Unit 1 Working like a biologist
1.1 Lenses and microscopes

We are learning how to:

- use a microscope
- prepare a slide for observing under a microscope

Magnifying glass, hand lens and microscope

Biologists often want to observe things that are very small. To do this they may use a magnifying glass or a hand lens.

These **optical devices** will typically make objects appear between 10× and 30× their natural size. Magnifying glasses and hand lenses can be carried about easily and are ideal for observing specimens in the field. However, if the biologist wants to observe something in detail they might prefer to use a microscope.

A simple microscope has two lenses called the **objective lens** and the **eye lens** or eyepiece. They are at each end of a tube that can be moved up and down in order to focus on an object.

Some microscopes have more than one objective lens. A low power lens is used to locate the area of a specimen to be examined and then the high power lens is used to observe that part of the specimen in more detail.

The **magnification** of a lens is usually given as a number. For example, an eye lens might have a magnification of times 5, or 5×. An objective lens might have a magnification of times 10, or 10×. The overall magnification of a microscope is the product of the magnification of the two lenses. Here, the overall magnification will be 5 × 10 = 50×.

FIG 1.1.1 Magnifying glass and hand lens

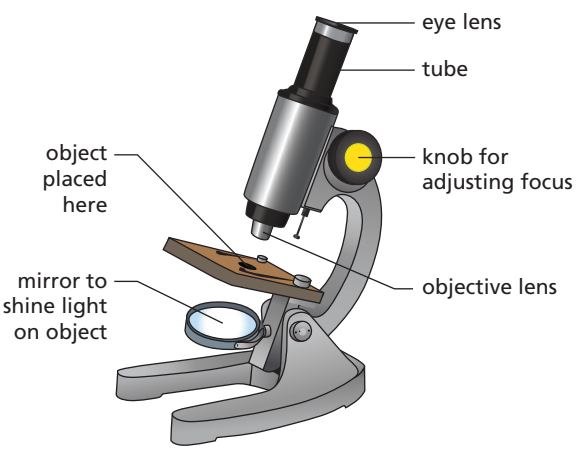

FIG 1.1.2 A simple microscope

FIG 1.1.3 Microscope with several objective lenses

Microscope slides and cover slips

Microscope slides are rectangles of glass. When a specimen is placed on a microscope slide it is covered by a much thinner piece of glass called a cover slip. This prevents the specimen from drying out and also protects the objective lens from coming into contact with the specimen. Cover slips are generally only used once before disposal.

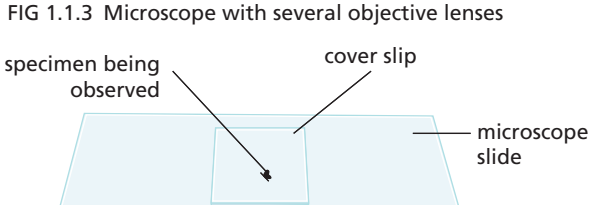

FIG 1.1.4 Microscope slide and cover slip

Before placing a specimen on a slide it is essential that the slide is thoroughly cleaned. Clean slides by spraying them with distilled water and wiping with an absorbent tissue. If the slide appears greasy use a small amount of methylated spirits. Rub the slide until it is dry and shiny. Handle the clean slide by its edges only.

Some specimens can be placed directly under the microscope on a slide but others look better when placed in a single drop of water on the slide. This is called a wet mount.

Activity 1.1.1

Learning how to use a microscope

Microscopes are expensive to buy and to repair if they are damaged. In this activity you will have the opportunity to learn how to use a microscope correctly.

Here is what you need:

- Microscope
- Microscope slide.

1. Look at the microscope and identify the parts.
2. Turn the knob that adjusts the focus and observe how this moves the tube up and down.
3. Put a small specimen on a slide in the middle of the microscope slide. For example, you could look at a hair.
4. Adjust the microscope until the specimen comes into focus.
5. If your microscope has more than one objective lens, look at the specimen thorough low power first and then through high power.
6. Practise drawing what you can see.

Interesting fact

Credit for inventing the optical microscope is normally given to the Dutch spectacle maker Zacharias Janssen, who lived in the 17th century.

Key terms

optical device device that produces or controls light

eye lens lens on a microscope nearer the eye

objective lens lens on a microscope nearer the specimen

magnification apparent change in size

Check your understanding

1. **a)** Why is it necessary to clean a microscope slide thoroughly on both sides before using it?

   b) Why is a cover slip sometimes placed on top of a specimen to be observed?

2. Table 1.1.1 shows some information about different microscopes. Copy and complete the table. The first line has been done for you.

Microscope	Magnification of eye lens	Magnification of objective lens	Overall magnification
A	5×	8×	40×
B	5×	12×	
C	10×		100×
D		12×	120×

TABLE 1.1.1

1.2 Examining and drawing cells under the microscope

We are learning how to:

- prepare a specimen for observation under a microscope
- observe and draw a specimen

All organisms are composed of **cells**. The human body contains many different kinds of cells. Although these many types of cells may differ in appearance and do different jobs within the body, they all have a similar basic structure.

Fig 1.2.1 shows the structure of a typical animal cell. The cell has three main parts:

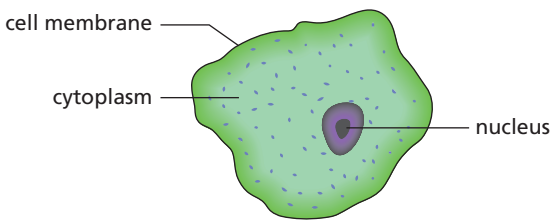

FIG 1.2.1 Structure of an animal cell

1. The nucleus is a small dark structure inside the cell.
2. The cytoplasm is a jelly-like substance that fills the cell.
3. The cell membrane is a thin layer that surrounds the cell.

You covered the roles of the different parts of the cell in Grade 7.

Cells are very small so to see individual cells you must use a microscope. Specimens prepared for examination under the microscope are sometimes stained with a dye. This makes it easier to see the different parts. Different **stains** are used for different kinds of cells. In Activity 1.2.1 you are going to use a stain called methylene blue, so your cells will look pale blue when you examine them.

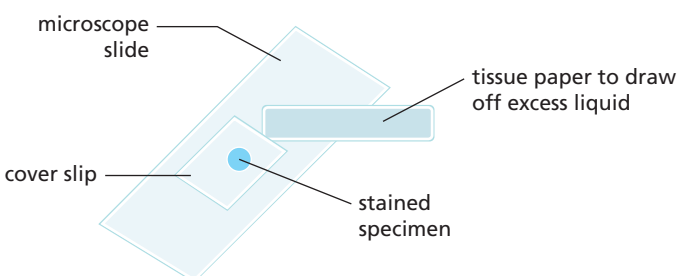

FIG 1.2.2 Wicking

The stain solution is put onto the specimen when it is on the microscope slide. This means that when the cover slip is put on it will float on the surface of the stain solution rather than settling on top of the specimen. The excess solution is drawn off by placing a tissue at the edge of the cover slip. Drawing off the excess water and stain in this way is called **wicking**.

When you come to draw your specimen it is important to draw what you can see and not what you think you should be able to see. You should not copy the cell in Fig 1.2.1.

Activity 1.2.1

Drawing cells from your own body

Here is what you need:

- Microscope
- Microscope slide
- Cover slip
- Methylene blue dye
- Tissue paper
- Wooden splint
- Distilled water.

Here is what you should do:

1. Cells are continually being worn off the surface of the body, including the inside of the cheek. Begin by washing out the inside of your mouth with clean water.
2. Collect some cheek cells by gently scraping the inside of your cheek with the flat end of a wooden splint.
3. Put a drop of distilled water on the microscrope slide.
4. Dip the end of the wooden splint into the drop of water on the slide, to deposit some of the cheek cells.
5. Place a single drop of stain solution on the specimen (see Figure 1.2.3) and leave it for about one minute.
6. After one minute carefully lower a cover slip onto the specimen. You will probably find that the cover slip sits on top of the water. Before the specimen can be observed the excess water and stain must be removed.
7. Place a tissue next to the cover slip so that it is just touching the stain solution. If you do this carefully the excess will be drawn into the tissue and the cover slip will be left sitting on top of your specimen of stained cells.
8. Before placing the slide onto the stage of the microscope, make sure that the underneath of the slide is dry, by wiping it with a dry tissue. Any stain solution under the slide will obscure the image and may damage the microscope.
9. Observe your cheek cells under low power. Low power makes it much easier to see the arrangement of cells and you can identify particular groups of cells that you would like to see in greater detail.
10. Alter the combination of lenses to view the image under higher power.
11. Draw some of your cheek cells.

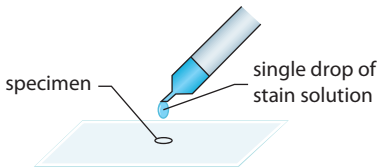

FIG 1.2.3

Key terms

cell basic unit from which all living tissue is made

stain chemical used to colour specimens for viewing under a microscope

wicking drawing off excess liquid using a tissue

Check your understanding

1. Why is it important that the mouth is clean and contains no particles of food before obtaining cheek cells?
2. Suggest why it is not a good idea to scrape off cheek cells using your fingernail.
3. Why is a stain added to the cheek cells?
4. Why is it essential that the dye used to colour a specimen does not come into contact with clothing?