

# Lecture 6



# Sterilization and Disinfection

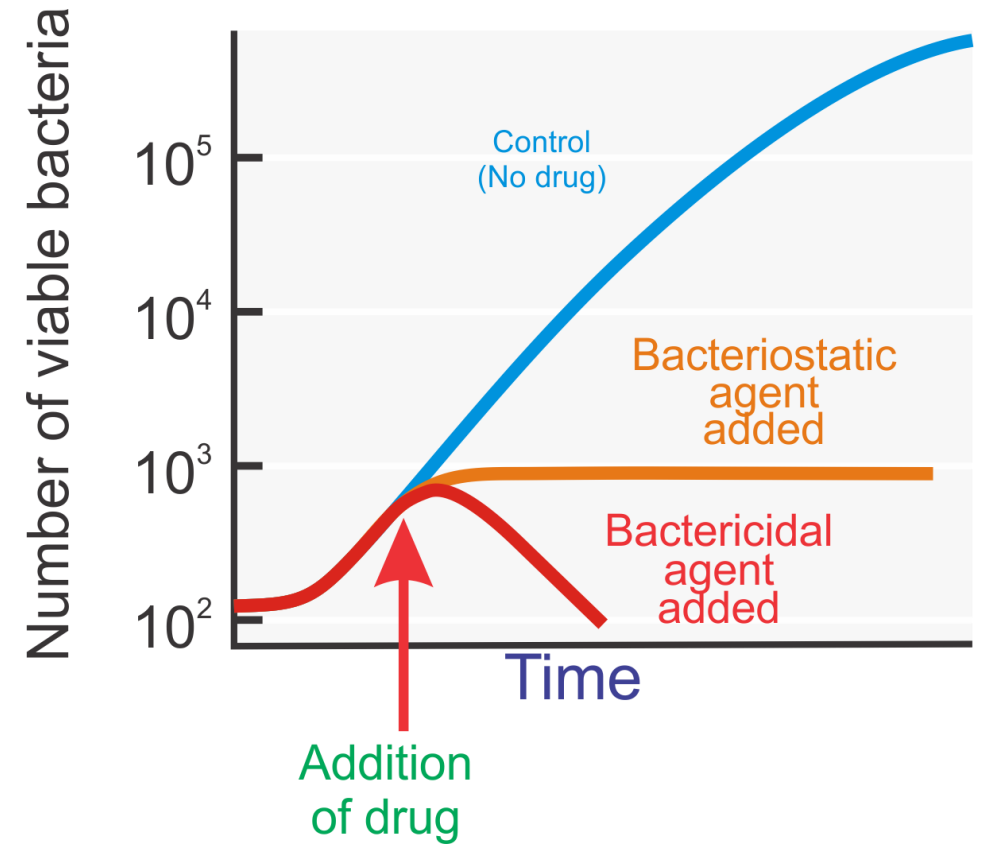
# Objectives



Define	Define [bactericidal, bacteriostatic, sterilization, disinfection]
Order	Order types of microorganisms according to level of resistance and identify most resistant types.
Classify	Classify methods of sterilization by heat; explain the principle and enumerate applications of each method.
Explain	Explain the principle and operating conditions of autoclave and hot air oven.
Explain	Explain the principle and enumerate applications of sterilization by filtration and sterilization by irradiation
Enumerate	Enumerate categories of disinfectants; give examples of some commonly used disinfectants and identify their applications.

# Definitions

Term	Definition
<b>Bactericidal</b>	<b>Kills</b> bacteria
<b>Bacteriostatic</b>	<b>Inhibits</b> growth of bacteria



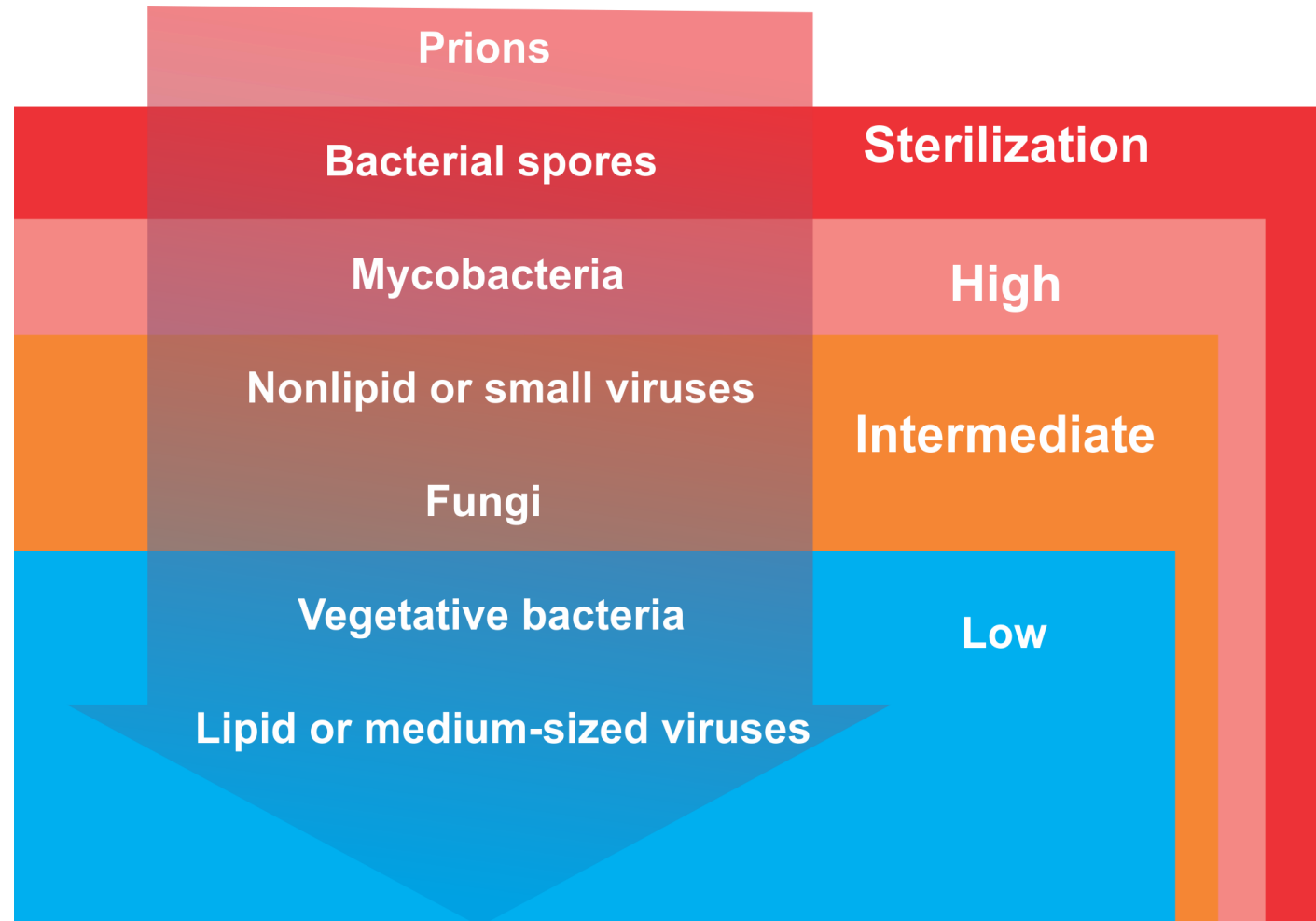
# Definitions

Term	Definition
<b>Sterilization</b>	Removal or killing of <b>all</b> living microorganisms including bacteria and their spores.
<b>Disinfection</b>	Removal or killing of <b>disease-causing</b> microorganisms (not necessarily all microorganisms).
<b>Antisepsis</b>	The removal or killing of <b>disease-causing</b> microorganisms from the surfaces of <b>living tissues</b> .



# Relative resistance

- Microorganisms differ in their resistance to disinfection and sterilization processes
- Bacterial endospores are the most resistant.



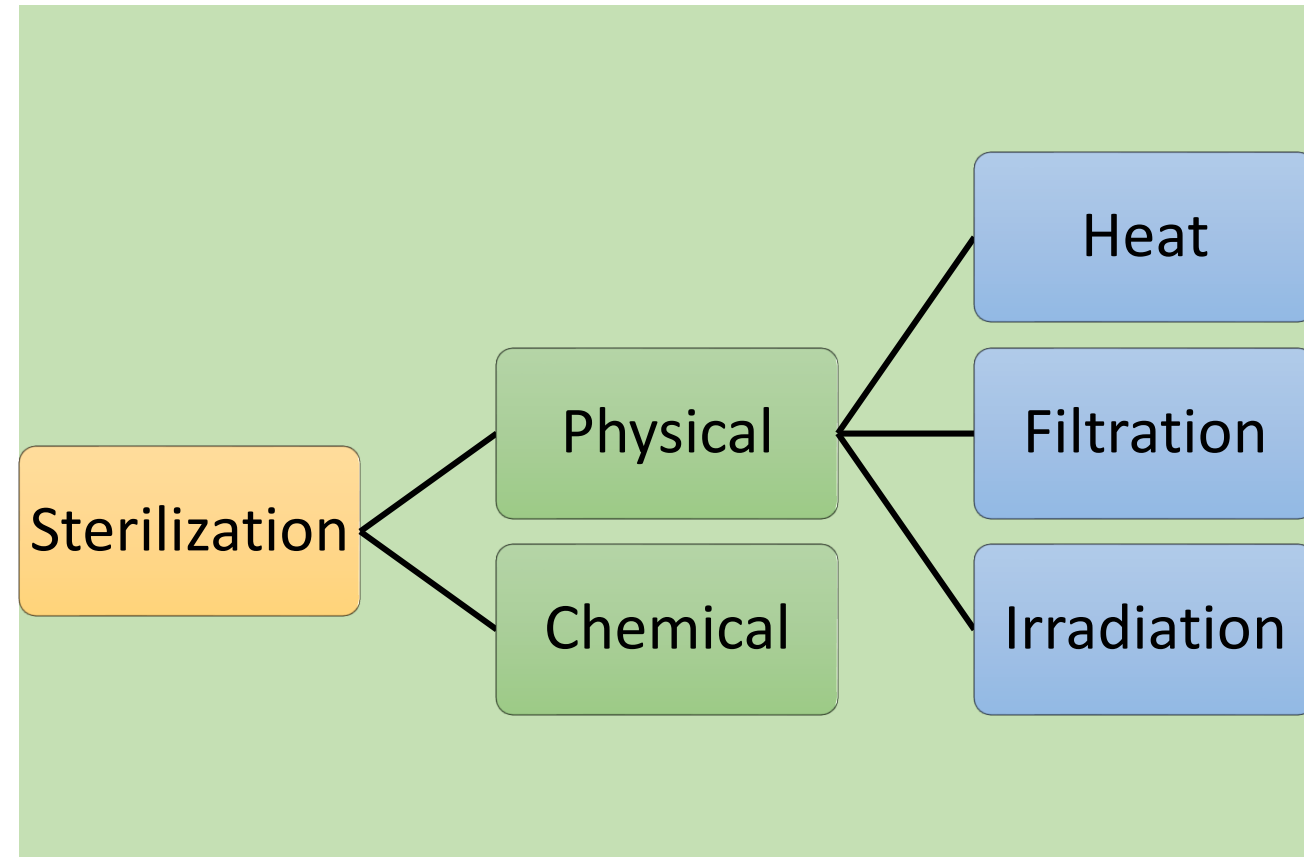
# Methods of sterilization:

There are two methods of sterilization:

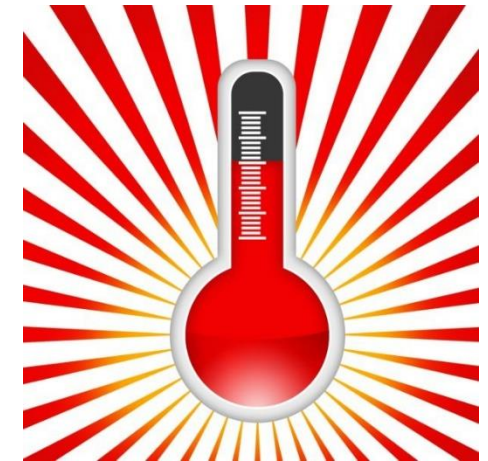
A- **Physical methods:**

1. Sterilization by Heat
2. Sterilization by Filtration
3. Sterilization by Irradiation

B- **Chemical methods**



# A. Sterilization by heat

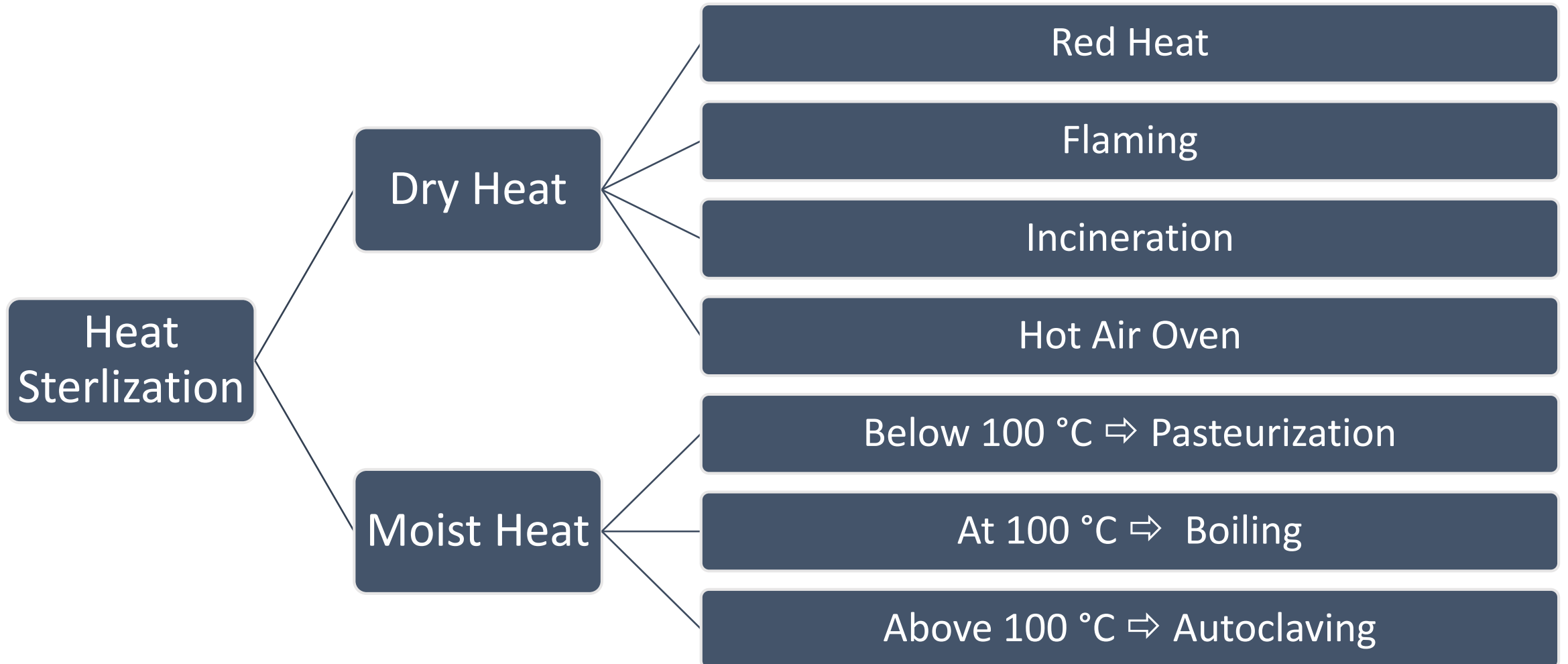


# Sterilization by heat

- Heat is the **most practical, reliable, and inexpensive** method of sterilization.
- It is used for sterilization of objects and materials that can **withstand** high temperatures.
- It can be either:
  - Dry heat
  - Moist Heat



# Methods of Sterilization by Heat



# 1. Red Heat

## Principal:

Holding object in Bunsen flame till they become red hot.

## Used for:

### **Sterilization of:**

- Bacteriological loops
- Tips of forceps



## 2. Flaming

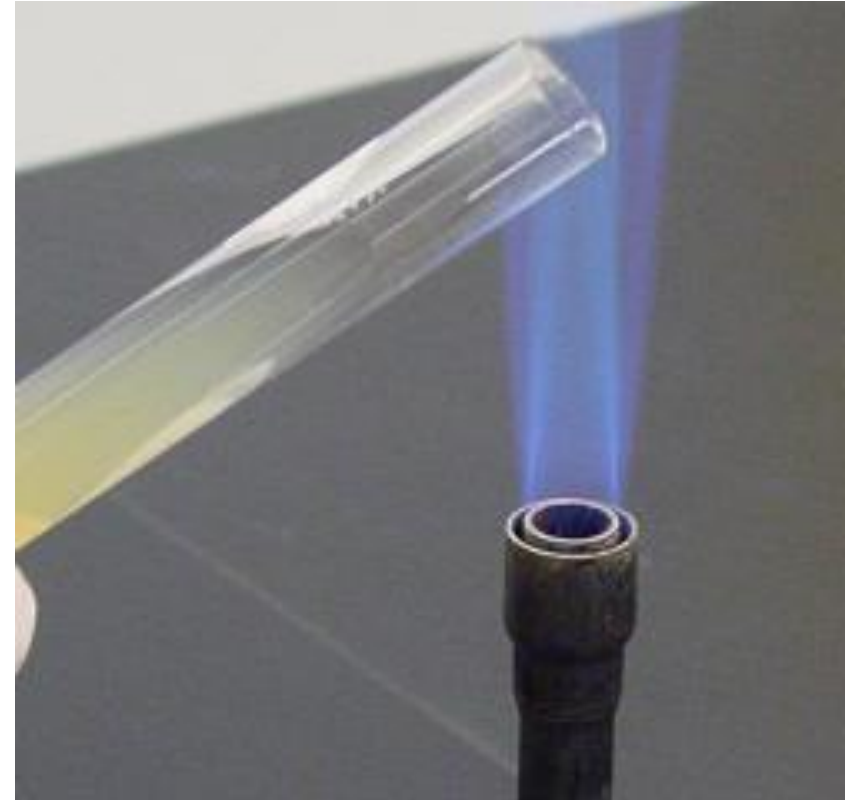
### Principal:

Passing the object through the flame of Bunsen burner without heating to redness.

### Used for:

Sterilization of:

- glass slides
- mouth of culture tubes.



# 3. Incineration

## Principal:

Infective materials is converted to sterile ash by burning in incinerator.

## Used for:

Destruction of contaminated disposable materials (**waste**).



## 4. Hot air oven

### Principle:

- Articles to be sterilized are exposed to high temperature in an electrically heated oven.
- Even distribution of heat throughout the chamber is achieved by a fan.

### Holding time:

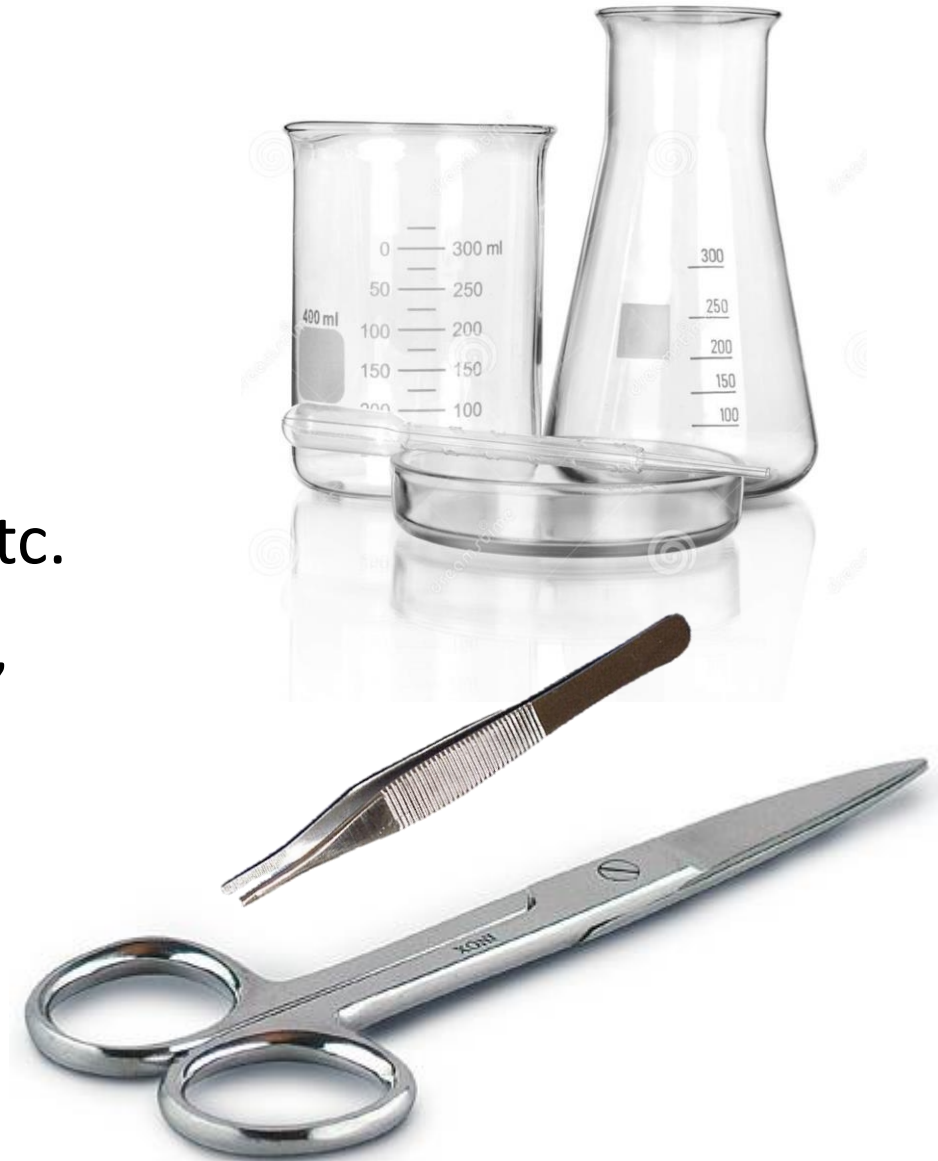
- 160°C for two hour
- 180°C for one hour

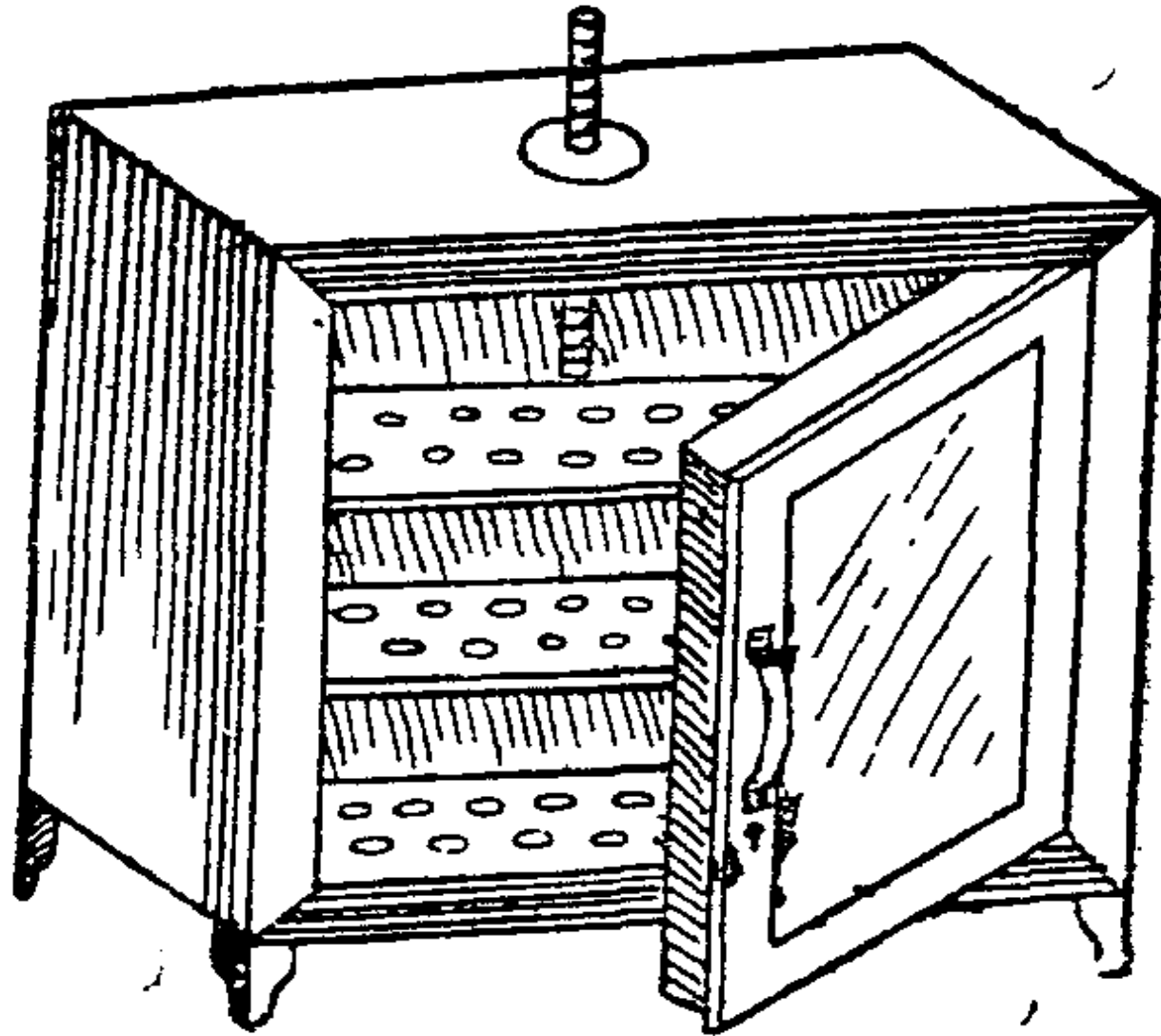


## 4. Hot air oven

### Used for Sterilization of:

- All **glasses**: test tubes, Petri dishes, flasks, pipettes.
- **Instruments**: as forceps, scalpels, scissors, etc.
- **Dry material** in sealed containers as fat, oils, powder.

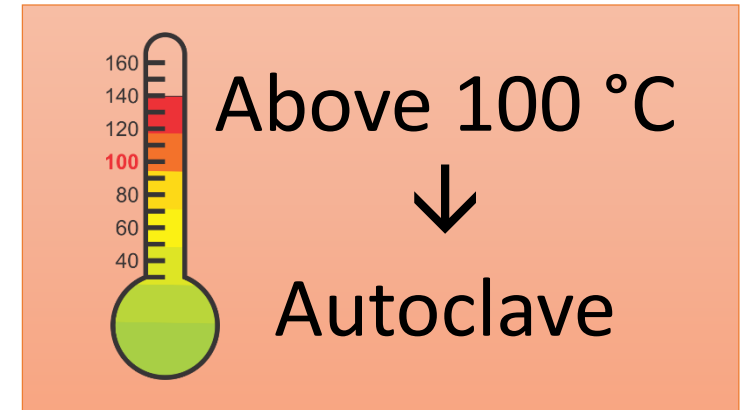
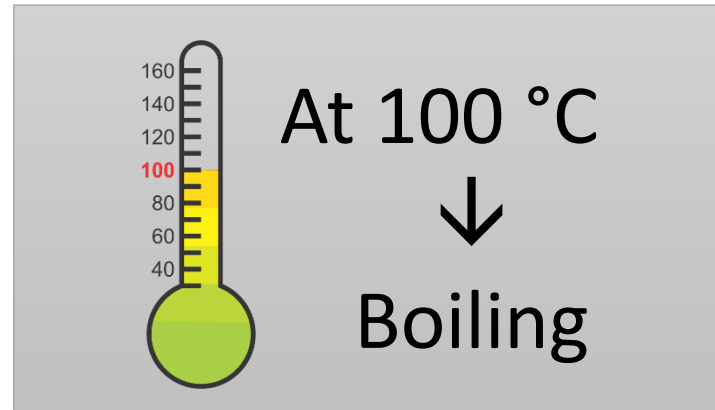
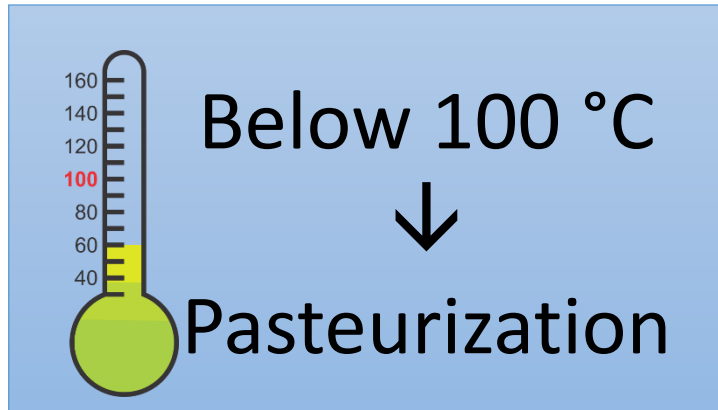




Hot air oven

# Moist Heat

Can be used at different temperatures:





# 1. Pasteurization (Below 100)

## Principal:

Pasteurization is a process of **heating** a liquid to a specific temperature for a definite length of time and then **cooling** it **immediately**.

## Used for:

Pasteurization is commonly used in milk processing.



## 2. Boiling (At 100 °C)

### Principle:

Boiling in water for fifteen minutes will kill most vegetative bacteria and inactivate viruses.

However boiling is ineffective against many bacterial and fungal **spores**.

### Used for:

Boiling water is used for disinfection of drinking water in emergency situations.



### 3. Autoclaving (above 100 °C)

#### Principle:

- When the pressure is increased inside a closed container, the temperature at which water boils exceeds 100°C.
- At **double** atmospheric pressure the temperature of the steam reaches **121°C**.
- Autoclaving is the most **reliable** method of sterilization that kills all kinds of bacteria and spores.

## 3. Autoclaving

### Temperature of sterilization:

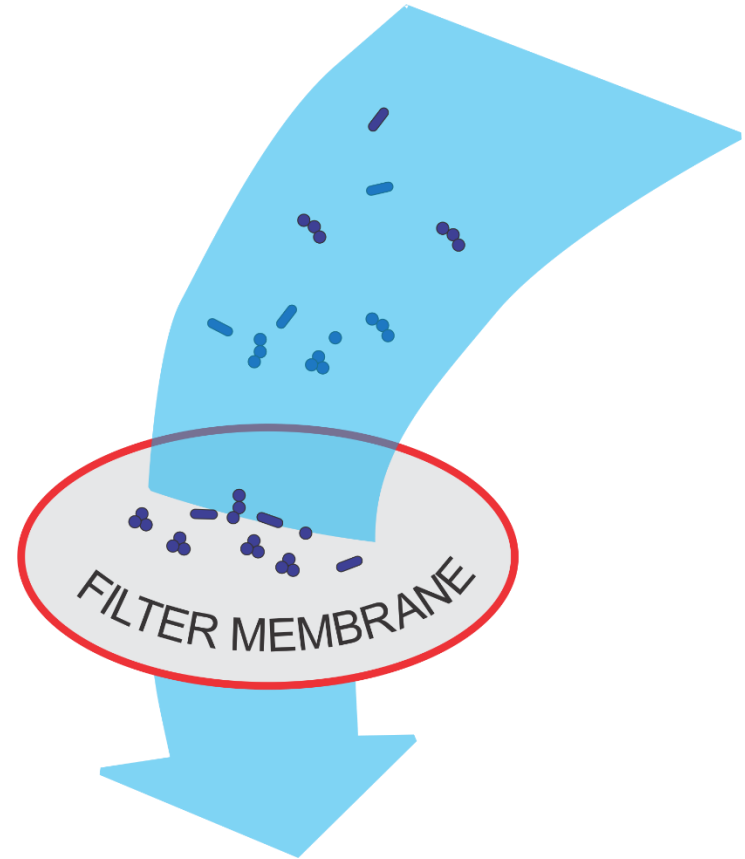
- 121°C for 20 – 30 minutes.

### Used for sterilization of:

- Culture media.
- Surgical supply e.g. dressing, and surgical instruments.

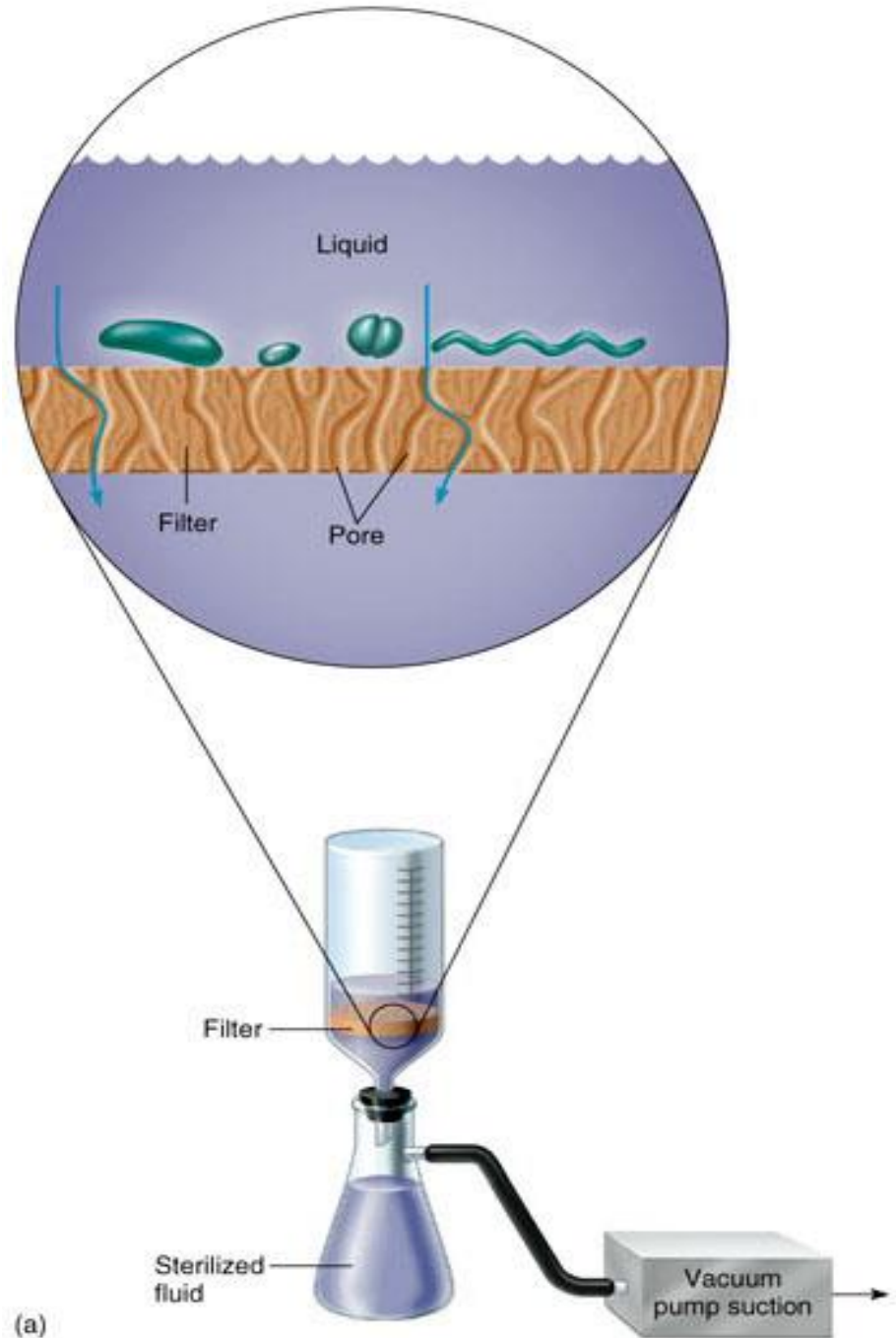


# Filtration



# Filtration

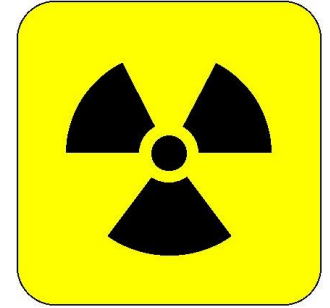
It is possible to remove bacteria from fluids by passing them through filters with pores so small that bacteria are arrested.



# Filtration

- Filtrations is used to sterilize liquids that would be damaged by heat as **sera**, **antibiotic** solutions and **vaccines**.

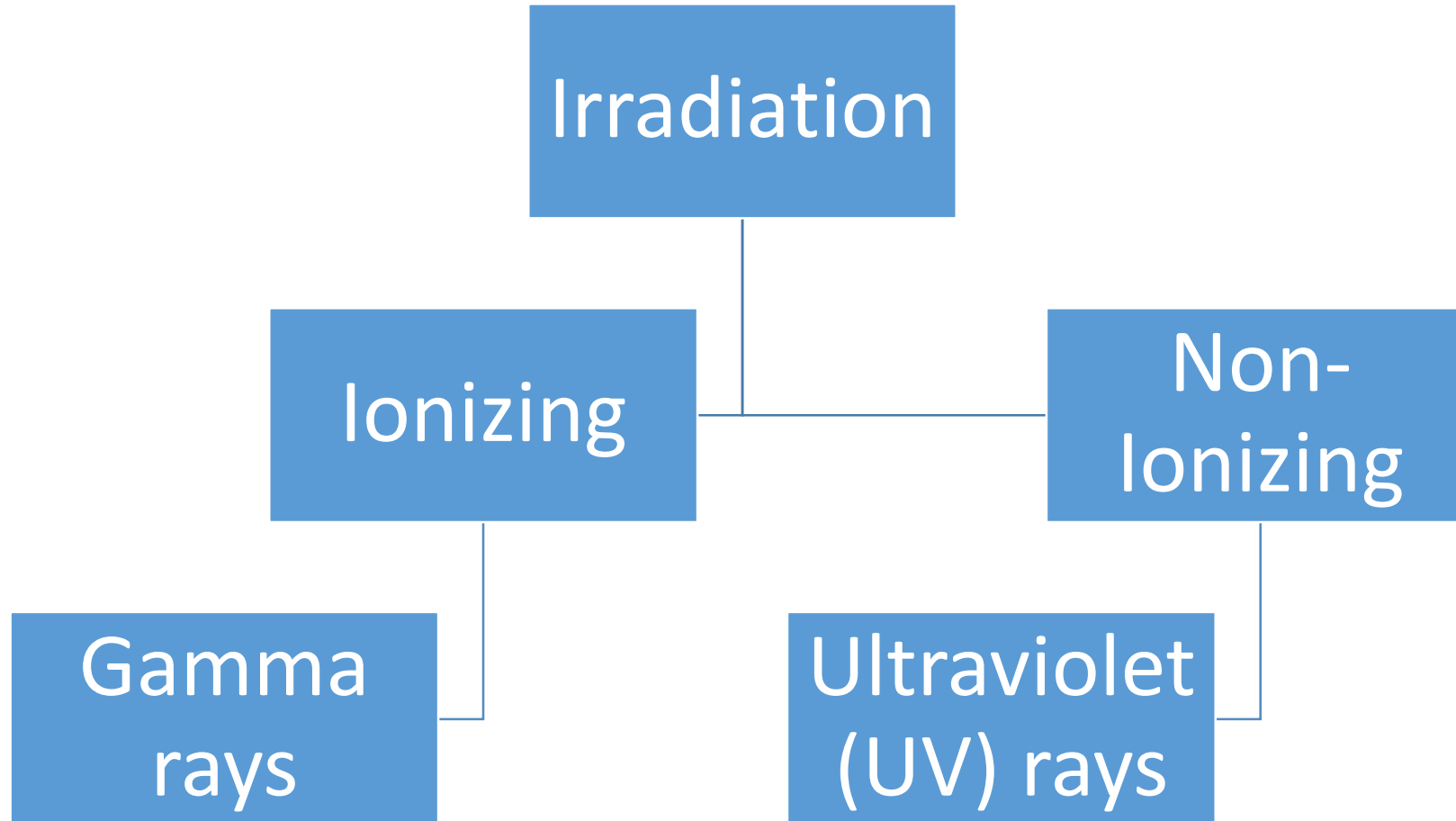




# C- Sterilization by irradiation



# Sterilization by irradiation



# Ultraviolet radiation

## *Used for.*

1. Sterilization of operating theatre.
2. Sterilization of the interiors of biological safety cabinets.



# Ionizing irradiation (gamma rays)

- Used for sterilization of an article not stand heat as rubber catheters, gloves, plastic syringes.



# Chemical methods of Sterilization



# *Disinfectant/ Antiseptics*

- *Disinfectant:*

- Are chemical materials used for sterilization but are toxic to the human tissues and cells.

- *Antiseptics:*

- Are chemicals for sterilization but not toxic to the human body e.g. "mouth gargles".

# Examples of disinfectant and antiseptics

There are a number of chemicals that can act as disinfectants or antiseptics. These include:

- **Phenol** and its derivatives e.g. Chloroxylenol (Dettol).
- **Halogens** e.g. Chlorine, povidone iodine (Betadine).
- **Alcohols** e.g. ethyl alcohol.
- **Aldehydes** e.g. glutaraldehyde (Cidex), Formalin.
- **Quaternary Ammonium Compounds** (Cationic detergents).

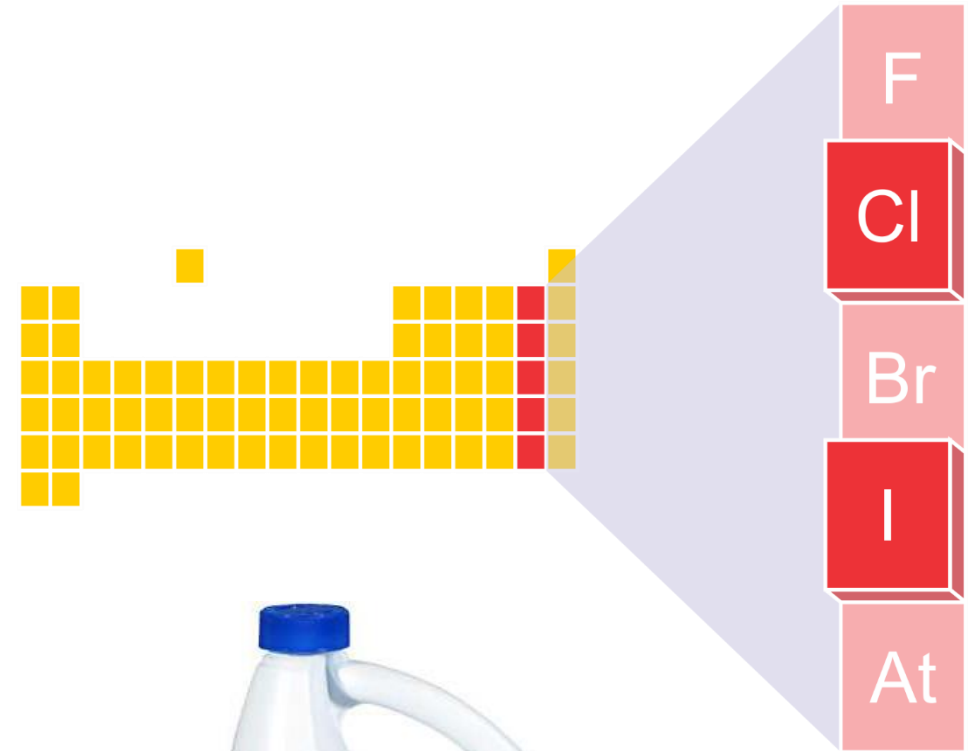
# Alcohols

- Ethyl alcohol and isopropyl alcohol are the two most widely used.
- Alcohol is commonly used as a **skin antiseptic** and is commonly used prior to injection.
- Alcohol-based (about 62% alcohol) hand rubs are very popular for sanitizing hands when hands are not visibly soiled.



# Halogens

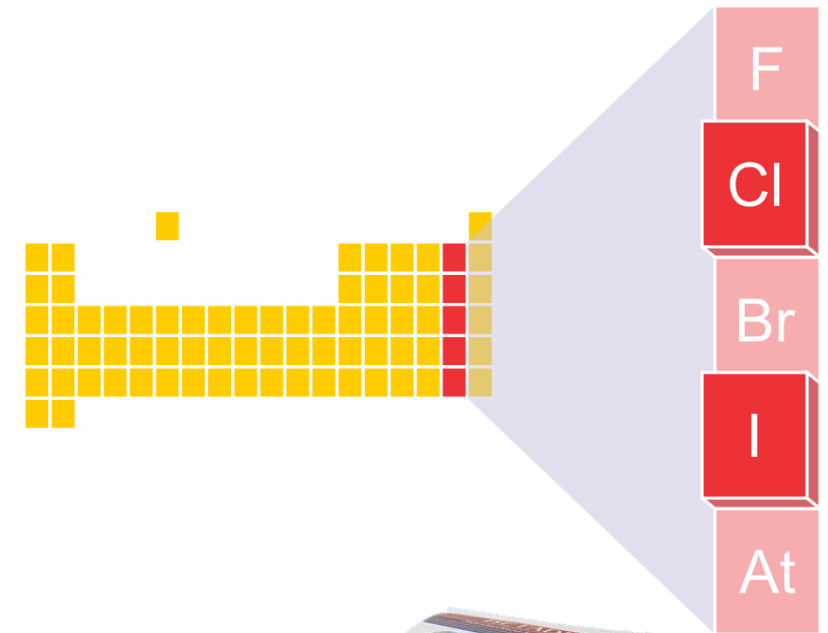
- **Chlorine** and **iodine** are the only two routinely used halogens.
- **Chlorine gas** has been employed to disinfect public water-supplies.
- **Sodium hypochlorite** ( $\text{NaOCl}$ ), is used as a household **disinfectant** (Clorox).





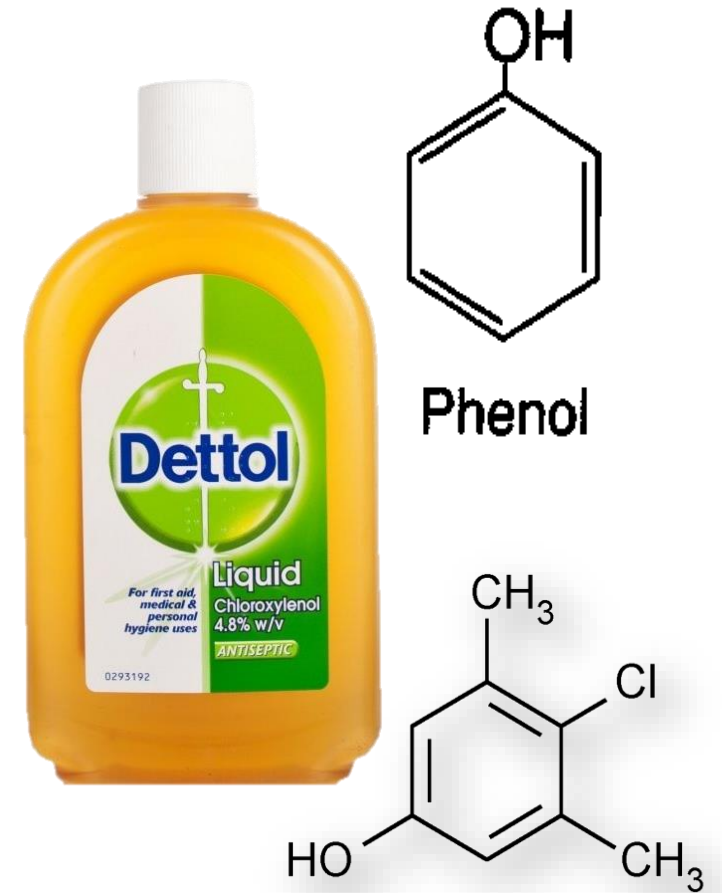
# Halogens

- Iodines are used mainly for **skin disinfection** and wound treatment.
- The most common commercial iodine preparation is Betadine, which is a *povidone-iodine*.



# Phenols

- Phenol is the ***oldest*** known disinfectant, but rarely used currently, because it ***irritates*** the skin and has a disagreeable ***odor***.
- **Phenolics** are phenol derivatives that are less irritating and more active.
- Example: **Chloroxylenol** is used in antiseptic and disinfectants solutions e.g. Dettol.





**Alcohol**



**Halogens**



**Phenol derivative**

**Examples of some commonly used disinfectants**

# Quizzes





1. Sterilization in autoclave is considered  
Sterilization by:

- A. Dry heat
- B. Moist heat
- C. Irradiation
- D. Filtration





2. Sterilization in autoclave is done at temperature of:

- A. 121°C for 20 minutes
- B. 180°C for 2 hours
- C. 180°C for 20 minute
- D. 121°C for 2 hours





3. Dry heat sterilization can be achieved by:

- A. Autoclave
- B. Hot air oven
- C. Boiling
- D. Incubator





4. Moist Heat sterilization can be achieved by:

- A. Autoclave
- B. Incineration
- C. Flaming
- D. Hot air oven







5. An agent that inhibit the growth of bacteria is:

- A. Bactericidal
- B. Bacteriostatic.





6. Bacteriostatic agent means:

- A. Which inhibit growth of bacteria.
- B. Which stimulate growth of bacteria.
- C. Which kills the bacteria.





7. Sterilization in Hot air oven is done at:

- A. at  $121^{\circ}\text{C}$  for 20 minutes
- B. at  $180^{\circ}\text{C}$  for 2 hours
- C. at  $180^{\circ}\text{C}$  for 20 minute
- D. at  $160^{\circ}\text{C}$  for 2 hours.





## 8. How can you sterilize culture media

- A. Boiling
- B. Incineration
- C. Autoclaving
- D. Hot air oven
- E. Filtration
- F. UV radiation.





## 9. How can you sterilize sera

- A. Boiling
- B. Incineration
- C. Autoclaving
- D. Hot air oven
- E. Filtration
- F. UV radiation





## 10. How can you sterilize Oil/powders

- A. Boiling
- B. Incineration
- C. Autoclaving
- D. Hot air oven
- E. Filtration
- F. UV radiation





# 11. How can you sterilize Bacteriological loops

- a) Boiling
- b) Red Heat
- c) Autoclaving
- d) Hot air oven
- e) Filtration
- f) UV radiation
- g) Gamma rays





## 12. How can you sterilize interiors of biological safety cabinets:

- a) Boiling
- b) Incineration
- c) Autoclaving
- d) Hot air oven
- e) Filtration
- f) UV radiation
- g) Gamma rays







13. How can you sterilize glassware e.g. test tubes:

- a) Boiling
- b) Incineration
- c) Hot air oven
- d) Filtration
- e) UV radiation
- f) Gamma rays





14. How can you sterilize plastic syringes:

- a) Boiling
- b) Incineration
- c) Hot air oven
- d) Filtration
- e) UV radiation
- f) Gamma rays





## 15. True or False

- a) Bactericidal inhibits growth of bacteria
- b) Bacteriostatic inhibits growth of bacteria
- c) Sterilization is the removal or killing of disease-causing microorganisms
- d) Disinfection is the removal or killing of disease-causing microorganisms
- e) Objects can be sterilized in hot air oven at  $160^{\circ}\text{C}$  for 20 minutes



# Skin can be sterilized by using:

- a) Antibiotics
- b) Disinfectant
- c) Irradiation
- d) Antiseptic