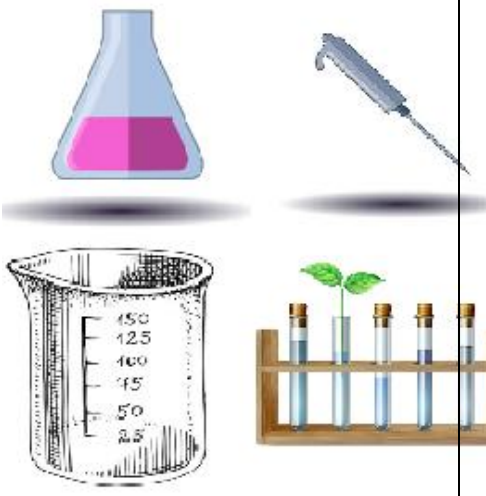
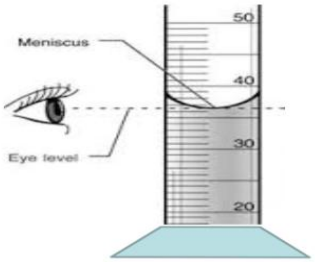
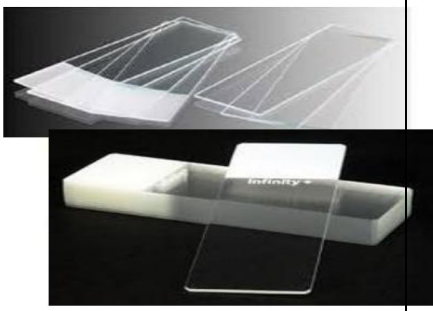
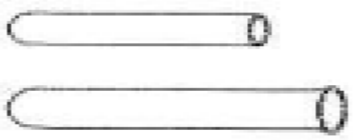
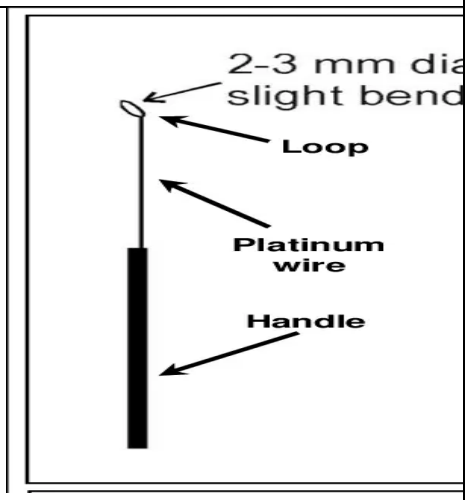
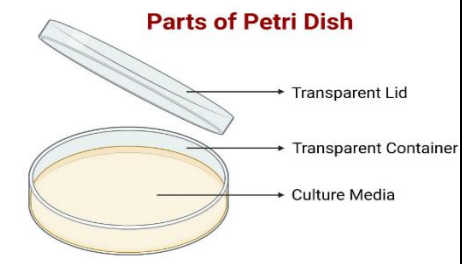
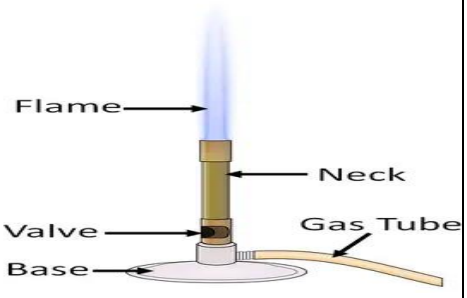
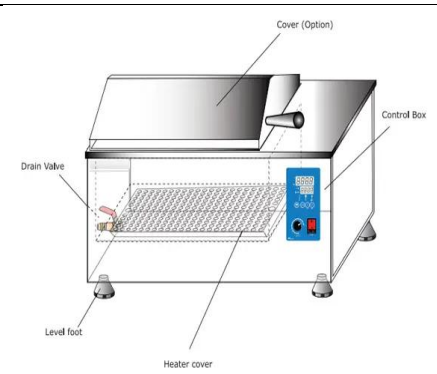
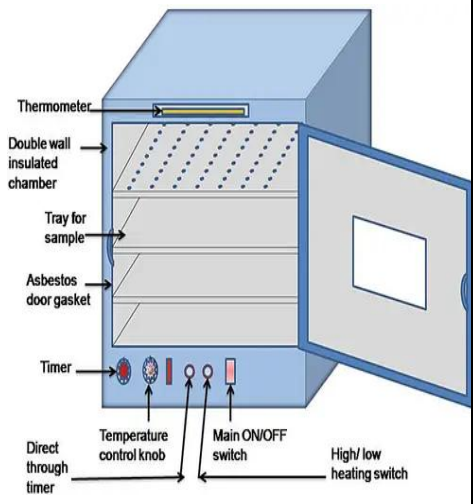
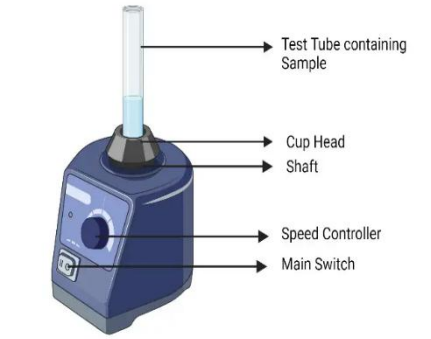
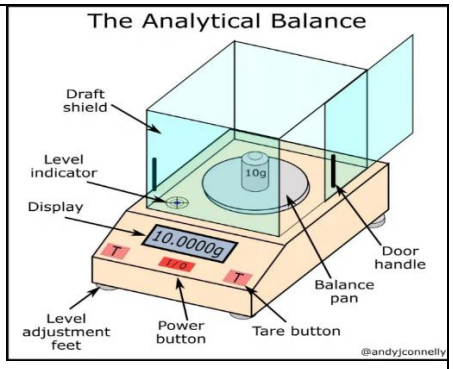
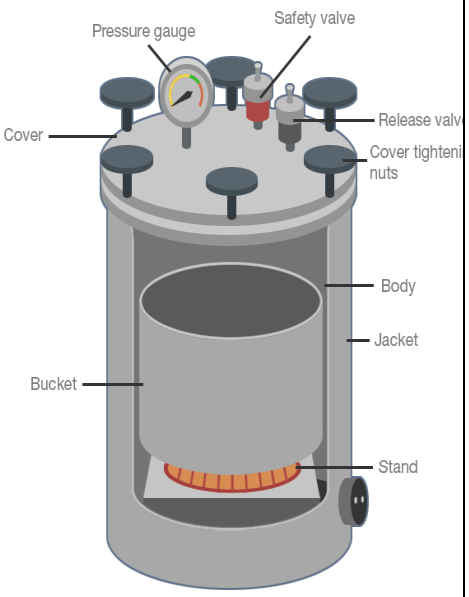
Microbiology Laboratory Equipment and tools

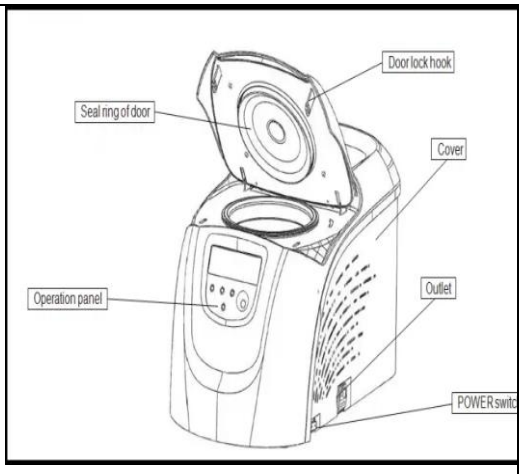
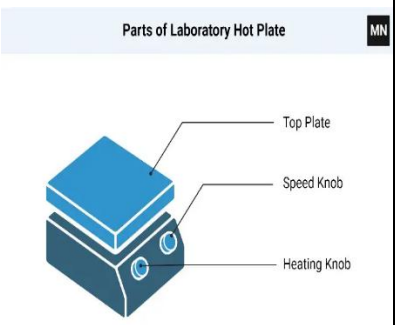
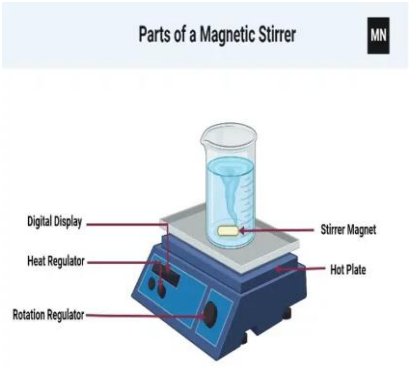
Instrument	description	Picture
flasks, beakers, pipettes, test tubes	**Method of operation:** Contains liquids and solutions, or moves them from one location to another. **Purpose:** Prevalent in all laboratory settings, glassware is used for the measurement, mixing, and observation of substances and solutions.	
Funnel	Used for filtration with filter paper.	
Cylinder	Measures the volume of liquid in mL. The liquid is measured at the meniscus (curved surface of the water) .	
Microscope slide Cover slide	Thin flat piece of glass used to hold objects in place under a microscope Covers specimens on the slide.	

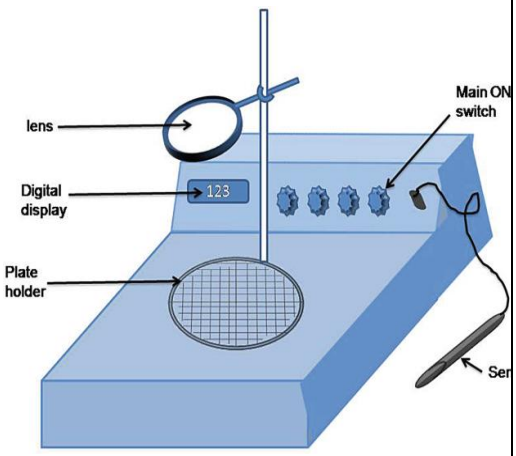
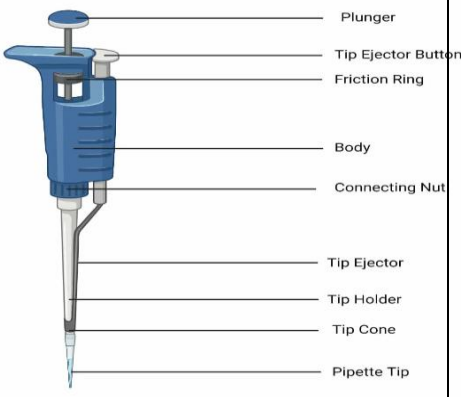
Microbiology Laboratory **Lab 2**

Test tube	Used to hold materials or liquids.	
Test tube rack	Holder test tube in the vertical position.	
Inoculation loop	Anatomy of a Wire Loop: Consists of a handle with a steel screw shaft that holds a metallic rod made of nichrome or platinum wire. Construction: The wire is wrapped around a small cylindrical object (like a pencil) to mechanically twist and form a small circular loop (recommended dimension of 5–7 mm) designed to hold an elongated film when dipped into a solution.	
Petri Dish	a Petri dish is used as a container to grow microbes with growth media in it.	
Bunsen burner	The primary device that provides warmth in laboratory experiments includes that of the Bunsen burner. It's named in honor of its inventor, R. W. Burner. It is also referred to as a spirit lamp due to the use of spirits for burning purposes.	

Water bath	Structure and Composition: A water bath is a small insulating box made of steel equipped with an electric heating coil electrode and controlled by a thermostat. Purpose: It supplies an unchanging, controlled temperature to samples and is used when precise heating with minimal fluctuation is required.	
Incubator	**Structure**: Features a double-walled chamber with insulated space between the walls to manage heat conduction, and an external knob to adjust the temperature. **Monitoring**: Includes a thermometer placed at the top to accurately record and check the internal temperature. **Purpose:** To maintain a controlled environment with optimal conditions in which one can cultivate microorganisms for later observation.	
vortex mixer	device used to mix or vortex small volumes of liquid in tubes or vials. It creates a swirling or vortex motion in the sample by rapidly shaking or vibrating the platform on which the tubes or vials are placed.	

Electrical balance	In experiments with biological or chemical substances the precise amount of chemical needs to be measured using an instrument. It is comprised of a single pan that weighs a single pan. Its weight is counterbalanced with weights, and is set to zero. **Purpose:** Used for incredibly precise measurements of mass.	
Autoclave	autoclave works on the principle of pressure and temperature to kill unwanted microorganisms that can cause lab contaminations. Autoclaves are also used to decontaminate media and solutions post-experiments as disposing of them without killing the microbes might lead to microbial spillage. **Purpose:** Used to prepare equipment for use, particularly culture media (the substances used to support the growth of microorganisms), as a hot air oven cannot be used to sterilize liquid or gel substances.	
Laminar Flow Hood & Biosafety Cabinet	They provide a sterile and protected environment for working with hazardous materials, prevent contamination, and protect lab personnel. With the increasing need for accurate and safe research practices, the use of these instruments has become an integral part of modern microbiology labs. **Purpose:** Prevent contamination of sensitive samples exposed to open air.	

centrifuge	The centrifuge is a device which rotates at a high rate and separates particles or substances by the density and mass with the help by centrifugal force. The force exerted by the centrifuge is measured in terms of revolutions every minute (rpm) of the angular speed.	
hot plate	A hot plate is a standard equipment item in scientific, educational, and industrial labs that offers a flat, heated surface to heat and maintain substance temperatures in vessels like beakers, flasks, or test tubes. Applications: Widely utilized for heating, boiling, evaporation, and gentle solution mixing. **Purpose:** To heat substances without the use of open flame. Convenient due to its portability	
magnetic stirre	A magnetic stirrer is a lab device used to mix or stir solutions utilizing a rotating magnetic field. It features a flat or cylindrical plate housing an embedded magnetic element beneath it and a Teflon-coated magnetic stir bar placed directly into the liquid. **Purpose**: Activating the device causes the rotating magnetic field to spin the stir bar, which generates a vortex to effectively stir the solution.	

oven	As air in an enclosed chamber heats and rises, a circular motion is created as the air is pushed back down, ensuring a consistent temperature throughout the chamber and sterilizing the equipment inside. **Purpose:** Used to sterilize solids and dry substances such as glassware, metal, and powders. Liquids cannot be sterilized via this method due to evaporation.	
Colony counter	Manual colony counters use handheld pen-style devices which use touch pressure to count each colony of bacteria. Modern electronic counters can count all colonies at once if a slide or petri dish is placed below a sensor. **Purpose:** Used to count the number of bacterial colonies present in liquid cultures and estimate the concentration of microorganisms.	
pipette	A pipette is a lab device used to measure out or dispense small amounts of liquid in volumes of milliliters (mL) or microliters (µL).	

The compound light microscope

Definition & Importance: Microscopy is the scientific discipline of using microscopes to magnify objects invisible to the naked eye .

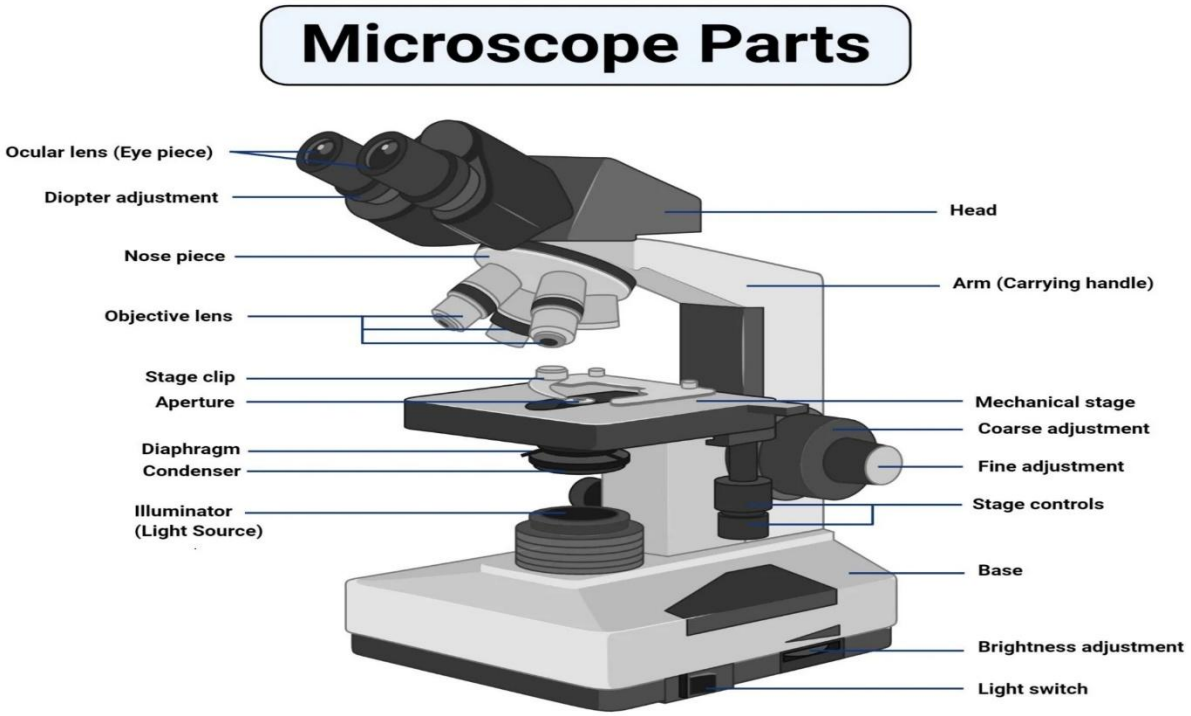
Light Microscopy & Components: Light microscopy uses natural or artificial transmitted visible light to visualize minute objects using structural and optical lens parts.

The Light (Optical) Microscope

Core Function: A light microscope is a vital laboratory instrument that uses visible light and lenses to detect, enlarge, and magnify very small, transparent specimens (such as cells, bacteria, and microbial particles).

Types Based on Lenses

1. **Simple Light Microscope:** Features a single lens and provides lower magnification.
2. **Compound Light Microscope:** Uses at least two sets of lenses (an objective lens and an eyepiece) aligned to bend light efficiently, resulting in a significantly higher magnification.



Structural parts of a microscope and their function:

There are three structural parts of the microscope i.e. head, base, and arm.

1. **Head** – This is also known as the body. It carries the optical parts in the upper part of the microscope.
2. **Base** – It acts as microscopes support. It also carries microscopic illuminators.
3. **Arms** – This is the part connecting the base and to the head and the eyepiece tube to the base of the microscope. It gives support to the head of the microscope and it is also used when carrying the microscope. Some high-quality microscopes have an articulated arm with more than one joint allowing more movement of the microscopic head for better viewing.

Optical parts of a microscope and their function:

The optical parts of the microscope are used to view, magnify, and produce an image from a specimen placed on a slide. These parts include:

1. **Eyepiece** – also known as the ocular. This is the part used to look through the microscope. Its found at the top of the microscope. Its standard magnification is 10x with an optional eyepiece having magnifications from 5X to 30X.
2. **Eyepiece tube** – it's the eyepiece holder. It carries the eyepiece just above the objective lens. In some microscopes such as the binoculars, the eyepiece tube is flexible and can be rotated for maximum visualization, for variance in distance. For monocular microscopes, they are none flexible.
3. **Objective lenses** – These are the major lenses used for specimen visualization. They have a magnification power of 40x-100X. There are about 1- 4 objective lenses placed on one microscope, in that some are rare facing and others face forward. Each lens has its own magnification power.
4. **Nose piece** – also known as the revolving turret. It holds the objective lenses. It is movable hence it cal revolve the objective lenses depending on the magnification power of the lens.
5. **The Adjustment knobs** – These are knobs that are used to focus the microscope. There are two types of adjustment knobs i.e fine adjustment knobs and coarse adjustment knobs.
6. **Stage** – This is the section in which the specimen is placed for viewing. They have stage clips that hold the specimen slides in place. The most common stage is the mechanical stage, which allows the control of the slides by moving the slides using the mechanical knobs on the stage instead of moving them manually.
7. **Aperture** – This is a hole on the microscope stage, through which the transmitted light from the source reaches the stage.

8. Microscopic illuminator – This is the microscopes light source, located at the base. It is used instead of a mirror. It captures light from an external source of a low voltage of about 100v.
9. **Condenser** – These are lenses that are used to collect and focus light from the illuminator into the specimen. They are found under the stage next to the diaphragm of the microscope. They play a major role in ensuring clear sharp images are produced with a high magnification of 400X and above. The higher the magnification of the condenser, the more the image clarity. More sophisticated microscopes come with an Abbe condenser that has a high magnification of about 1000X.
10. **Diaphragm** – it's also known as the iris. Its found under the stage of the microscope and its primary role is to control the amount of light that reaches the specimen. It's an adjustable apparatus, hence controlling the light intensity and the size of the beam of light that gets to the specimen. For high-quality microscopes, the diaphragm comes attached with an Abbe condenser and combined they are able to control the light focus and light intensity that reaches the specimen.
11. **Condenser focus knob** – this is a knob that moves the condenser up or down thus controlling the focus of light on the specimen.
12. **Abbe Condenser** – this is a condenser specially designed for high-quality microscopes, which makes the condenser to be movable and allows very high magnification of above 400X. High-quality microscopes normally have a high numerical aperture than objective lenses.
13. **The rack stop** – It controls how far the stages should go preventing the objective lens from getting too close to the specimen slide which may damage the specimen. It is responsible for preventing the specimen slide from coming too far up and hitting the objective lens.