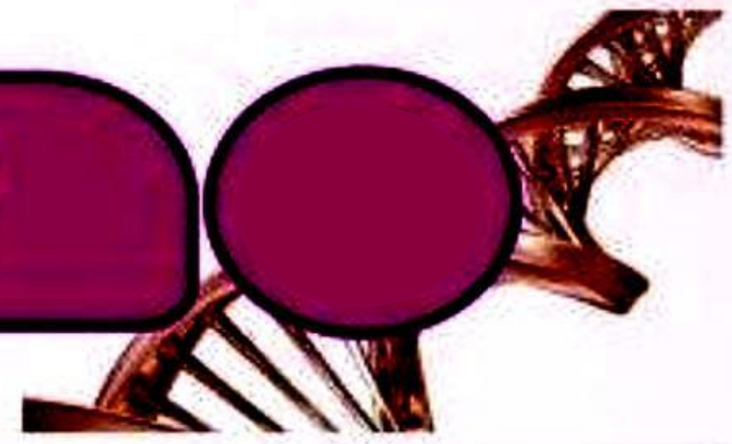
EXPERIMENT



Aim

To study the parts of a compound microscope.

THEORY

Microscope is an extensively used instrument in a biological laboratory. It magnifies and resolves the image of the object seen through it using combination of various lenses. A compound microscope is a complex assemblage or combination of different lenses that enable highly magnified image formation of the microscopic biological objects (e.g., cells, tissues) and help in studying the intricate details of cells and tissues. Compound microscope uses natural light to magnify and resolve the image of the object.

WORKING OF A MICROSCOPE

It is based on the following two scientific facts-

1. **Magnification**

   The ratio of increased image to that formed on retina of an unaided normal eye is termed as magnification of the microscope. 5X, 10X or 40X indicates the strength of magnification. Magnification of compound microscope = Magnifying power of objective lens × Magnifying power of eye piece of ocular lens, e.g. a 5X eye piece and a 40X objective will magnify the image 5×40 =200 times. In general, in a compound microscope eye piece lens are 10X or 15X and objective lens are 10X as well as 40X.

2. **Resolving Power**

   Resolution is the minimum distance at which distinction of two closed points as two separates' points are possible. The formula for obtaining the resolving power of microscope is $R = \frac{\lambda}{2NA}$

   where, λ = wave length of light source, NA = Numerical Aperture.

   Since, numerical aperture is negligible, it can be ignored.

   Resolving power $R = \frac{\lambda}{2}$

   λ of visible light = 4000-7000 Å.

   If we take the average as 6000 Å, the resolving power = $\frac{6000}{2}$ = 3000Å.

   Therefore, the resolving power of a light compound microscope = 0.30μ or 3000 Å or 300 nm.

MATERIAL REQUIRED

A compound microscope, muslin cloth, lens cleaning fluid and lens cleaning paper.

PROCEDURE

1. Place the microscope on the working table.
2. Remove dust by wiping the microscope with the help of muslin or silk cloth.
3. Clean the lenses with the help of lens cleaning fluid and lens cleaning paper.
4. Identify the various parts of the microscope and draw a well labelled diagram of microscope by labelling its various parts.
5. Take a permanent slide or temporary slide prepared by you and keep it on the stage, fix with clips after focussing and view.
6. Learn to use the microscope by adjusting the focus, by moving the coarse adjustment and fine adjustment knobs.

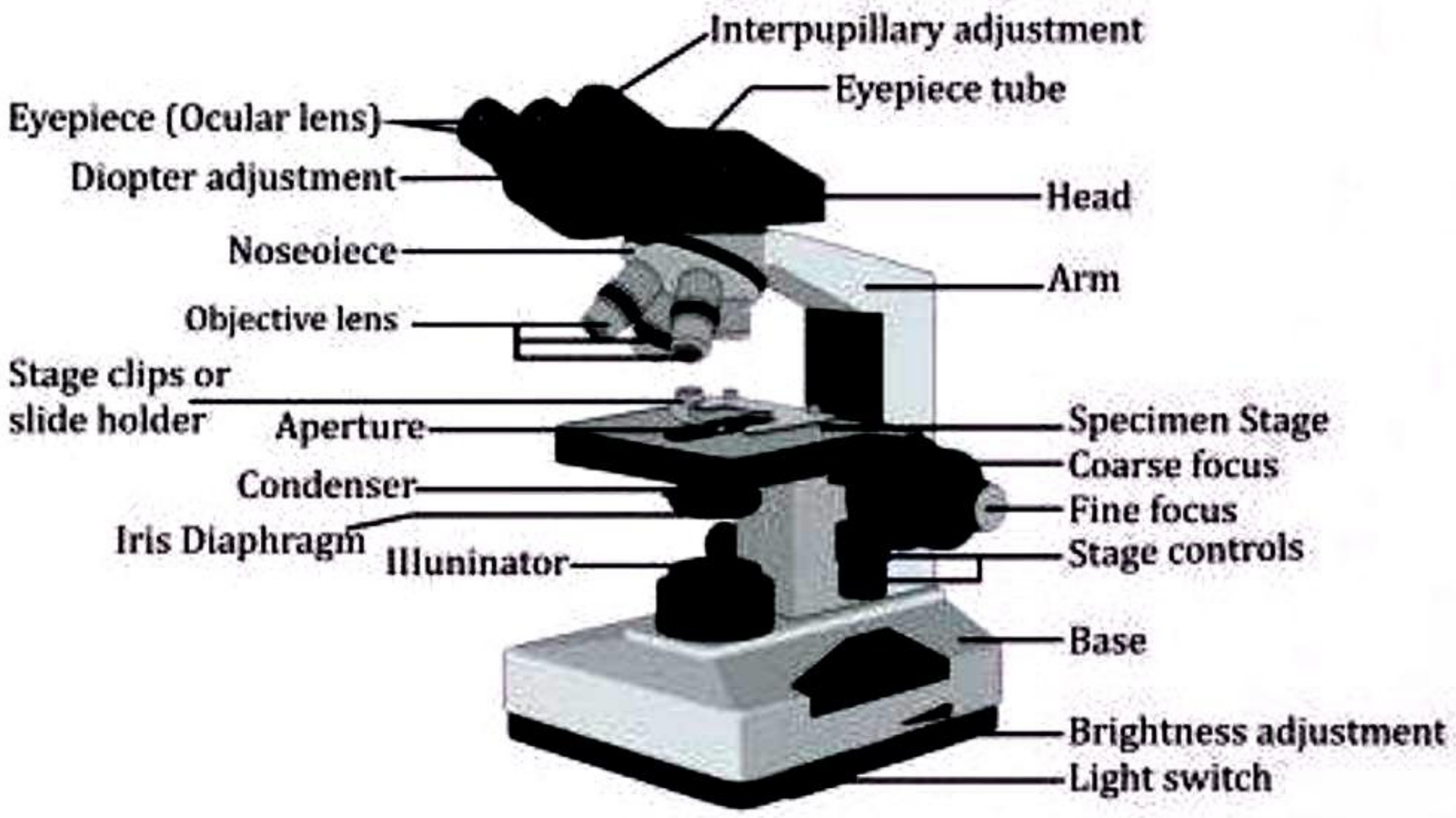
OBSERVATION

Compound microscope has following two types:

MECHANICAL PARTS	
Base or foot	A horse shoe-shaped metallic structure that supports the microscope.
Pillar	A small vertical projection of the base.
Arm	It is the vertical and curved part of the microscope which connects the body tube to the base of the microscope and is used for handling the instrument. It can be tilted to different angles on the inclination joint.
Inclination joint	The arm is attached to the pillar at this joint. The microscope can be tilted at this.
Stage	It is a flat/round/square/rectangular platform which is attached to the lower end of the arm. Slide or object to be magnified is kept on it.
Stage clips	These are two metal clips that hold the slide firmly in place. These are attached to the stage. The material to be observed is adjusted by moving the slide and then fixing it at the desired position with the help of clips.
Diaphragm	It is attached to the base of the stage and regulates or adjusts the amount of lighting into the microscope, i.e. it regulates the aperture size.
Condenser	Two or more lens systems that gather and focus the parallel part of the beam of light from the illuminator onto the specimen being viewed. Some microscopes don't have this part.
Body tube head	It is a tubular hollow part which is attached to the upper part of the arm. It connects the eyepiece to the objective lenses and can be moved up and down with the help of screws.
Nose piece	It is a circular, metallic and rotating structure attached below the body tube. Three different objective lenses can be fitted into it. The viewer spins the nose piece to select the different objective lenses.
Coarse adjustment screw	A big sized screw which helps in moving up or down for general focussing of object or specimen. It is used for low magnification focussing
Fine adjustment screw	A small sized screw used for fine tuning or focussing of the object and increases the details of the specimen. It is used for high magnification focussing

OPTICAL PARTS	
Plano-concave mirror	It is attached to the lower end of the arm and has plano-concave surfaces which are used to reflect the converging light rays from an external source up through the bottom of the stage into the microscope in order to get brightly illuminated image of object.
Objective lens	These lenses are attached to the nose piece and is the most important part of a compound microscope. Objective lens is a lens system made up of many lenses in a definite pattern. It is of three types: **(i) Low power objective lens** with magnifying power 10X. **(ii) High power objective lens** with magnifying power 40X. It is also called as high dry objective lens because it is used without adding any fluid in the medium between specimen and objective. **(iii) Oil immersion objective** lens with magnifying power of 100X treated as third objective lens in some microscope. It uses cedar wood oil as immersion oil.
Eye piece lens or ocular lens	This lens is fitted at the top of the body tube through which the magnified image of the object can be seen. It has the magnification of 10X or 15X.

Parts of a Compound microscope



WORKING OF MICROSCOPE

1. The mirror is adjusted in diffused source of light so that sufficient light enters into the microscope.
2. The light entering into the microscope should be regulated to minimum by the help of diaphragm and adjustment screws.
3. Keep a clean prepared slide on the centre of the stage such that it lies just under the objective lens and completely illuminated by diaphragm.
4. Locate the object and focus it under low power objective by using coarse adjustment screw. For obtaining the higher magnification turn the nose piece to next higher power by using fine adjustment screw.
5. The higher power objective should be used only when object is properly mounted under cover-slip.

HANDLING OF MICROSCOPE

1. The lens and metal parts should be cleaned with the help of tissue paper or muslin cloth before handling

of microscope and after use.

2. It should be covered when not in use.
3. Objective lens should not be removed ordinarily from the nose piece.
4. The slides should be focused in low power first and then changed to high power.
5. Always handle the microscope, operating screws, condenser, etc. carefully.
6. Proper careful placing of microscope is required, when it is not in use.
7. After using of immersion objective lens wipe the lens to remove any leftover smudge, before changing the magnification.

PRECAUTIONS

1. Hold the microscope with both the hands in an upright position, while carrying it.
2. Always change to low power objective lens after using the high-power objective lens.
3. Do not move the coarse adjustment screw, while using the high-power objective lens.
4. While observing, the objective lens should be carefully adjusted, so as to avoid touching the slide lest it breaks the slide.
5. Always observe the objects of slides under microscope with both the eyes open.

VIVA VOCE

Q1. What would happen if direct sun rays are focused by the mirror into the body tube?

Ans. If the direct sun rays are focused by the mirror into the tube body, it will harm our eyes, while observing the specimen. Therefore, diffused light or northern light is used for focussing the object.

Q2. Which of the following parts provides support and supports the weight of a microscope?

(a) Arm
(b) Stage
(c) Body tube
(d) Foot

Ans. (d) Basal foot or base provides stable support and supports the weight of a microscope.

Q3. To which part of a microscope is the objective lenses fitted?

(a) Nose piece
(b) Diaphragm
(c) Stage
(d) Arm

Ans. The objective lenses are fitted to the nose piece which is the circular, rotating, metallic structure below the body tube.

Q4. Give a difference between light microscope and electron microscope?

Ans. The light microscope uses sunlight as a source of illumination while, beam of electrons in vacuum is used as source of illumination in an electron microscope.

Q5. What is the difference between a dissecting and a compound microscope?

Ans. The dissecting microscope has lower magnification and is used to magnify small animal's objects or to perform dissection of small animal or to see large section, while compound microscope has high magnification power as well as resolving power and is used to see the minute details of cells and tissues

Q6. When should the concave surface and plane surface of the mirror be used in the microscope?

Ans. The plane surface of the mirror should be used when the light is bright while, concave surface should be used when the light is dim.

Q7. What do you mean by magnification power of a microscope?

Ans. The ability of the microscope to enlarge the object under focus is termed as magnification power.

Q8. Magnification power of a microscope is calculated by:

(a) Magnifying power of eye piece × magnifying power of minor.

(b) Magnifying power of eye piece × magnifying power of objective.

(c) Magnifying power of objective × magnifying power of plane mirror.

(d) None of the above.

Ans. Magnification power of a microscope a calculated by magnifying power of eye piece.
magnifying power of objective

Q9. What is the magnification of a dissecting microscope?

Ans. The magnification of a dissecting microscope may be 5X, 10X or 20X.

Q10. What is the resolving power of a microscope?

Ans. The ability of the microscope to distinguish two points as two separate points is known as resolving power.

Q11. Give the formula to calculate the resolving power.

Ans. Resolving power (R) = $\frac{\lambda}{2NA}$ where, λ = Wavelength of light source NA = Numerical aperture.

Q12. What is the resolving power of a light microscope?

Ans. The resolving power of a light microscope is 0.30 μ or 300 mm.