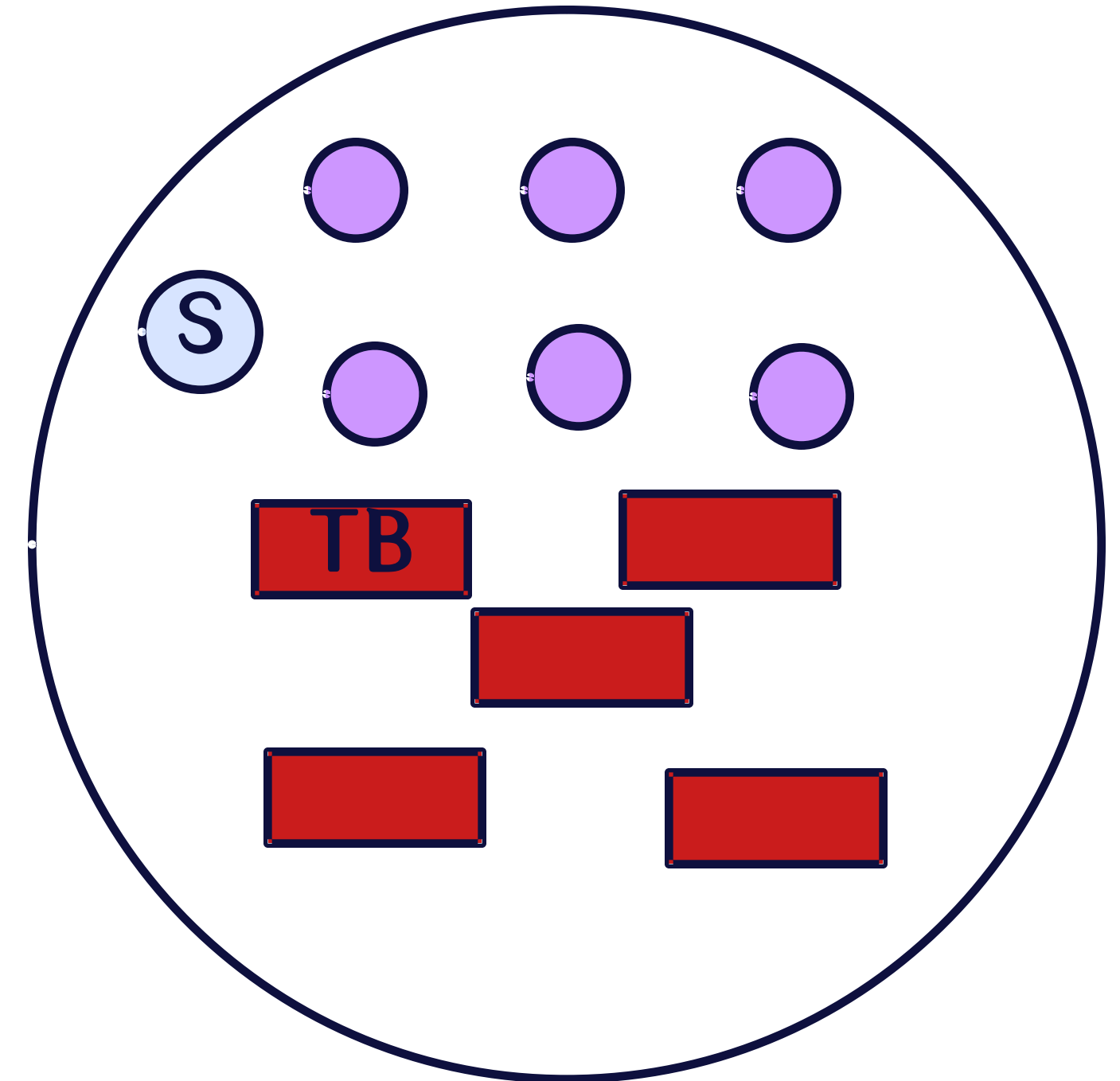


I) *Low level disinfectants*

Kills MOST

microbes, EXCEPT TB & bacterial Spore

(Tuberculosis)



I) Low level disinfectants

I) Quaternary Ammonium Compounds

- Benzethonium Chloride
- Benzalkonium chloride

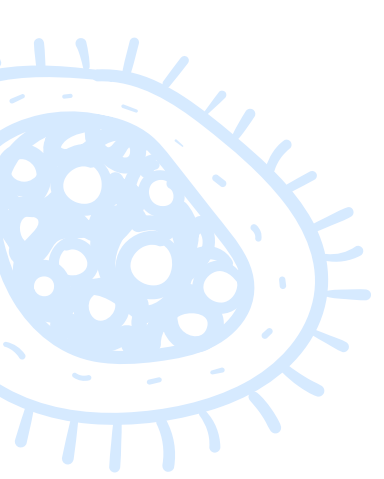


I) *Low level* disinfectants

Disinfection of:-

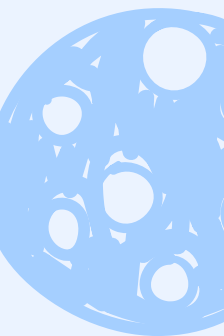
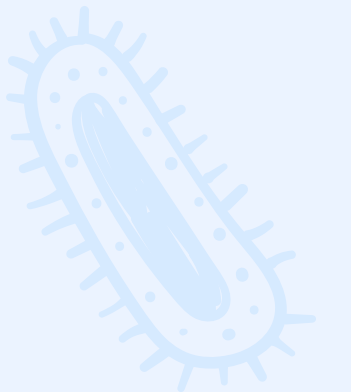
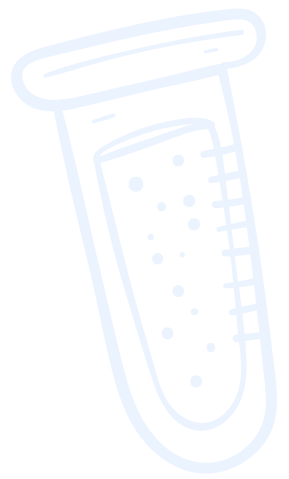
- Floors
- **Blood spills**





Chemical agents for disinfection or Antiseptics

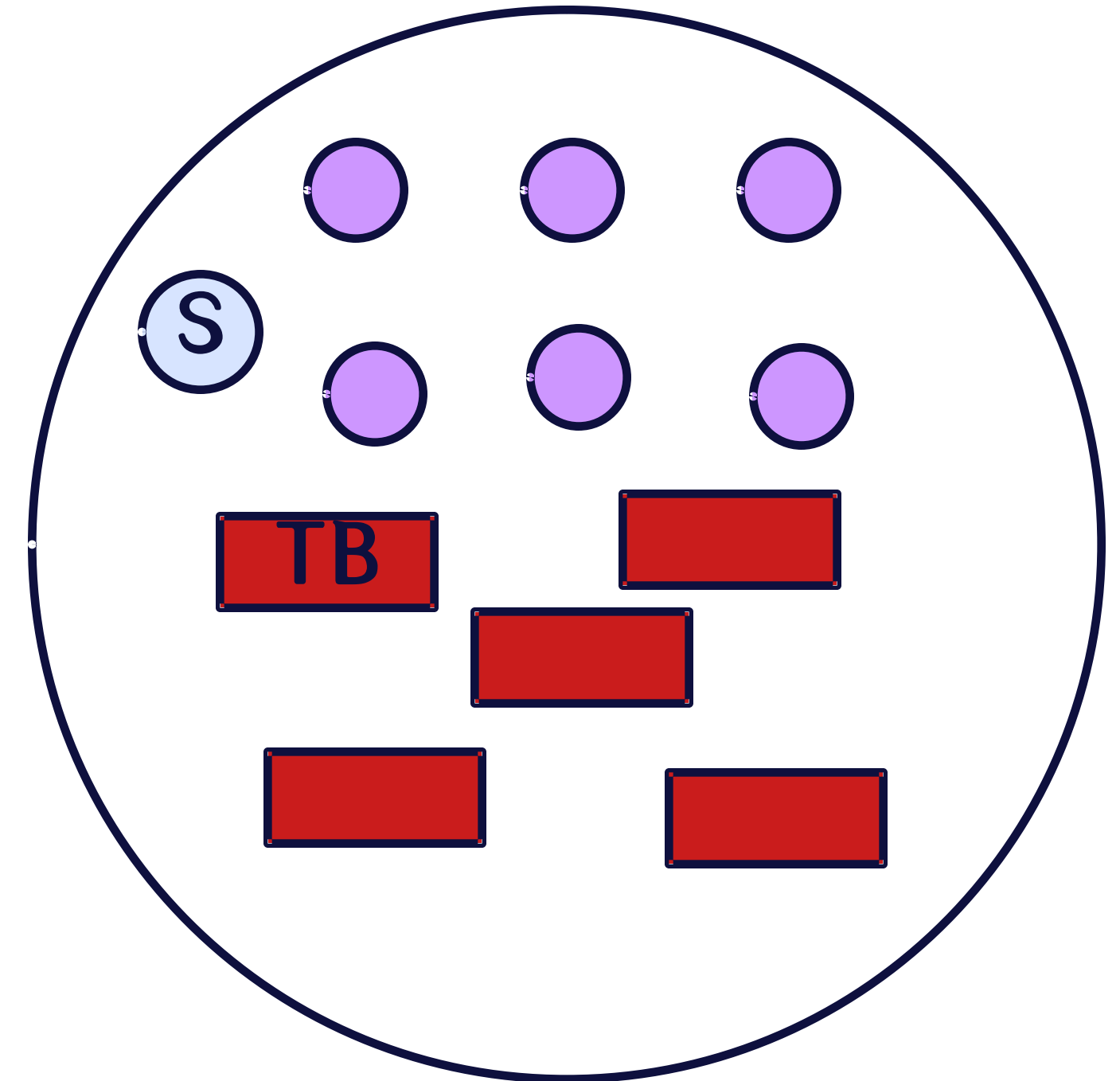
II) Intermediate level disinfectants

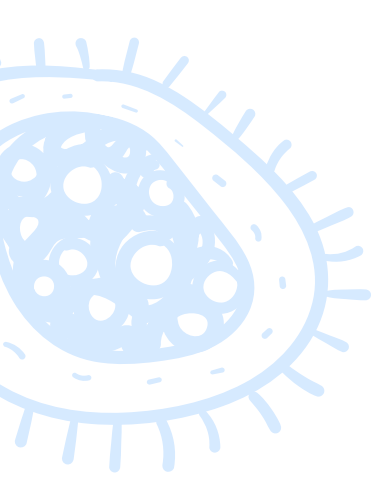


II) Intermediate level disinfection

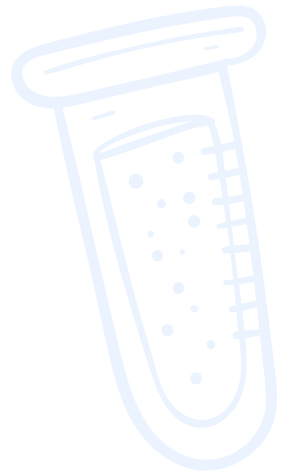
Kills most (all)

Microbes, EXCEPT bacterial Spore



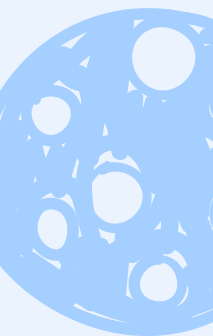
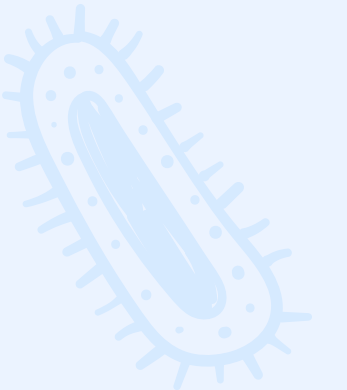


Chemical agents for disinfection or Antiseptics



II) Intermediate level disinfectants

I) Alcohols



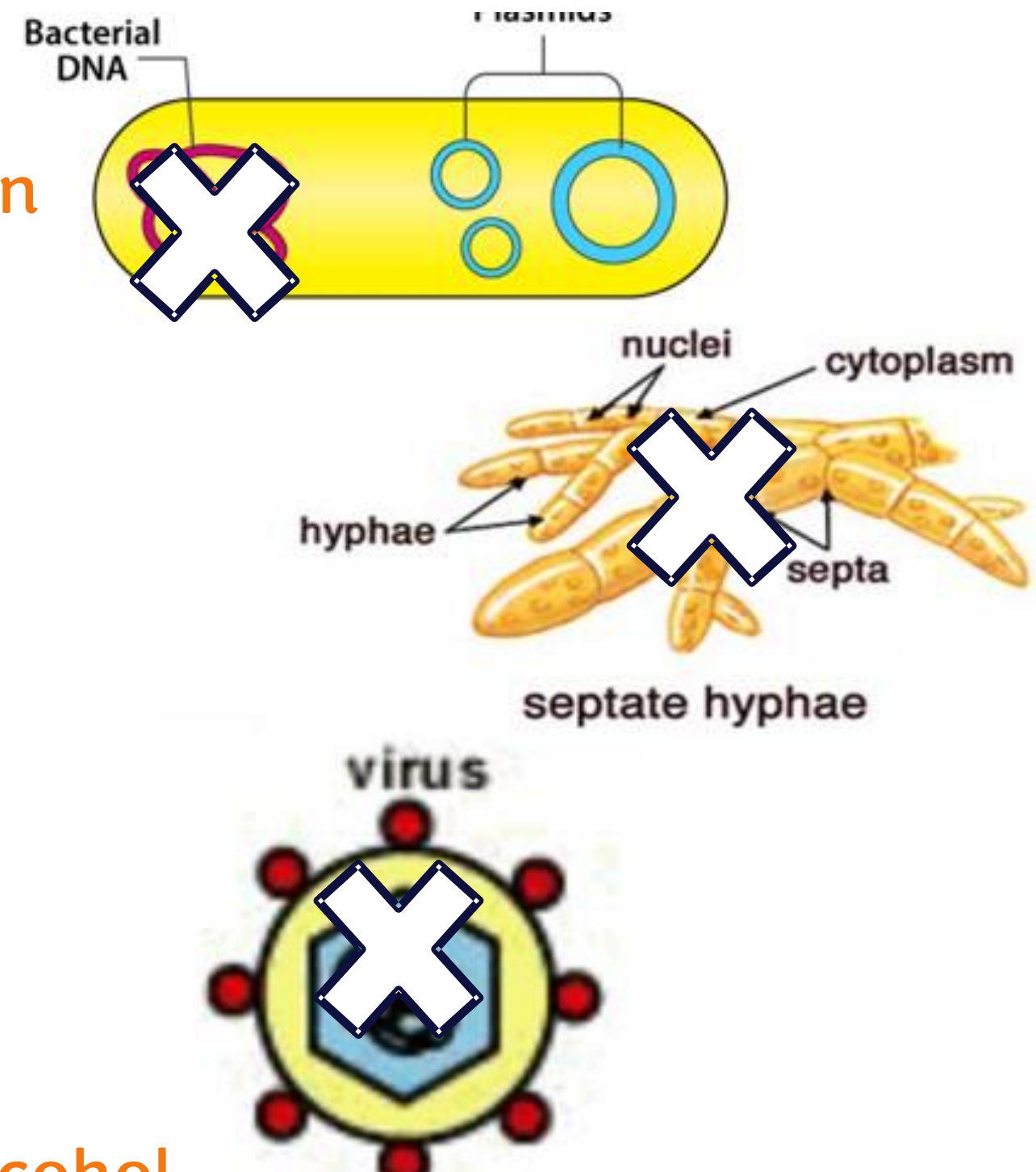
I) Alcohols

Alcohol 70%

Diluted in water that helps in penetration of alcohol in the bacteria so that the bacteria will not realize what is happening. If it was 100% alcohol, bacteria will be shocked and it will get rid of alcohol

- Bactericidal
- Fungicidal
- Viricidal (Enveloped)

Has a lipid bilayer that the alcohol can disrupt



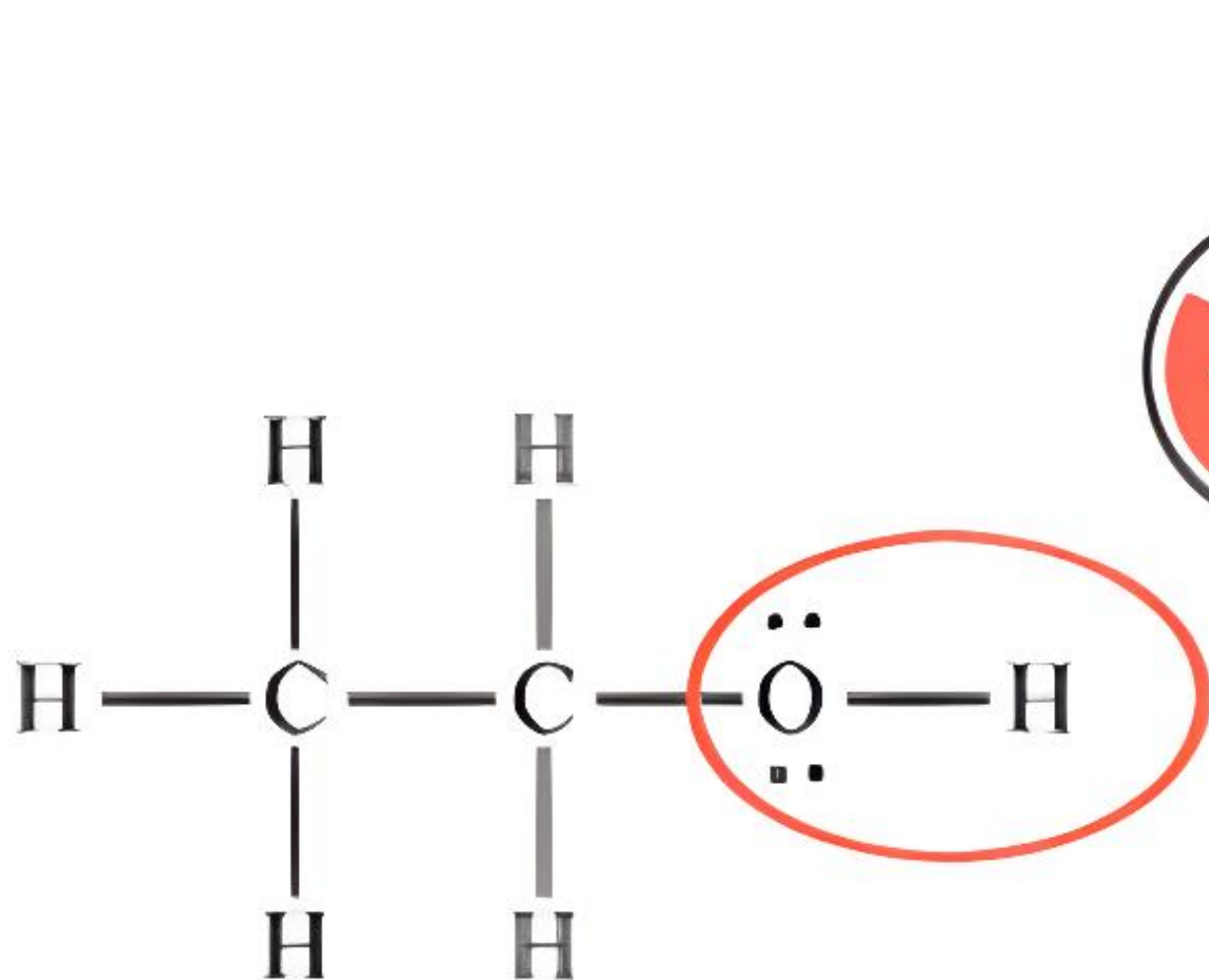
I) Alcohols

Kill microbes by:–

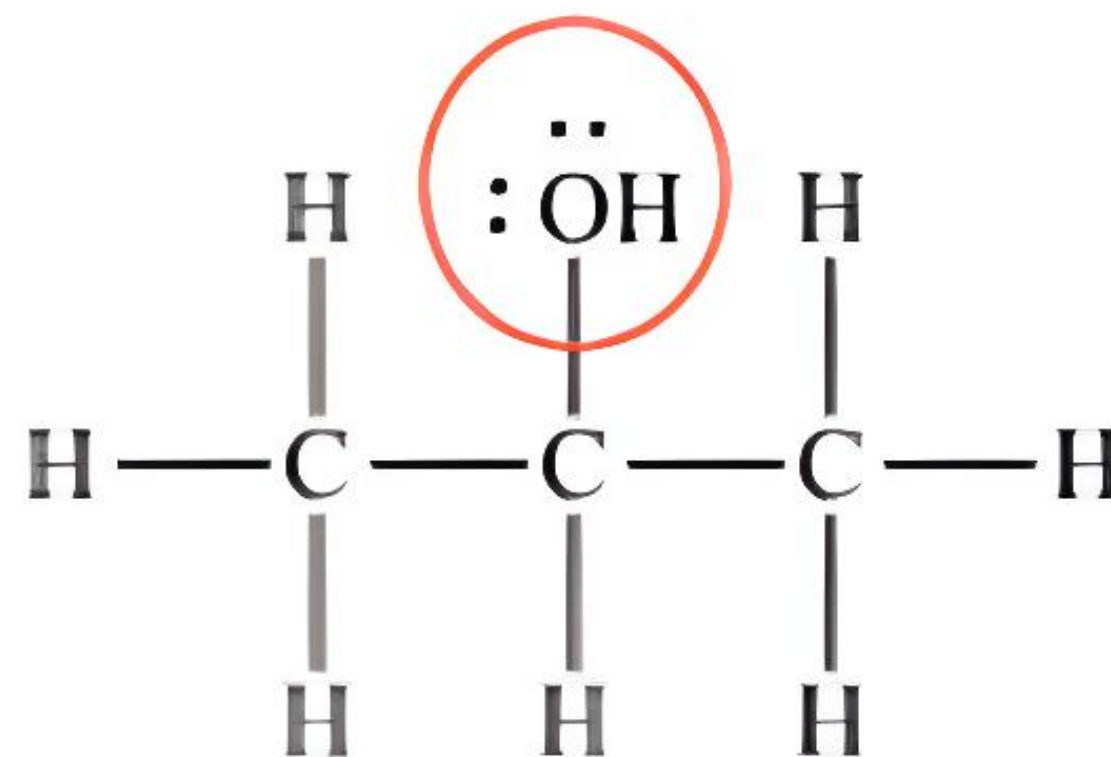
- Denaturation
- Membrane damage
- Disruption of lipid containing



I) Alcohols



ETHANOL



ISOPROPYL
ALCOHOL

II) Intermediate level disinfection

- **Ethanol**
(Ethyl alcohol)



II) Intermediate level disinfection

- **Isopropanol**
(Isopropyl alcohol)



II) Intermediate level disinfection

- Used as:–
- Antiseptics
- Hand sanitizers



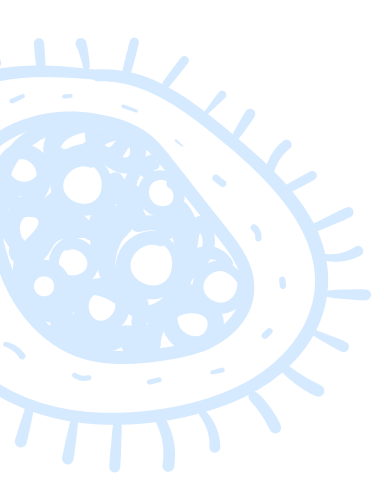
II) Intermediate level disinfection

- **Methanol**
(Methyl alcohol)

Not used at all
For if only inhalation of it can cause:

- **Blindness**
- **Damage in brain**
- **Death**

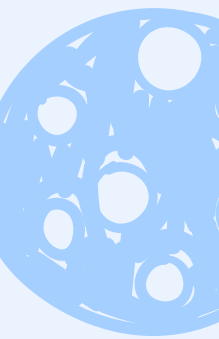
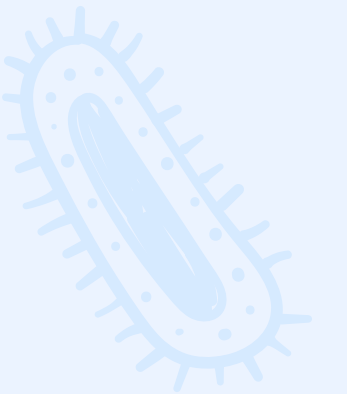
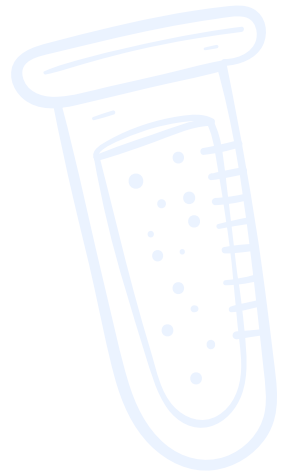




Chemical agents for disinfection or Antiseptics

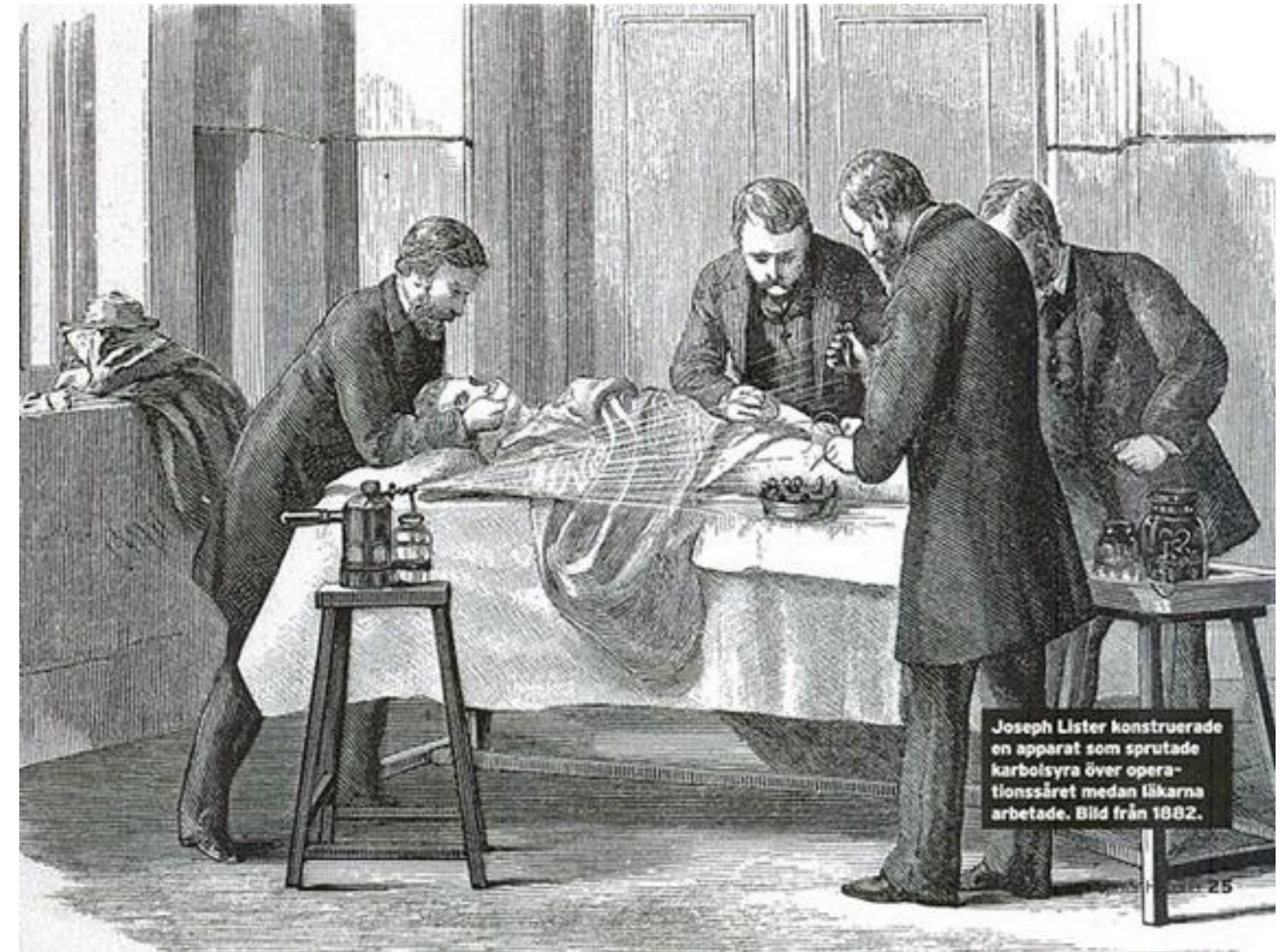
II) Intermediate level disinfectants

2) Phenols



2) Phenols

First used in the *operation room* by Lister in 1867. التاريخ غير مطلوب



II) Intermediate level disinfection

Phenol derivatives

- Cresol (*Lysol*)
- Chloroxylenol

II) Intermediate level disinfection

Phenol kill derivatives

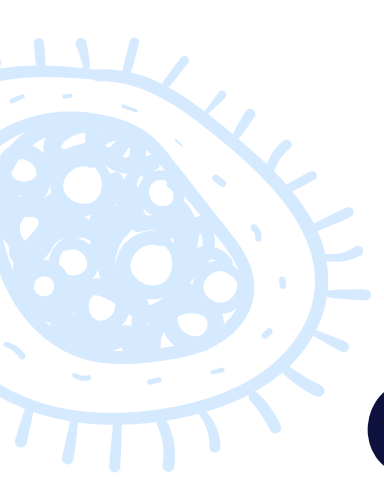
- Denaturation
- Membrane damage



II) Intermediate level disinfection

- Disinfectants
 - Floors
 - Culture spills



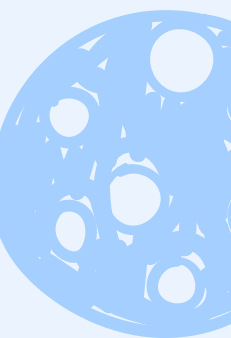
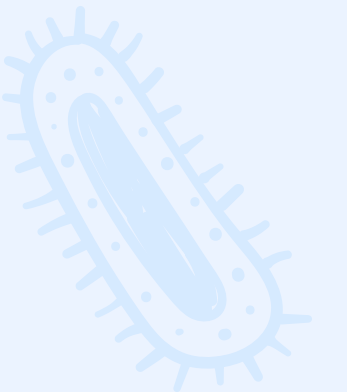
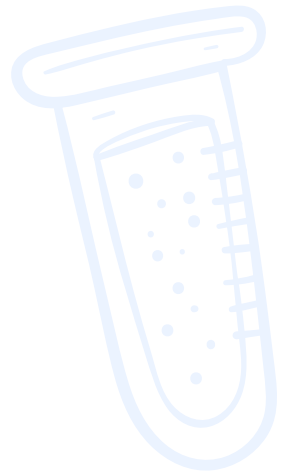


Chemical agents for disinfection or Antiseptics

II) Intermediate level disinfectants

- Biguanides

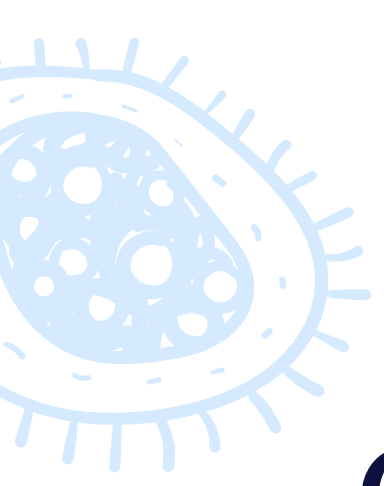
3) Chlorhexidine



II) Intermediate level disinfection

- Biguanides
- Chlorhexidine
- Antiseptic (Mouth washing)

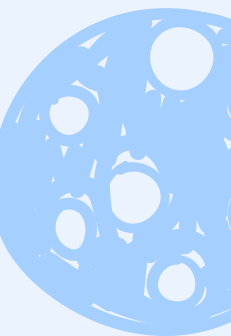
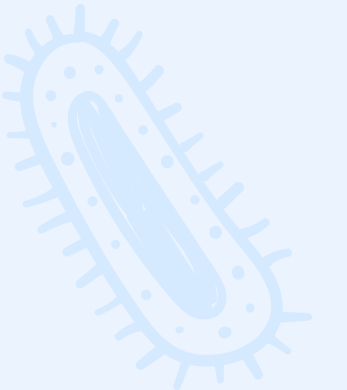
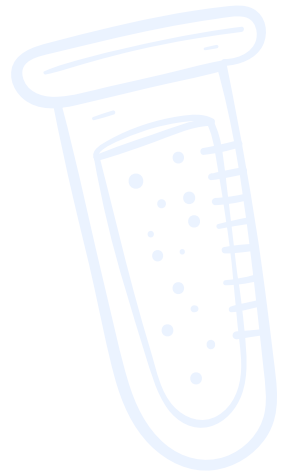




Chemical agents for disinfection or Antiseptics

II) Intermediate level disinfectants

4) Halogens



4) Halogens

- **Chlorines** Chlorine is halogen but it is **NOT** an intermediate level disinfectant ; but rather a high level disinfectant.

- **Iodines**
- **Fluorine**

4) Halogens

- Kill microbes by
- Oxidation
- Denaturation



4) Halogens

- Iodines
- Tincture Iodine
(2% Iodine + 2.4% sodium
iodide in 50% ethanol)



Skin antiseptics

4) Halogens

Skin antiseptics

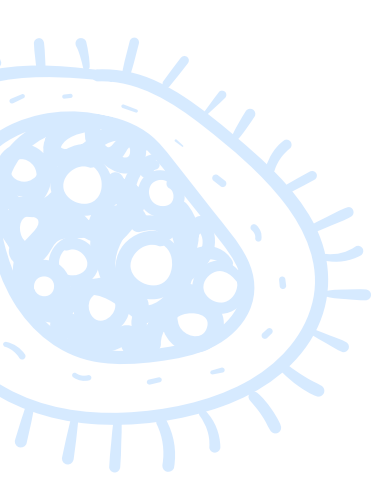
Betadine
(Povidone + Iodine)



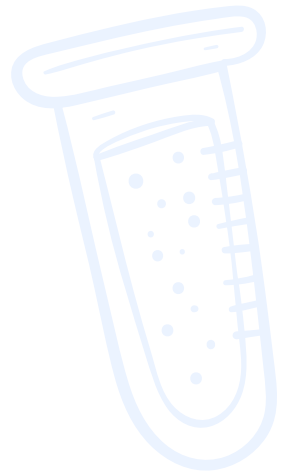
4) Halogens

- Fluoride
Toothpaste



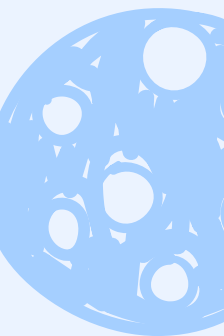
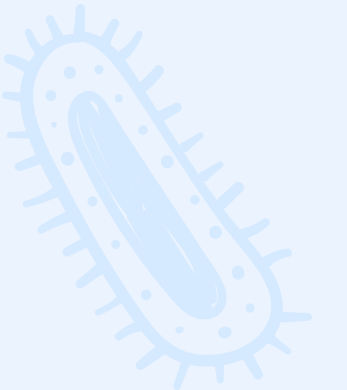


Chemical agents for disinfection or Antiseptics



II) Intermediate level disinfectants

5) Heavy metals



5) Heavy metals

- **Copper**
- **Nickle**
- **Zinc**



Antimicrobial activity

5) Heavy metals

kill microbes by:–

- Denaturation
- Inhibition enzymatic activity



5) Heavy metals

**Toxic to human & animal in
excessive concentration
(causes Argyria)**

**Used in low and studied
concentrations**



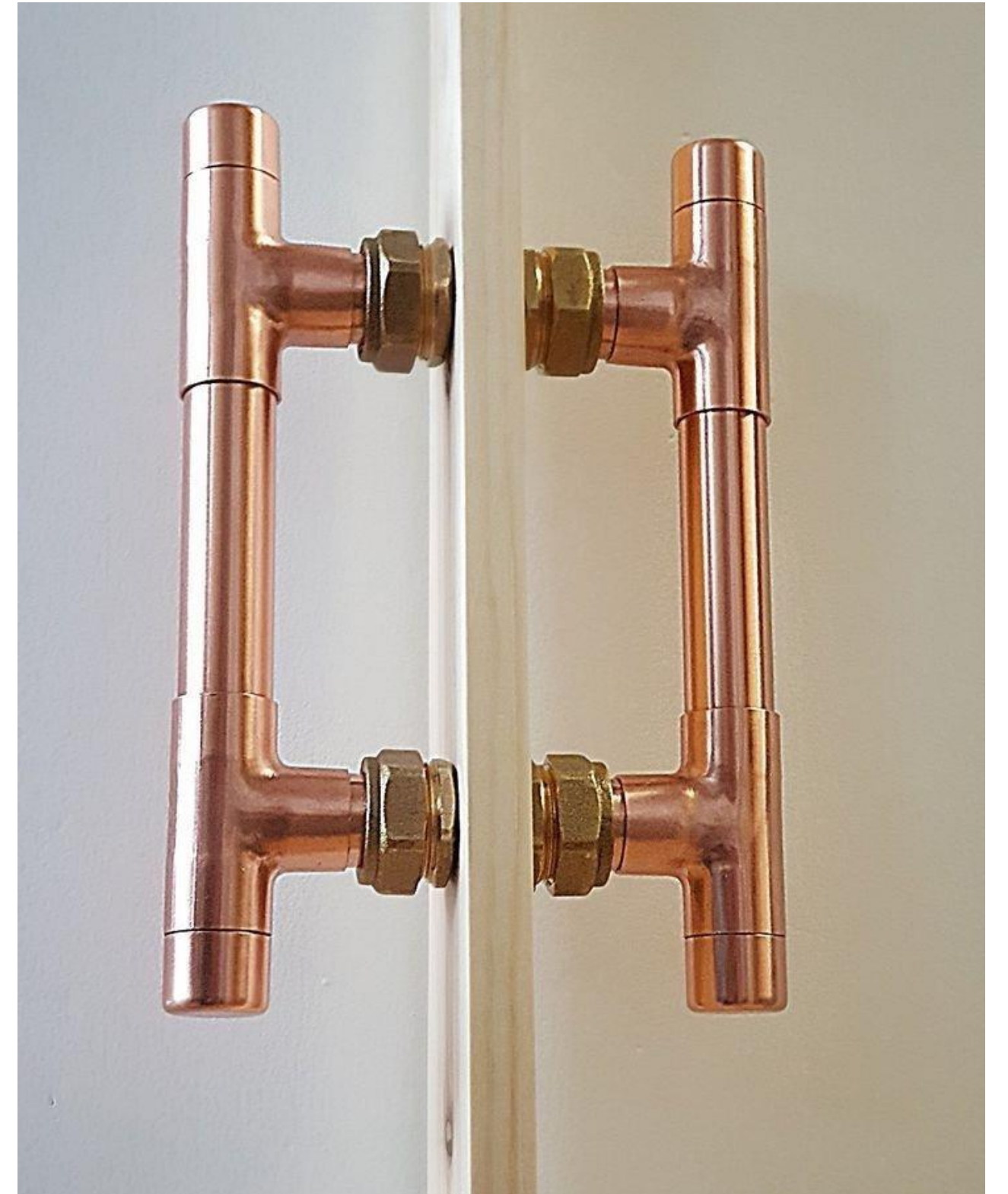
**Bluish color in hands
and face if used
excessively .**

5) Heavy metals

- Copper
- Nickle
- Zinc

(Doorknobs)

To control infections



5) Heavy metals

- Silver

(Drinking water was stored
in silver jugs because it's anti
microbial)



5) Heavy metals

- **Silver nitrate drops**

Ophthalmia neonatorum is primarily transmitted during pregnancy through passage through birth canal at delivery, an infant can become infected by direct contact with the mothers breast canal, which may contain bacteria or viruses from a sexually transmitted infection such as chlamydia or gonorrhea



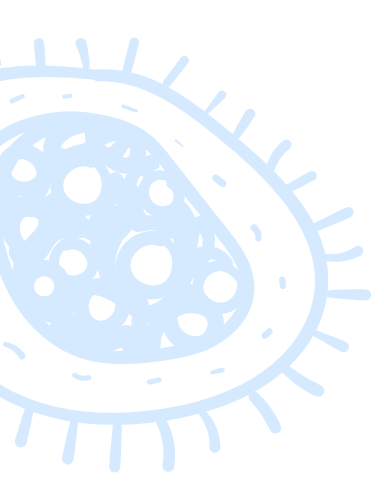
ophthalmia neonatorum

5) Heavy metals

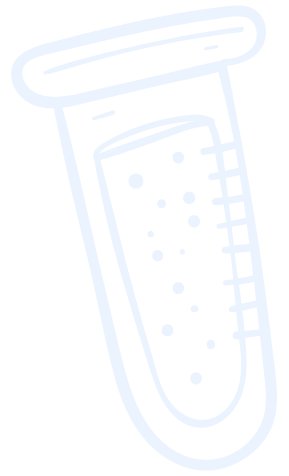
- **Zinic (Zinic oxide)**
- **Calamine lotion**

An anti microbial drug that is used in cases of chicken pox to reduce itchiness, an for eczema .
- **Baby powder**

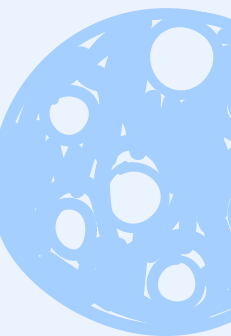
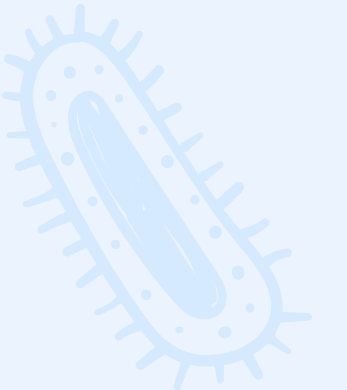




Chemical agents for disinfection or Antiseptics

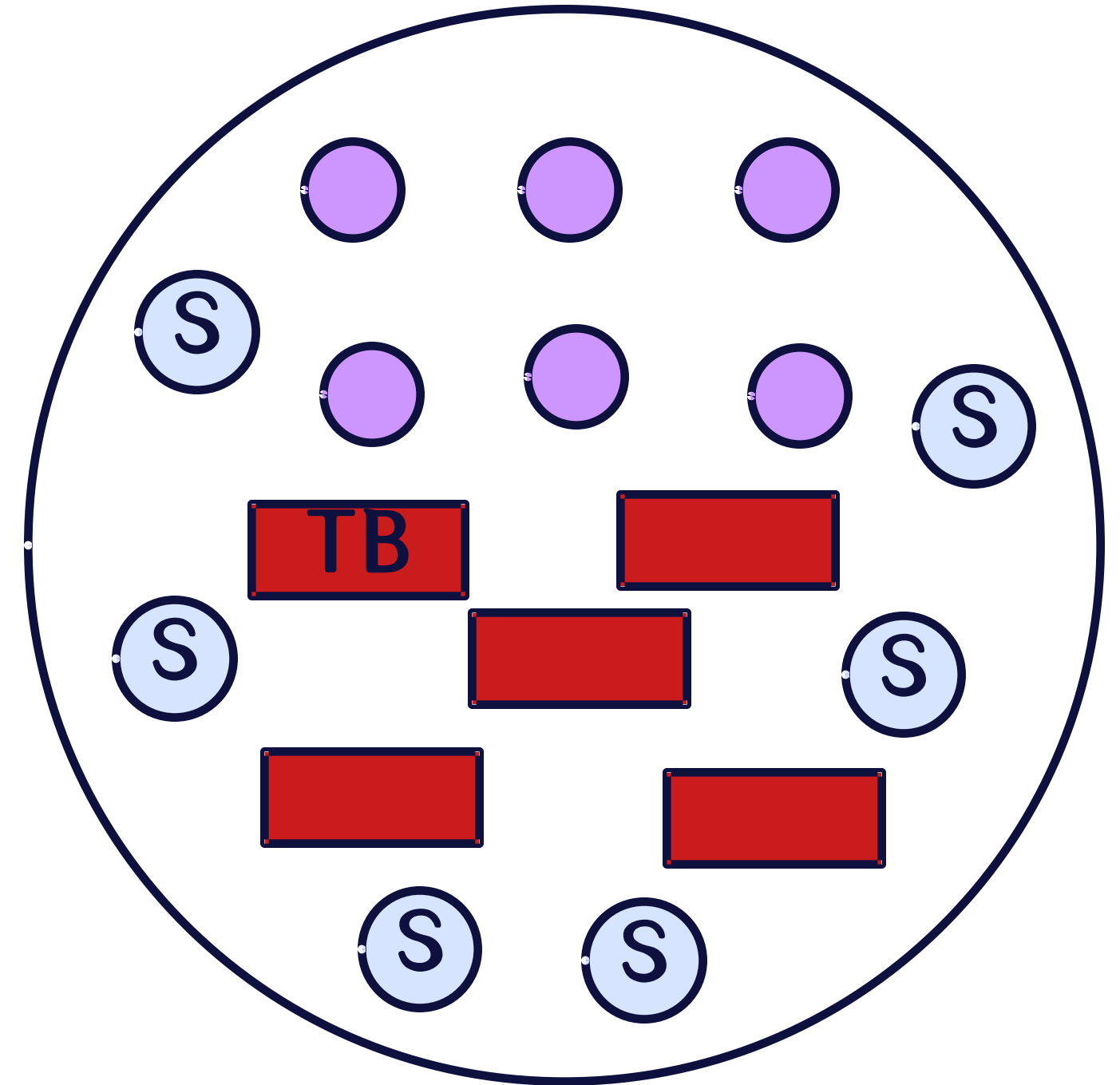


III) High level disinfectant



High level disinfectant

- Kills all microbes except large
numbers of bacterial spore



I) Chlorine High level

- Water
- Swimming pool



I) Chlorine

Sodium Hypochlorite NaOCl
(Chlorine+ Sodium + Oxygen)

- Disinfectant in homes & hospitals



- Corrosive

2) Hydrogen peroxide

- **Antiseptic**

Can be Used for living tissues



3) Glutaraldehyde 2% and 4) Peracetic acid

Can be either sterilants or disinfectants depending on contact time (see the next slide)



20 minutes → disinfection

- Needs ~10 hours → reaching a high level of disinfection and nearly sterilized

I have factors that help me know whether this chemical is a disinfectant or a sterilant

Or factors that help know whether to use disinfection process or sterilization process.

One of these factors is **the concentration** ; so for example we have the same chemical and a higher concentration level of it it might function as a sterilant. Another factor is the **contact time** ; how much time did the item stay in the solution, and did it achieve sterilization or disinfection?

From '23 batch modified.

Level	Agent	Effect	Use Cases
Low-Level	Quaternary Ammonium Compounds: 1.Benzalkonium Chloride, 2.Benzethonium Chloride	Kills most microbes except Mycobacterium tuberculosis and spores	Disinfection of floors, blood spills
Intermediate-Level	Alcohols (70% Ethanol, Isopropanol)	Bactericidal, fungicidal, virucidal (enveloped viruses)	Hand sanitizers, antiseptics
	Phenols (Chloroxylenol, Cresol)	Membrane damage, protein denaturation	Disinfection of floors, culture spills
	Chlorhexidine (Biguanides)	Antiseptic	Mouthwash
	Halogens (Fluoride, Iodine)	Oxidation, denaturation	Skin antiseptics, Toothpaste
	Heavy Metals (Copper, Zinc)	Enzyme inhibition, protein denaturation	Doorknobs, calamine lotion, baby powder
High-Level	Chlorine (Sodium Hypochlorite)	Kills all microbes except large numbers Of bacterial spores	Water treatment, hospital disinfection
	Hydrogen Peroxide		Antiseptic
	Glutaraldehyde (2%) and Peracetic Acid	Disinfectant, sterilant (based on contact time)	High-level disinfectant, sterilant



Additional Resources:

رسالة من الفريق العلمي:



For any feedback, scan the code or click on it.



Corrections from previous versions:

Versions	Slide # and Place of Error	Before Correction	After Correction
V0 → V1			
V1 → V2			