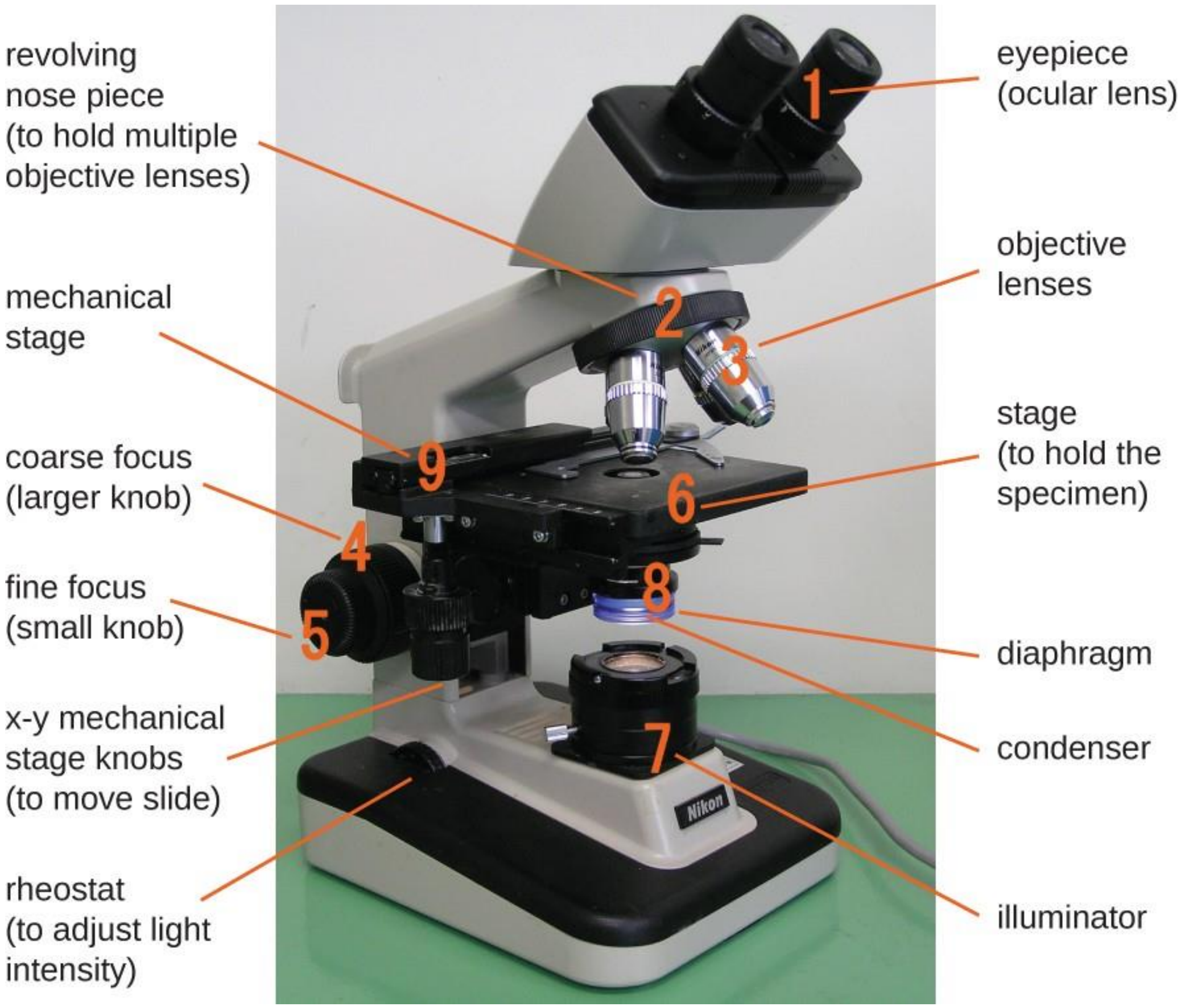
EXPERIMENT THREE

Optical microscopy



Microscope Definition- Microscopes are instruments that are used in science laboratories, to visualize very minute objects such as cells, microorganisms, giving a contrasting image, that is magnified. Microscopes are made up of lenses for magnification, each with its own magnification powers. Depending on the type of lens, it will magnify the specimen according to its focal strength.

Their ability to function is because they have been constructed with special components that enable them to achieve high magnification levels. they can view very small specimens and distinguish their structural differences, for example, the view of animal and plant cells, viewing of microscopic bacterial cells.

Microscopes are generally made up of structural parts for holding and supporting the microscope and its components and the optical parts which are used for magnification and viewing of the specimen images. This description defines the parts of a microscope and the functions they perform to enable the visualization of specimens.

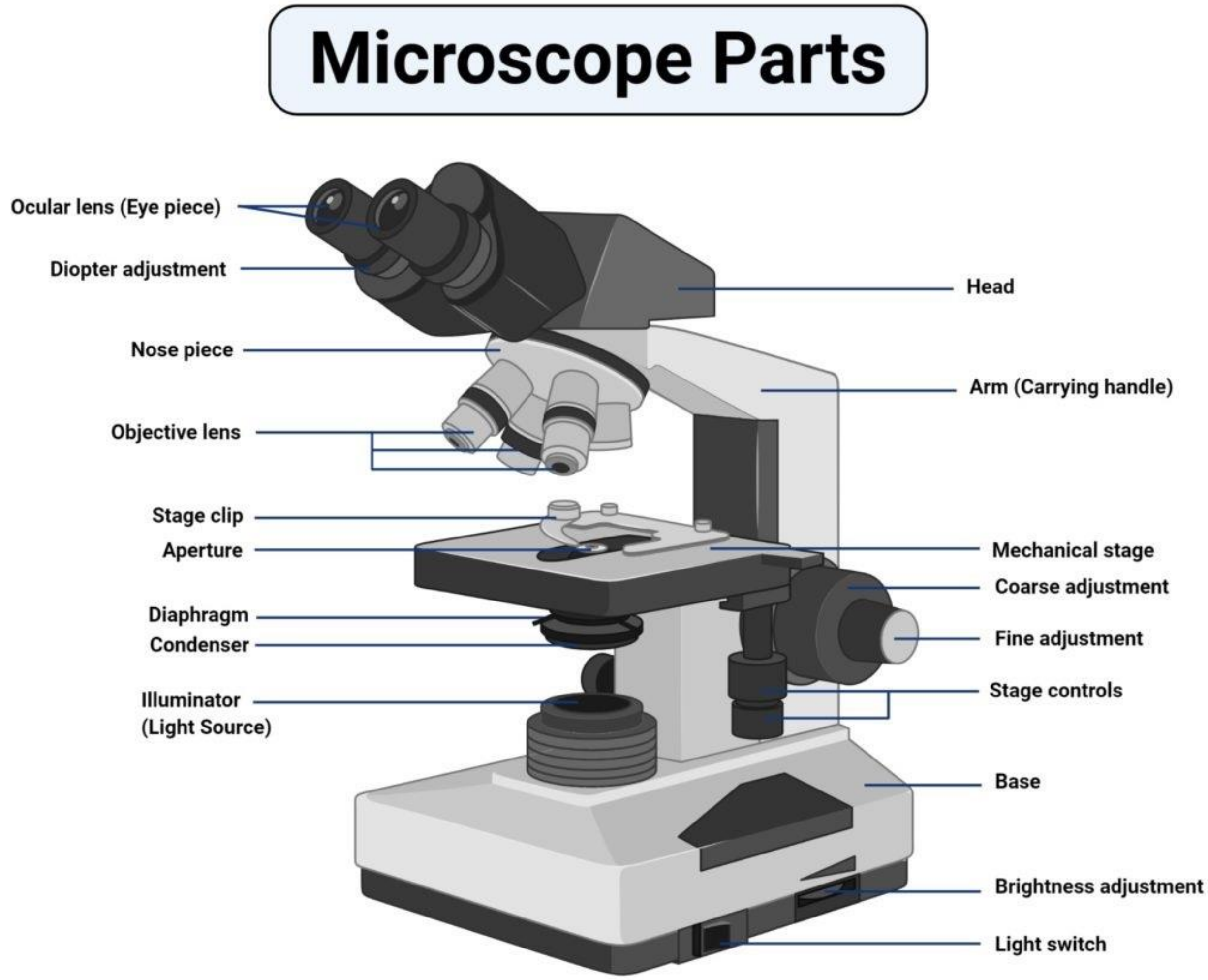


Figure: Parts of a microscope

What is a light microscope?

It is a device that shows the structure of living organisms that are not visible to the eye and the optical microscope can enlarge the studied objects from (50) to more than (1000) times.

optical microscopy is a technique working to closely view a sample through the magnification of a lens with visible light.

An optical microscope, also sometimes known as a light microscope, uses one or a series of lenses to magnify images of small samples with visible light. The lenses are placed between the sample and the viewer's eye to magnify the image so that it can be examined in greater detail.

Study of parts of a complex optical microscope:

A complex microscope is a sensitive tool that must be handled with care and consists of the following parts:

1. **Eyepiece** – also known as the ocular. this is the part used to look through the microscope. It's found at the top of the microscope. Its standard magnification is 10x with an optional eyepiece having magnifications from 5X – 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 on which the specimen is placed for viewing. They have stage clips that hold the specimen slides in place. The most common stage is a mechanical stage, which allows the control of the slides by moving the slides using the mechanical knobs on the stage instead of moving it 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. It's 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 on 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.

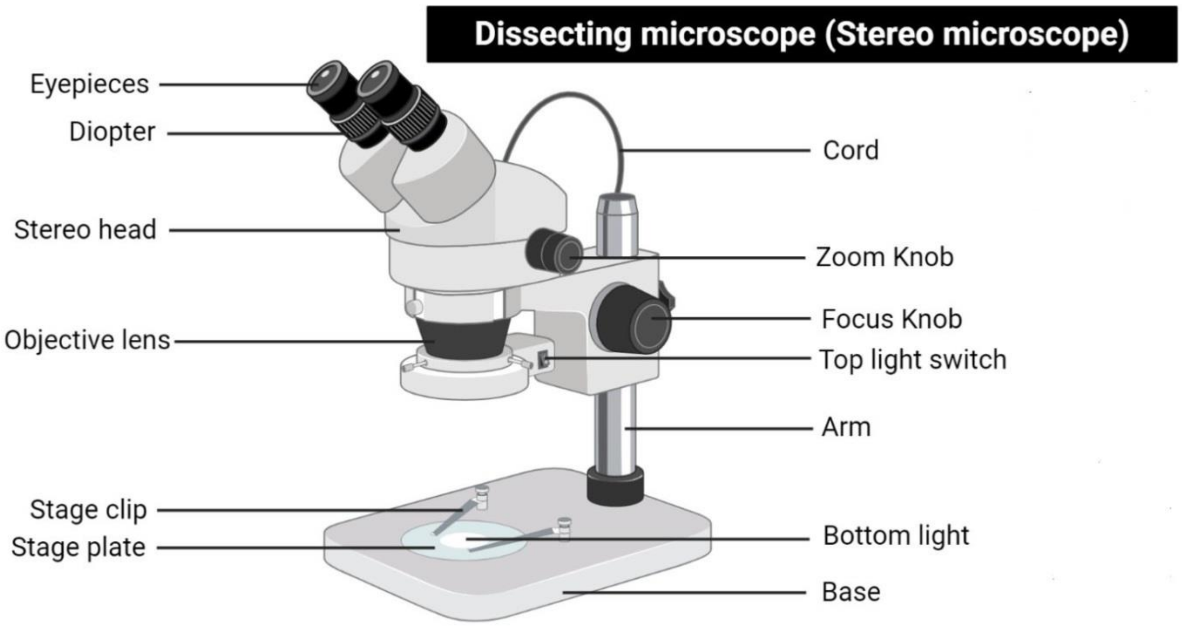
13. **Base: It is the bottom of the microscope**

Types of optical microscopes

There are many types of optical microscopes. They can vary from a very basic design to a high complexity that offers higher resolution and contrast. Some of the types of optical microscopes include the following:

- Simple microscope: a single lens to magnify the image of the sample, similar to a magnifying glass.
- Compound microscope: a series of lenses to magnify the sample image to a higher resolution, more commonly used in modern research.

- Digital microscope: may have simple or compound lenses, but uses a computer to visualize the image without the need for an eyepiece to view the sample.
- Stereo microscope: provides a stereoscopic image, which is useful for dissections.
- Comparison microscope: allows for the simultaneous view of two different samples, one in each eye.
- Inverted microscope: views the sample from underneath, which is useful to examine liquid cell cultures.



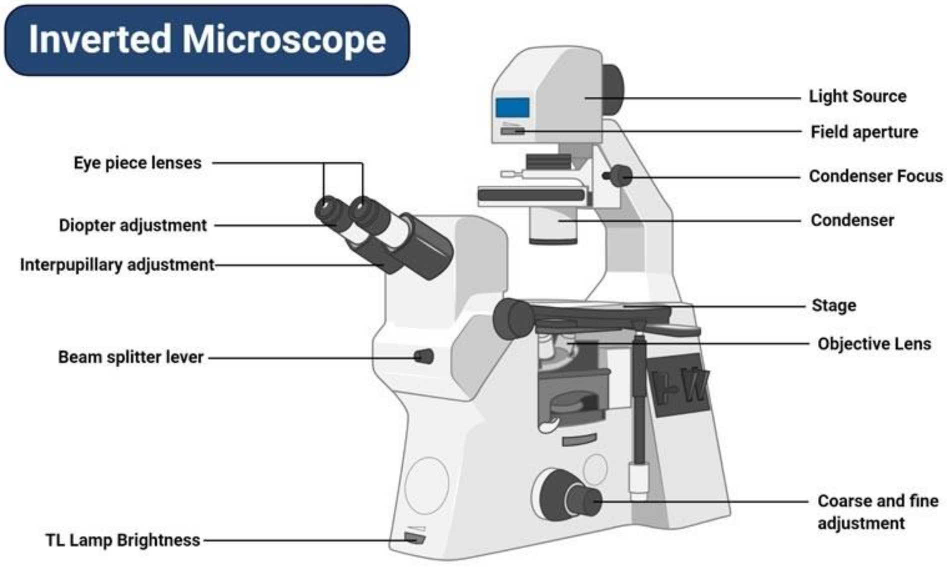


Figure: Inverted Microscope

Operation, applications and limitations

Optical microscopy is commonly used in many research areas including microbiology, microelectronics, nanophysics, biotechnology. It can also be useful to view biological samples for medical diagnoses, known as histopathology.

Microscopes in Botanical Field

Lab professionals and students who want to study the features of leaves, their cells, and many features of a plant, use this device. Botanists do multiple researches on various plants and fungi for research purposes which helps them find many new features.

Microscopes in Biological Field

We have seen this device in every biological laboratory. This device is used for observing microorganisms and their features. In this field, microscopes are used to study bacteria, cells and many more. This device helps biologists in their study of living organisms and their cell structures.

Microscope in Crime Detection

Use of microscopes in crime fields helps to simplify complex evidences and helps in studying them to solve cases. We use this device for forensics purposes and prove the convict is innocent or not. There is major application of these devices in this field and without it will not be possible to examine certain things which are not visible with naked eye.

Microscopes in Education

In various institutions, colleges, schools and universities, among various optical instruments, this lab tool will be found in every laboratory of major departments. Students use this device to learn new things and understand the world around them. Because of its excellent usage, it is one of the favorite device of students.

Microscopes in Medical field

Human's greatest contribution to healthcare would not have been possible without the use of microscopes. Scientists and lab professionals use this device to study various viruses and bacteria and find out cure for various diseases. Researchers use this device to study deadly microorganisms and how they affect human body