10 The Correct Use of the Microscope

Many measures have been taken from ancient times to observe small things by magnifying them. Different equipment have been produced and used for this purpose.

Do Activity 10.1 by using instruments or materials that can be supplied from your home environment easily.

Activity 10.1

You will need :-

A closed glass bottle filled with water, a glass sphere, a glass slide with a drop of water, a sealed transparent polythene bag filled with water, a water filled filamentous bulb sealed with wax

Method :-

Observe small letters by using each of the above instruments or substances.

You can observe that small letters are magnified in size.

One common feature of above mentioned instruments is the presence of water. Did you find out another feature common to the all instruments?

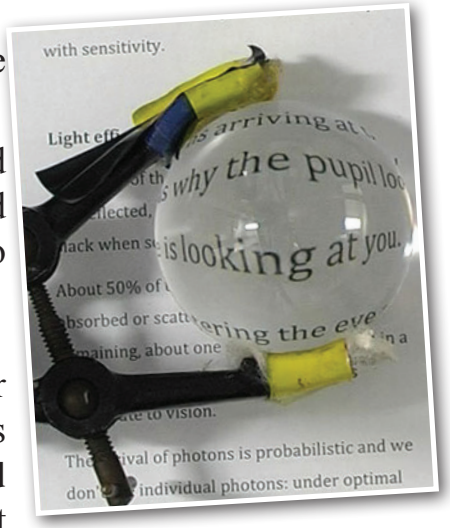


Figure 10.1 ▲ Letters are magnified when seen through a glass sphere

You must have observed that the other common feature of the above instruments was the curved surface or the **protruded** surface. You might now understand that these curved surfaces can be used to magnify small items. **Convex lens** is an instrument with these features, which is found in school laboratory.

10.1 The simple microscope

A hand lens/simple microscope can be produced by fixing a handle with a frame to a convex lens.

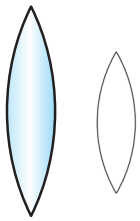


Figure 10.2 ▲ Convex lens

Figure 10.3 ▲ Hand lens

Activity 10.2

Observe the letters that you used in the above activity using a hand lens. Make sure to adjust only the object (letters) and do not change the distance between the lens and the eye.

Figure 10.4 ▲ Observing an object through a lens

You will observe that when the distance between hand lens and letters are increased gradually the letters will appear more and more larger. At a particular limit the letters will be seen with a maximum size. When the distance is increased further, the letters will become unclear.

Therefore, you will realize that there should be a constant distance kept between the object and the lens when an object is observed by a hand lens.

10.2 Magnification of a microscope and resolving power

Magnification

You might have observed that the size of the letter will be increased by several times. The number of times a specimen is magnified is known as the **magnification** of the lens or the magnifying power.

Activity 10.3

Observe different things by using a hand lens. Use a table to record your observations. Try to separate things which cannot be seen through your naked eye clearly.

Table 10.1

Materials observed	Observation
1. Soil sample	Sand particles with different sizes, gravel and several insects are observed.
2.	
3.	

Resolution

Resolution is the minimum distance by which two points must be separated in order to be seen as two distinct points.

There should be at least a minimum distance of 0.1mm between two adjacent points to distinguish between them by the naked eye. Now you will realize that the resolution of the naked eye is around 0.1mm.

Activity 10.4

You will need :- Colourful picture from a paper, a hand lens

Method :-

Observe a picture from the paper by a hand lens.

Present your observations to the class.

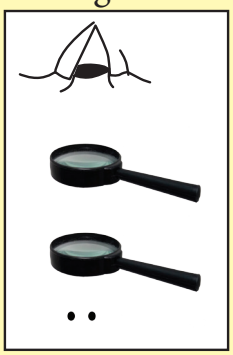
You will observe that the respective image is composed of a large number of small dots seen by the naked eye. You will see these dots very clearly by a hand lens. Now you will realize that the resolving power of the hand lens is higher than the resolving power of the naked eye.

Activity 10.5

You will need :- A white paper, a pencil or a pen, two hand lenses

Method :-

- Mark two dots with a distance of about 0.5 mm.
- Observe the distance between the two dots and their magnification by using a hand lens.



- Now use two hand lenses to observe the distance between two dots and their magnification.

It must be clear to you that the distance between the two dots is maximum and magnification is maximum when two lenses are used for the observations. Accordingly two hand lenses or two convex lenses can be used to obtain a higher magnification and high resolution.

Similarly, the compound light microscope is produced using two convex lenses with a high magnification power.

10.3 Compound light microscope

The compound light microscope is made of at least two convex lenses. Therefore, it is called the compound microscope and it is also called the light microscope because light is used.

Although micro organisms cannot be observed through a hand lens, they can be observed through the compound light microscope.
The maximum magnification of a developed compound light microscope is 2000 times and the maximum resolution is about 0.2µm (0.0002mm).

(The resolving power of the compound light microscope is 500 times than the naked human eye.)

Activity 10.6

Let us identify the parts of a compound light microscope

Observe the compound light microscope in your school laboratory. Identify its main parts and functions with the assistance of your teacher.

Check whether you have identified all the parts of it.

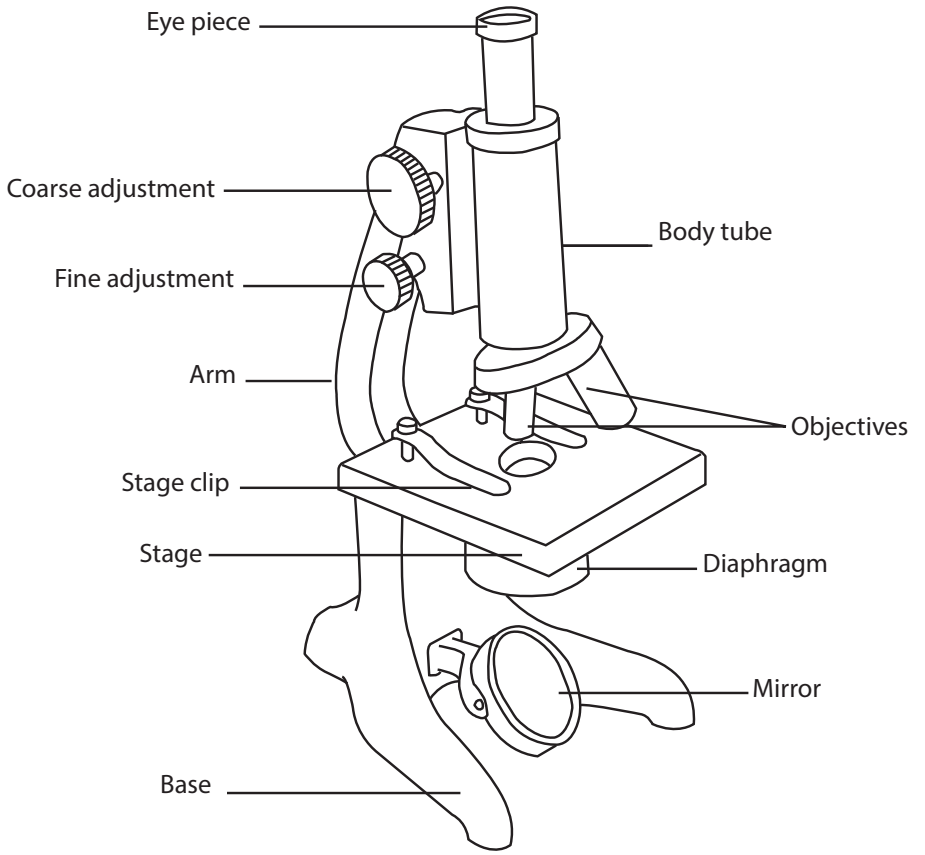


Figure10.5 ▲ Parts of a compound light microscope

Table 10.2 ▼ Parts of a microscope

Part of the microscope	Description
Eye piece	The closest lens to the eye. It is a convex lens. Magnification is shown as x5, x10 or x15. The specimen is magnified by using them.
Objective lens	The closest lens to the specimen. They are made of convex lenses. It magnifies the specimen. Mostly there are 3 objective lenses that can be identified. They are 1. Lower power objective lens The lens with the least magnification (x4,x5 or x8) 2. Mid power objective lens The lens with the medium magnification (x10) 3. High power objective lens The lens with the highest magnification (x40)
Coarse adjustment	To adjust the body tube to get a clear image of the specimen
Fine adjustment	To adjust the body tube finaly to get a clearer image of the specimen
Stage	To keep the slide of the specimen
Clip	To keep the slide of the specimen on the stage
Diaphragm	Control the amount of light obtained by the specimen
Mirror	Contains concave and flat surfaces. Focuses light on to the diaphragm
Base	Keep the microscope on the supporting surface steadily

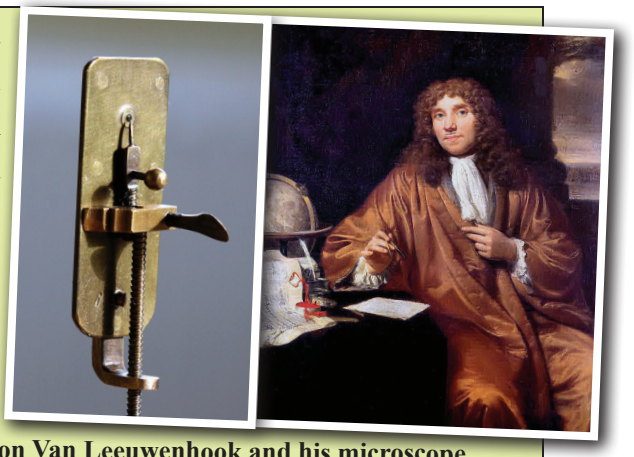
For extra knowledge

A bit from the history.....

The compound light microscope was first made by Zacharias Janssen. The magnification power of it was 9 times and it was similar to a toy telescope.

Zacharias Janssen and his microscope

But the honour of making a microscope first goes to the Dutch scientist Anton Van Leeuwenhook (1632-1723). The reason is that a world not seen from a naked eye was revealed by this instrument.



Anton Van Leeuwenhook and his microscope

Assignment 10.1

Prepare a report on the history of the microscope.

The correct method to use a compound light microscope.

1. First, keep the microscope on a vertical table steadily (in a place where strong sunlight will not fall).
2. Use the rough adjustment to bring the lower power objective lens down.
3. Adjust the mirror and the diaphragm to obtain a clear spot of light by keeping the eye open on the eye piece.
4. Fix the prepared slide on the stage using clips.
5. Bring the low power objective lens upward using the rough adjustment until a clear image is obtained. Making sure that both eyes are open during the process, keep the comfortable eye at a distance of 1 cm to the eye piece.
6. Try to obtain a clear image using fine adjustment.
7. A sharp and clear image could be obtained by adjusting the middle and high power objective lens if necessary.
8. Use the rough adjustment to bring the lower power objective lens upward after the observation.
9. Remove the specimen from the stage. Use a dry piece of cotton cloth wipe the stage.

Factors to be considered in the use of microscope

1. When the microscope is carried from one place to another, the arm of the microscope should be held by your familiar hand and the other hand should be kept below the base of the microscope. Then hold the microscope towards your body.

Figure 10.6

2. Wipe the stage using a clean piece of cotton after using the microscope.
3. If the microscope is not used for a long period of time, the lenses should be removed and place inside a desiccator with silica gel or anhydrous calcium chloride.
4. The microscope should be stored in an upward position to minimise the accumulation of dust.
5. Use clear slide and coverslips in the observation.
6. Do not change the lenses of one microscope to another.

Calculation of the magnification power of a microscope

The magnification power means the number of times that the speciman is subjected to be magnified. The number of times is obtained by multiplying the magnification of the eye piece with the magnification of the objective lens.

Magnification of microscope	=	Magnification of eye piece	×	Magnification of objective lens

Question :-

The magnification of eye piece was x10 and the magnification of the objective lens was x40 in a particular microscopic observation.

What is the magnification of the microscope?

Magnification of the microscope = Magnification of the eye piece × Magnification of the objective lens

= 10 × 40

= 400

The magnification should be stated in the following way when linear (line) diagrams are drawn upon observing a specimen.

Magnification of the eye piece	×	Magnification of the objective lens	×	The number of times the visual image is magnified when drawn

Observation of plant and animal tissue with a compound light microscope.

Activity 10.7

You will need :-

A compound light microscope, slides, cover slips, a leaf of betel, a leaf of Rhoeo, a bulb of onion, a slide made of cheek cells

Method :-Observe above mentioned types of plants and animals cells/ tissues by various magnification powers. Draw line diagrams and mention the magnification of each of them.

The Figure 10.8 show the linear diagrams of the Rhoeo lower epidermal tissue observed through a light microscope.

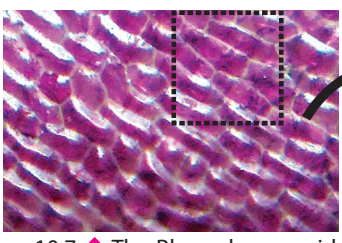


Figure 10.7 ▲ The Rhoeo lower epidermal tissue under low power of microscope (10 x 4)

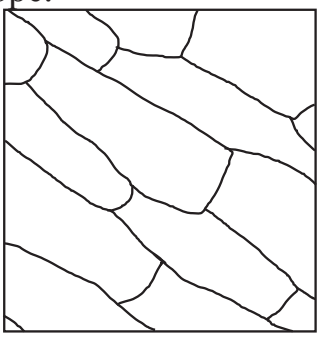


Figure 10.8 ▲ The linear diagram of the Rhoeo lower epidermal tissue (10 x 4 x 3)

The Figure 10.10 show the linear diagrams of the human cheeks cells observed through a light microscope.

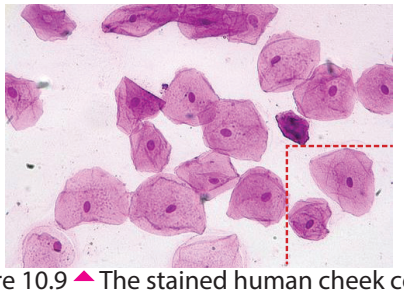


Figure 10.9 ▲ The stained human cheek cells under high power of light microscope (10x40)

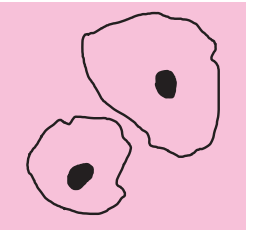


Figure 10.10 ▲ The linear diagram of the human cheek cells (10x40x2)

Assignment 10.2

List the differences between the simple microscope and the compound light microscope.

10.4 The electron microscope

An electron beam is used in the electron microscope instead of light rays.
The maximum magnification power of an electron microscope is 500 000 times. The maximum resolution of it is about 0.0005µm. This is 200 000 times than a healthy human eye. Although virus cannot be observed by a light microscope, they can be observed by an electron microscope.

Figure10.11 ▲ The electron microscope

Uses of the electron microscope

- To observe the activity of pathogenic microorganisms (virus, bacteria) during research.
- To learn about internal structure of the cell in detail.
- Used in genetic research.

Figure10.12 ▲ Image of a AIDS virus under the electron microscope

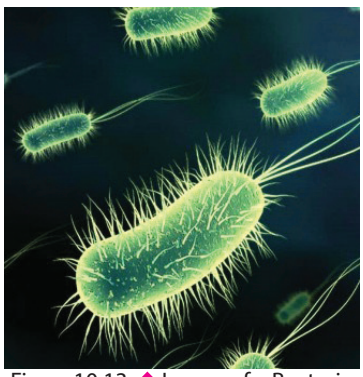


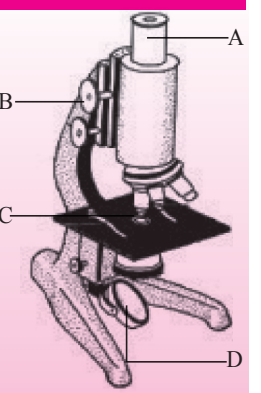
Figure10.13 ▲ Image of a Bacteria under the electron microscope

Summary

- Transparent objects with a convex nature can be used to observe small things in a large scale.
- Hand lens, light microscope, and electron microscope are three optical instruments used to observe small things in a large scale.
- The magnification of a light microscope is obtained by multiplying the magnification of the eye piece with the magnification of the objective lens.
- The minimum distance that should be present to clearly distinguish between two adjacent points or objects is called resolution.
- The electron microscope has a higher magnification and a higher resolving power than the light microscope.

Exercise

1. Name the parts labelled as A to D in the picture of a microscope.



2. The magnification of the eye piece was x10 and the magnification of the objective lens was x40 in a particular microscopic observation. What is the magnification of the microscope?

3. Write two factors to be considered when a microscope is used.

Technical Terms

Simple microscope	-	සරල අණ්වීක්ෂය	-	எளிய நுணுக்குக் காட்டி
Magnification	-	විශාලනය	-	உருப்பெருக்கம்
Resolution	-	විභේදනය	-	பிரிவலுத் தன்மை
Resolving power	-	විභේදන බලය	-	
Compound light Microscope	-	සංයුක්ත ආලෝක අණ්වීක්ෂය	-	ஒளி நுணுக்குக் காட்டி
Eye piece	-	උපනෙත	-	பார்வைத் துண்டு
Objective lens	-	අවනෙත	-	பொருள் வில்லை
Electron microscope	-	ඉලෙක්ට්‍රෝන අණ්වීක්ෂය	-	இலத்திரன் நுணுக்குக் காட்டி