Microscope

A microscope is The microscope is a precision instrument with optical subsystems (lenses, filters, prisms, condensers); mechanical subsystems controlling the position of the sample in tridimensional space X, Y, Z; electrical (transformers and light source) and electronic subsystems (cameras, video) to produce highly magnified images of small specimens or objects especially when they are too small to be seen by the naked eye. The word microscope comes from the fusion of the Greek words micros which means small. Microscopy is the use of a microscope or investigation by a microscope.

1. Parts of Microscope

The main parts of the microscope are shown in figure 1.

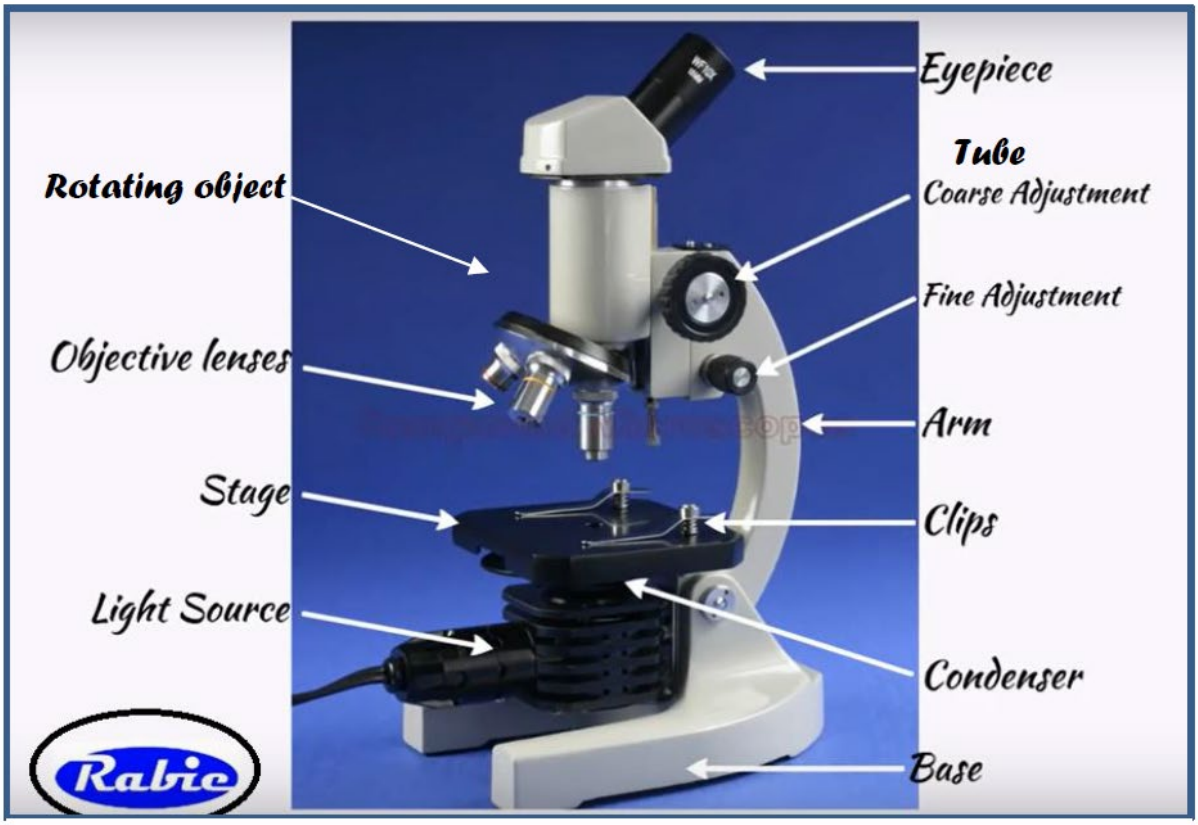


Figure 1: shows the parts of microscope

1. Eye piece: consists of a series of lenses mounted in a tube (barrel) at the upper end of the microscope. Its basic function is to look at the focused, magnified image projected by the objective lens and magnify that image a second time before your eye looks at the image of the specimen.

2. Arm: also called stand or limb that contains the focus mechanism and supports the stage, as well as the body or head which contains the eyepieces. It provides the rigidity of a microscope as it rises from the base. A few types of arms are:

❖ Fixed: a type of arm where the arm and the body are integral parts of the microscope and connected solidly to the base.

❖ Pillar (Post): a type of arm which consists of a single post rising vertically from the base. The microscope body can rotate about the post and also be moved up and down on it.

❖ Boom (Universal): a long boom type stand used to support a microscope body. It has many adjustments allowing the microscope to be aligned in a wide variety of configurations. This is the least common type of arm.

3. Stage: The platform beneath the objectives on which the slide or object to be placed. It has a smooth, flat surface and can be rectangular.

4. Coarse adjustment: used to make large changes in focus.

5. Fine adjustment: used to small adjustment of focus.

6. Base: is the bottom support part of the microscope to provide balance and rigidity.

7. Tube: reflect the lights up to the viewer eyes.

8. Rotating object (Nosepiece): to hold multiple objective lenses of various magnifications for allow quick change of objective.

9. Objective lens are the closest to the specimen and most important of microscope. Their basic function is to gather the light passing through the specimen and then to project the image up into the body of the microscope. Most quality microscopes use glass for the objectives and even for beginner microscopes. Objective lens are consist of :-

❖ Low power objective: The first lens with magnification usually 4X.

❖ Medium power objective: The second lens with magnification usually 10X.

❖ High power objective: The third lens with high magnification usually 43X.

10. Stage clips: used to keep the slide in place.

11. Condenser: Lens (Sub-stage Condenser) is a glass lens or lens system located within or below the stage on compound microscopes. Its basic function is to gather the light coming in from the light source

and to concentrate that light into a light cone onto the specimen. Some condensers can be designed to have special accessories for phase contrast, polarized light, differential interference, and dark field microscopy

12. Diaphragm is also called the sub-stage diaphragm or aperture diaphragm: The diaphragm is normally located under the stage of a microscope and it adjusts the amount of light passing into the slide or specimen used to vary the amount of light passing through the slide. There are two types of diaphragm

❖ Disc Diaphragm — is the simplest and least expensive of the two types. It is located between the light source and the slide or specimen. It contains a rotating disk (usually fixed) with five to ten

openings of differing diameters which limit the amount of light passing through to the specimen.

❖ Iris Diaphragm — is the better and more expensive of the two types. It has a continuously variable diameter (like the iris of an eye or a camera shutter) which has a function to limit the size of the opening through which light passes from the light source to optimize resolution, contrast, and sharpness. It is usually controlled by a lever.

13. Light source: the source of light which illuminates the object or specimen to be observed. There are various types of illumination lamps or bulbs:

❖ Tungsten — is an incandescent bulb filament which is the most common and least expensive. They give off a yellowish hue and give off moderate heat. They are typically 15-watt or 20-watt.

❖ Halogen — is a lamp which generally is the hottest light source for a microscope. The light is very bright, very white, and concentrated. The halogen type is more expensive than the tungsten. They are typically 15-watt or 20-watt.

❖ Fluorescent - is a lamp that is cool in temperature. The light is bright and white and very sharp while being comfortable to the eye. The fluorescent is great for observing live specimens. They are typically 5-watt to 10-watt and generate the same brightness as the tungsten or halogens do. They can be built in the base of a microscope or they can be attached (called a ring light) to observe from above.

❖ LED – these are light emitting diodes which provide a bright light source with-virtually no heat. The white beam is brighter and cooler than the other illumination systems. They are typically battery operated and thus are cordless and great for outdoor use also.

14. Head (Body) The head is the upper part of the microscope that connects the eyepiece to the nosepiece or turret. Some heads are fixed in place and allow you to tilt them from angles of 0° up to 60°. There are several types of heads:

❖ Monocular: this is a microscope with a single eyepiece.

❖ Binocular: this is a microscope with two eyepieces, one for each eye.

Trinocular: this is a microscope with a binocular head for viewing and an additional port that can be used for a third eyepiece for a second person.

2. Types of Microscope

The majority of microscopes are called light (bright field) microscopes since they rely on light to observe the magnified image of a specimen or object. The categories of microscope are:

1. Compound (high power microscopes).

2. Stereo or dissecting (low power microscopes).

3. Phase Contrast.

4. Fluorescence.

5. Metallurgical.

6. Electron Beams. 7. Digital.

1- Compound Microscope

This is the most common type of microscope. It can also be referred to as a biological or research microscope. The compound microscope is refer to as a high power microscope. The magnification (power) can have a range from about 40x to 1000x and some can go up to 1500x or 2000x. Much serious work of a compound microscope is done at 400x to 500x.

Principle of Compound Microscope

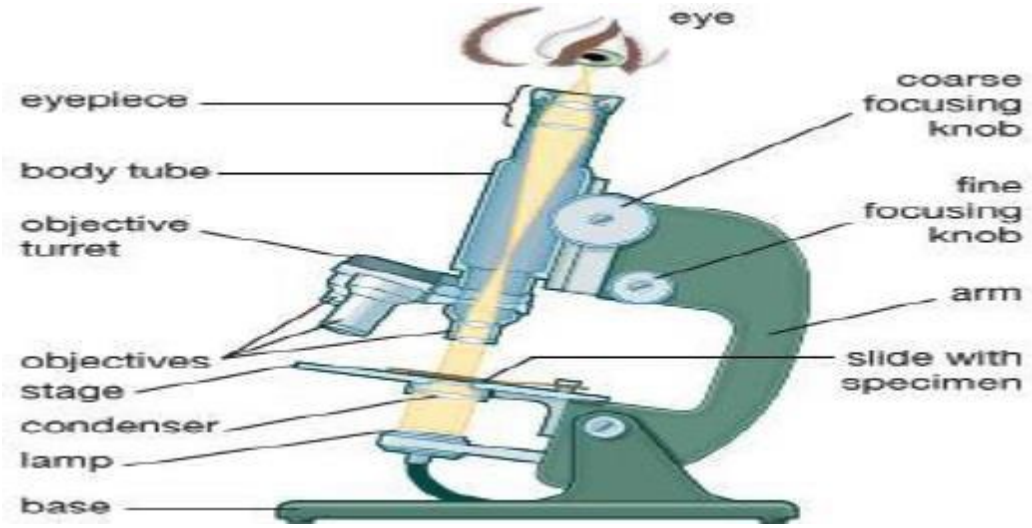
▪ A single light path passes through a series of lenses in a line where each lens magnifies the image over the previous one.

▪ The image is seen by the observer as if it were only 10" (250mm) from your eye. A compound microscope uses light to illuminate the specimen or object so that you can see it with your eye.

▪ The objective lens usually consists of three or four lenses (sometimes even five) on a rotating nosepiece (turret) so that the power can be changed

▪ . The image produced at the eye is two dimensional (2-D) and usually reversed and upside down.

▪ The most used light method is trans-illumination (light projected from below to pass through the specimen). At 400x much detail can be seen at the cellular level of biological specimens.



Figrue2: Compound Microscope

2- Stereo Microscope

Stereo microscopes are the second most common type of microscope. They can also be referred to as dissection, or inspection microscopes. The stereo microscope is referring to as a low power microscope. Magnification (power) can have a range from about 10x to 80x with magnification in the 10x to 40x the most popular. Also, zoom models from about 10x to 60x or so are very convenient. Low power is used for examining larger sized items like insect parts, flower parts, rocks and fossils, stamps, coins, PC boards, material surfaces, hair, etc.

Principle of Stereo Microscope

▪ There are two separate light paths (as opposed to a single light path in a compound microscope) which produce a true stereo.

▪ Three dimensional (3-D) image of the specimen or object, within the objective lens you will find two lenses (one for each path of light) side-by-side.

▪ The optical design parameters of a stereo microscope limit its 3-D effects to low powers only. Also in the category of low power microscopes is the single light path (like a compound microscope) type usually referred to as a dissecting microscope.

▪ Most stereo microscopes have both top and bottom built-in or attached illumination to handle various objects and specimens of all varieties, shapes, and colors.

▪ A stereo microscope uses light (from desk or table lamps, indirect sunlight, other interior light sources, or from built-in or attached lamps) to illuminate the specimen or object so that you can see it with your eyes.

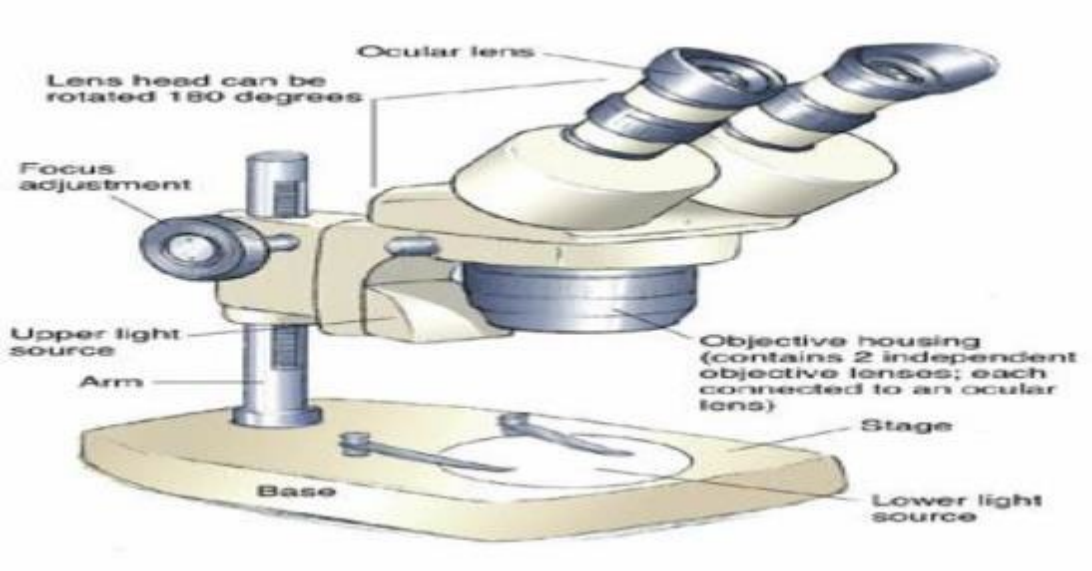


Figure3: Stereo Microscope