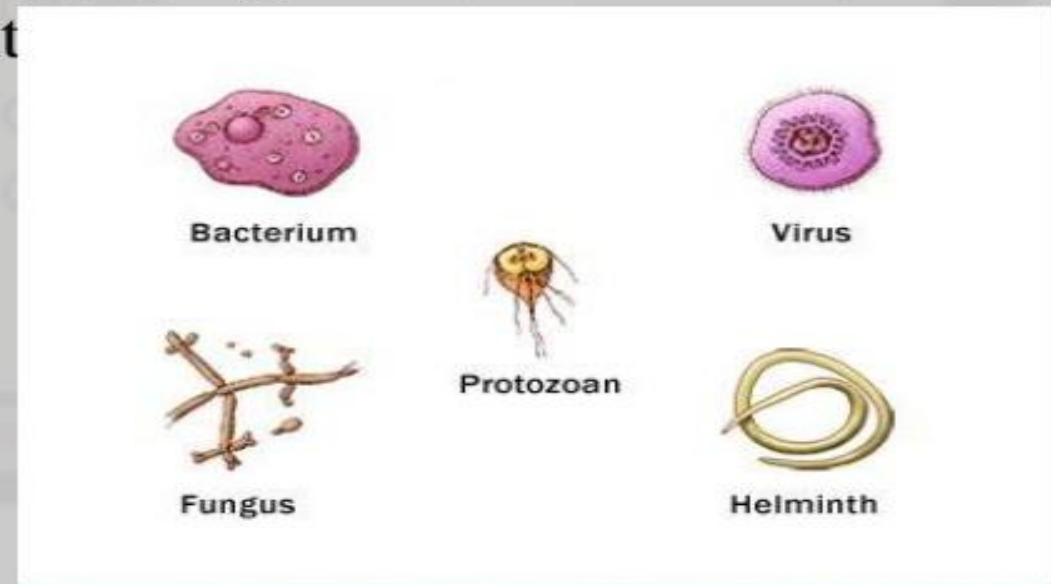


Principle,
Working and
Application of
Autoclave

STERILIZATION

- **Sterilization** is a term referring to any process that removes or kills all forms of microbial organisms such as fungi, bacteria, viruses, spore forms, etc. present on a surface, contained in a fluid, or in a compound such as biological culture media.
- Sterilization can be achieved by applying heat, chemicals, irradiation, high pressure, and filtration of them.



AUTOCLAVE

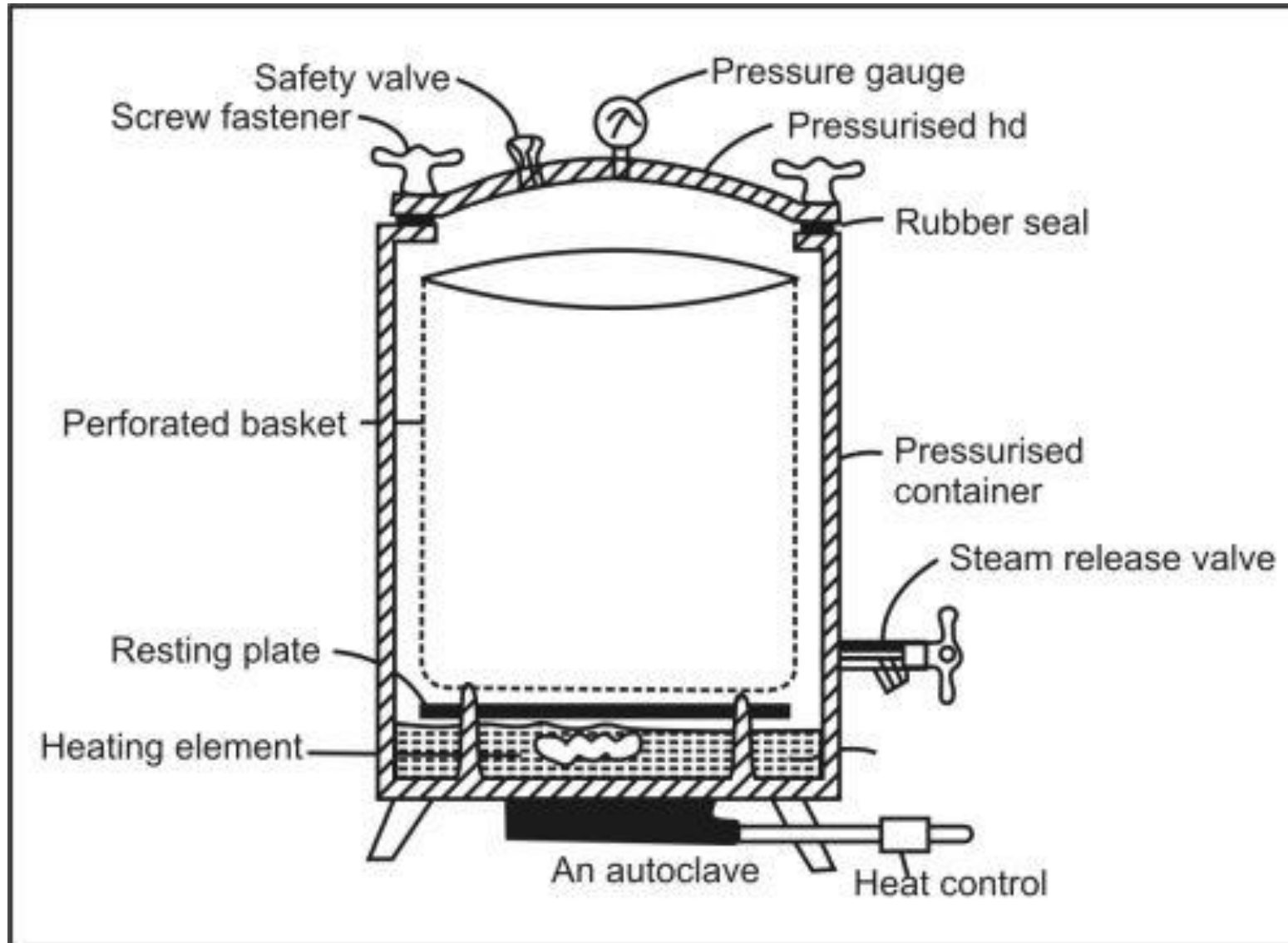
- The autoclave is a equipment used to remove microorganisms (Virus, Bacteria, fungus etc.) and spores using high pressure and high temperature steam Sterilization



Principle

- The autoclave works on the principle of moist heat sterilization where steam under pressure is used to sterilize the material present inside the chamber.
- The high pressure increases the boiling point of water and thus helps achieve a higher temperature for sterilization.
- Water usually boils at 100°C under normal atmospheric pressure (760 mm of Hg); however, the boiling point of water increases if the pressure is to be increased.
- Similarly, the high pressure also facilitates the rapid penetration of heat into deeper parts of the material, and moisture present in the steam causes the coagulation of proteins causing an irreversible loss of function and activity of microbes.
- This principle is employed in an autoclave where the water boils at 121°C at the pressure of 15 psi or 775 mm of Hg.
- When this steam comes in contact on the surface, it kills the microbes by giving off latent heat.
- The condensed liquid ensures the moist killing of the microbes.
- Once the sterilization phase is completed (which depends on the level of contamination of material inside), the pressure is released from the inside of the chamber through the whistle.

Construction



Construction

- **a. Pressure Chamber**

- The pressure chamber is the main component of a steam autoclave consisting of an inner chamber and an outer jacket.
- The inner chamber is made up of stainless steel or gunmetal, which is present inside the out chamber made up of an iron case.
- The inner chamber is the case where the materials to be sterilized are put.
- The size of the pressure chamber ranges from 100 L to 3000 L.

- **b. Lid/ Door**

- The purpose of the lid is to seal off the outside the atmosphere and create a sterilized condition on heat inside of the autoclave.
- The lid is made airtight via the screw clamps and asbestos washer.
- The lid consists of various other components like:

- **Pressure gauge**
- A pressure gauge is present on the lid of the autoclave to indicate the pressure created in the autoclave during sterilization.
- The pressure gauge is essential as it assures the safety of the autoclave and the working condition of the operation.
- **Pressure releasing unit/ Whistle**
- A whistle is present on the lid of the autoclave is the same as that of the pressure cooker.
- The whistle controls the pressure inside the chamber by releasing a certain amount of vapor by lifting itself.
- **Safety valve**
- A safety valve is present on the lid of autoclave, which is crucial in cases where the autoclave fails to perform its action or the pressure inside increases uncontrollably.
- The valve has a thin layer of rubber that bursts itself to release the pressure and to avoid the danger of explosion.
- **c. Steam generator/ Electrical heater**
- An electrical steam generator or boiler is present underneath the chamber that uses an electric heating system to heat the water and generate steam in the inner and the outer chamber.
- The level of water present in the inner chamber is vital as if the water is not sufficient; there are chances of the burning of the heating system.
- Similarly, if the water is more than necessary, it might interfere with the trays and other components present inside the chamber.

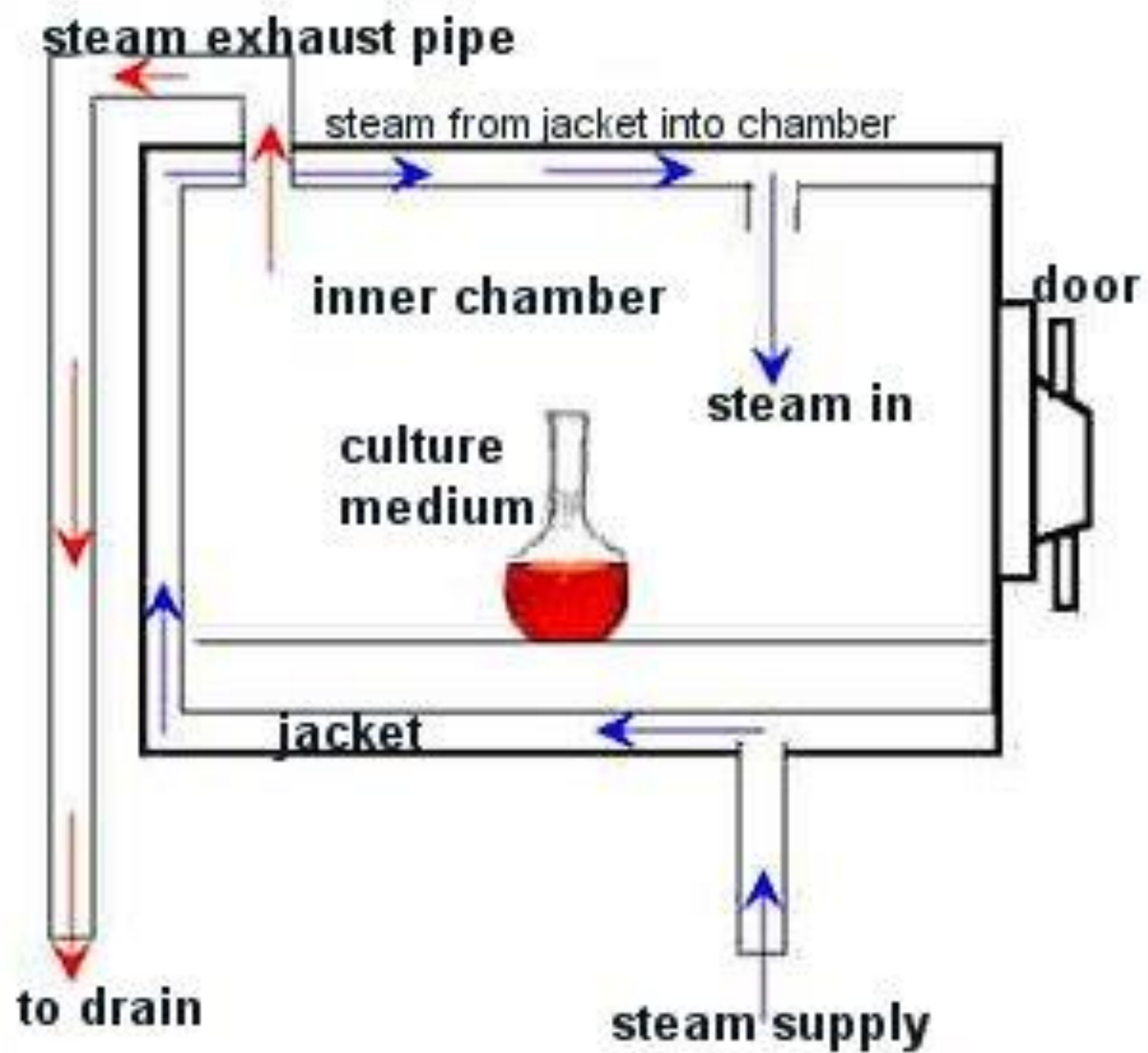
- **d. Wastewater cooler**
- Many autoclaves are provided with a system to cool the effluent before it enters the draining pipes.
- This system prevents any damage to the drainage pipe due to the boiling water being sent out of the autoclave.

Working

In general, an autoclave is run at a temperature of 121° C for at least 30 minutes by using saturated steam under at least 15 psi of pressure. The following are the steps to be followed while running an autoclave:

- Before beginning to use the autoclave, it should be checked for any items left from the previous cycle.
- A sufficient amount of water is then put inside the chamber.
- Now, the materials to be sterilized are placed inside the chamber.
- The lid is then closed, and the screws are tightened to ensure an airtight condition, and the electric heater is switched on.
- The safety valves are adjusted to maintain the required pressure in the chamber.
- Once the water inside the chamber boils, the air-water mixture is allowed to escape through the discharge tube to let all the air inside to be displaced. The complete displacement can be ensured once the water bubbles cease to come out from the pipe.

- The drainage pipe is then closed, and the steam inside is allowed to reach the desired levels (15 lbs in most cases).
- Once the pressure is reached, the whistle blows to remove excess pressure from the chamber.
- After the whistle, the autoclave is run for a holding period, which is 15 minutes in most cases.
- Now, the electric heater is switched off, and the autoclave is allowed to cool until the pressure gauge indicates the pressure inside has lowered down to that of the atmospheric pressure.
- The discharge pipe is then opened to allow the entry of air from the outside into the autoclave.
- Finally, the lid is opened, and the sterilized materials are taken out of the chamber.



Applications

Autoclaves are important devices to ensure the sterilization of materials containing water as they cannot be sterilized by dry heat sterilization. Besides, autoclaves are used for various other purposes.

- 1.They are used to decontaminate specific biological waste and sterilize media, instruments, and labware.
- 2.Regulated medical waste that might contain bacteria, viruses, and other biological materials are recommended to be inactivated by autoclaving before disposal.
- 3.In medical labs, autoclaves are used to sterilize medical equipment, glassware, surgical equipment, and medical wastes.
- 4.Similarly, autoclaves are used for the sterilization of culture media, autoclavable containers, plastic tubes, and pipette tips.