1.1 Plant and Animal Cells

Here is a summary of what you will learn in this section:

- Cells have special structures that enable them to perform important life functions.
- Scientists use technology, such as the microscope, to understand the cell.

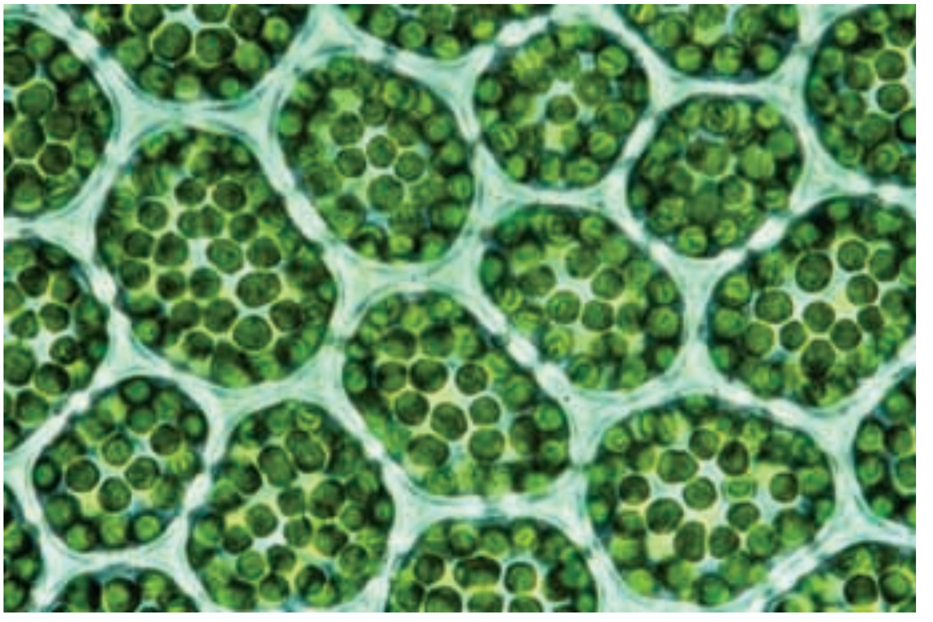

Figure 1.1 A piece of moss, as seen through a microscope, shows many cells filled with chloroplasts, an organelle involved in photosynthesis. The cells are shown at a magnification of 500×.

The Discovery of the Cell

When the microscope was invented in the mid-1600s, it became possible for scientists to look at the previously invisible world of the cell. Imagine the strange and beautiful structures that appeared before the eyes of these scientists. Today, we use sophisticated electron microscopes that allow us to not only see the cell in detail but also to get a glimpse of some amazing sights (Figure 1.1).

Robert Hooke was the first to describe cells in 1663 (Figure 1.2). He thought that the cells were the passages for fluids in a plant. Today, we understand that a cell is the basic building block of life. Every living organism is made of cells. A cell takes in nutrients from its environment and releases waste products into its environment. A cell can also divide to make copies of itself. A cell contains everything that it needs to live and grow.

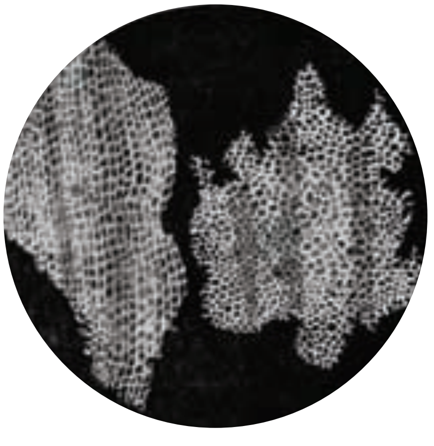

Figure 1.2 Robert Hooke's drawing of cork cells, as seen under a microscope. He used the term "cells" based on what he saw.

Using Technology to Study the Cell

In the early days of cell biology, scientists used simple light microscopes to view sliced sections of living cells. These microscopes helped scientists see and study the external structure of a cell but revealed few details about the tiny specialized working parts within the cell.

Advances in technology, such as the development of the electron microscope (Figure 1.3), have allowed biologists to learn detailed information about different cell parts and their functions. Technology has also made the process of learning about the cell easier. For example, the electron microscope can produce images that are 1000 times more detailed than the light microscope (Figure 1.4).

The discovery of the cell is an example of how scientific knowledge depends on technology. As our technology continues to improve, our knowledge and understanding of the cell will continue to expand.

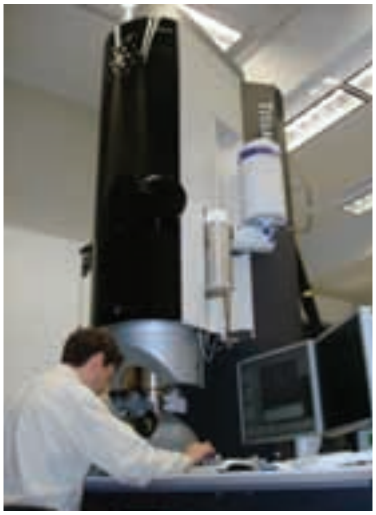

Figure 1.3 The world's most powerful electron microscope, the Titan 80-300 Cubed, was installed at McMaster University in Hamilton, Ontario, in October 2008.

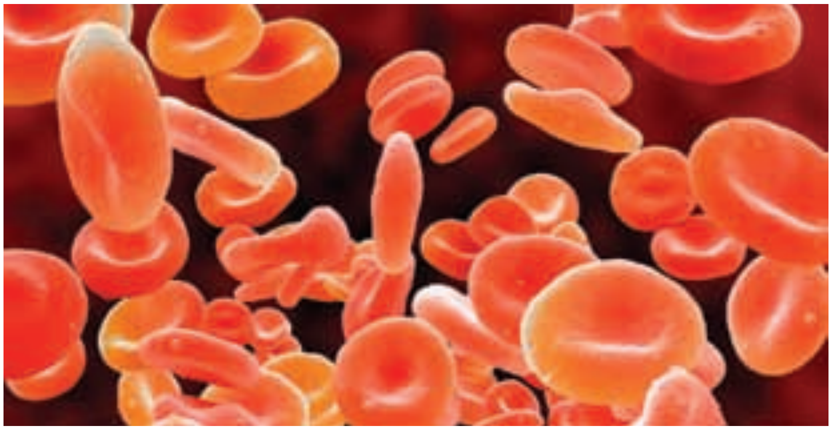

Figure 1.4 Red blood cells viewed through a scanning electron microscope (magnification 3700×)

A2 *Quick Lab*

What We Remember about the Cell

Cells come in a variety of shapes and sizes. However, there are some structures that are common to cells. There are also some differences. This activity will give you an opportunity to review the information that you know about the cell.

Purpose

To create a graphic organizer that shows what you remember about the cell

Procedure

1. Work in a small group of 2–4 students.
2. Brainstorm for two minutes with your group about what you remember about the cell. You may wish to use words, pictures, or phrases. Think about the different parts of the cell, the functions of these parts, or different examples of cells.
3. Create a graphic organizer using the words, pictures, or phrases that you came up with in step 2.

Questions

4. Sometimes, we remember things better if we can visualize an example or illustration. What type of cell did you visualize when you were brainstorming about the cell?
5. There are many parts in a cell. Sometimes, it is easier to remember the functions of the different cell parts by using analogies to everyday things. For example, we may say that the cell has a part that acts like a brain. Use an analogy to describe one specific part of the cell that you placed in your graphic organizer.
6. Did your group find that it was easier to remember the parts of the cell, functions of the cell, or examples of cells? Explain.

WORDS MATTER

The word "cell" is derived from the Latin word *cellula*, meaning small compartment. The word "cyto," as in cytoplasm, is from the Greek root meaning cell.

Cell Parts and Their Functions

All living things are made of cells. Our bodies are made up of between 10 trillion (10^{13}) and 100 trillion (10^{14}) cells. A **cell** is the basic unit of life. Each cell contains smaller parts called **organelles**. These organelles have special functions that maintain all the life processes of the cell, including:

- intake of nutrients
- movement
- growth
- response to stimuli
- exchange of gases
- waste removal
- reproduction

There are two types of cells: plant cells and animal cells (Figures 1.5 and 1.6).

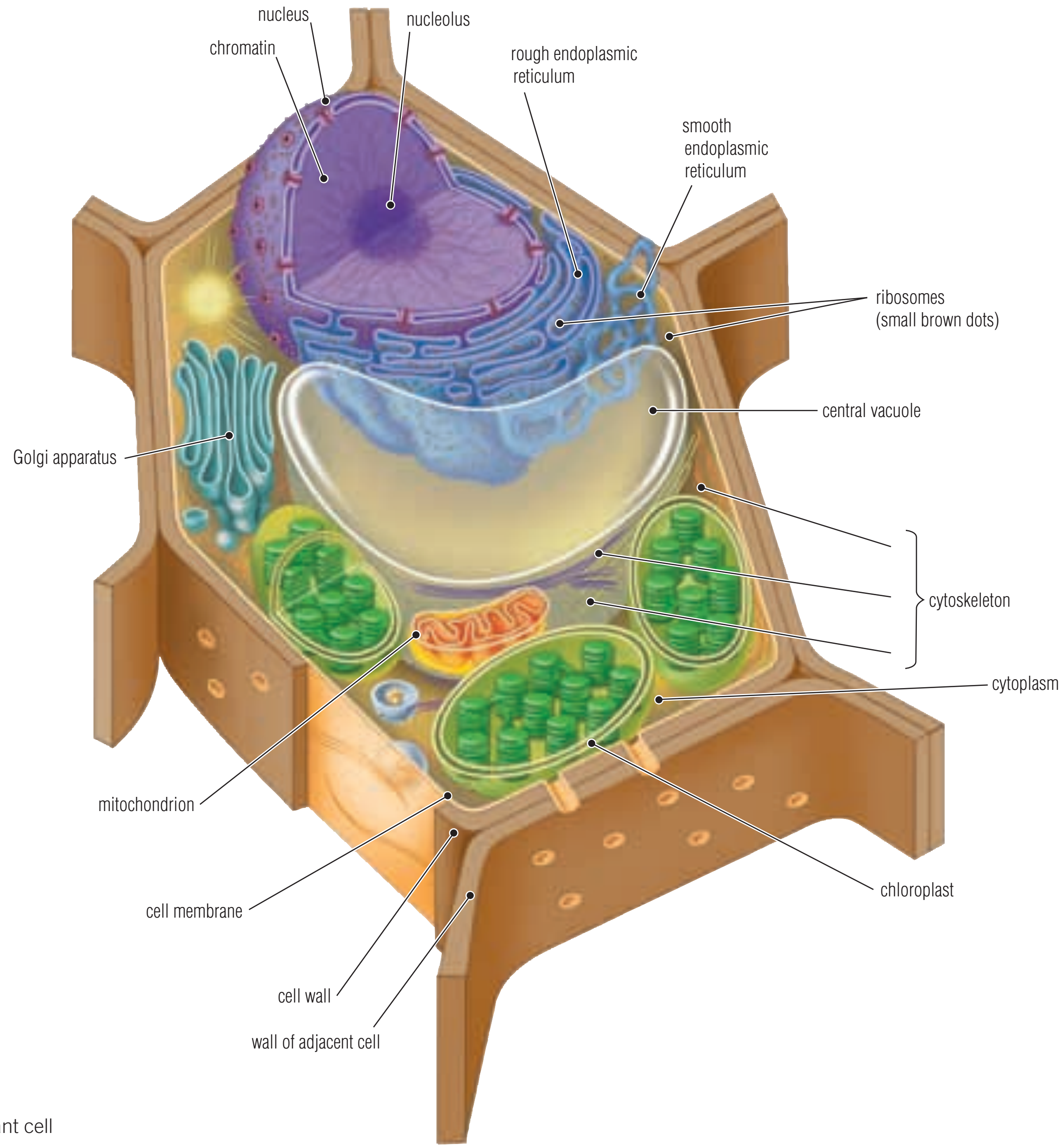

Figure 1.5 A plant cell

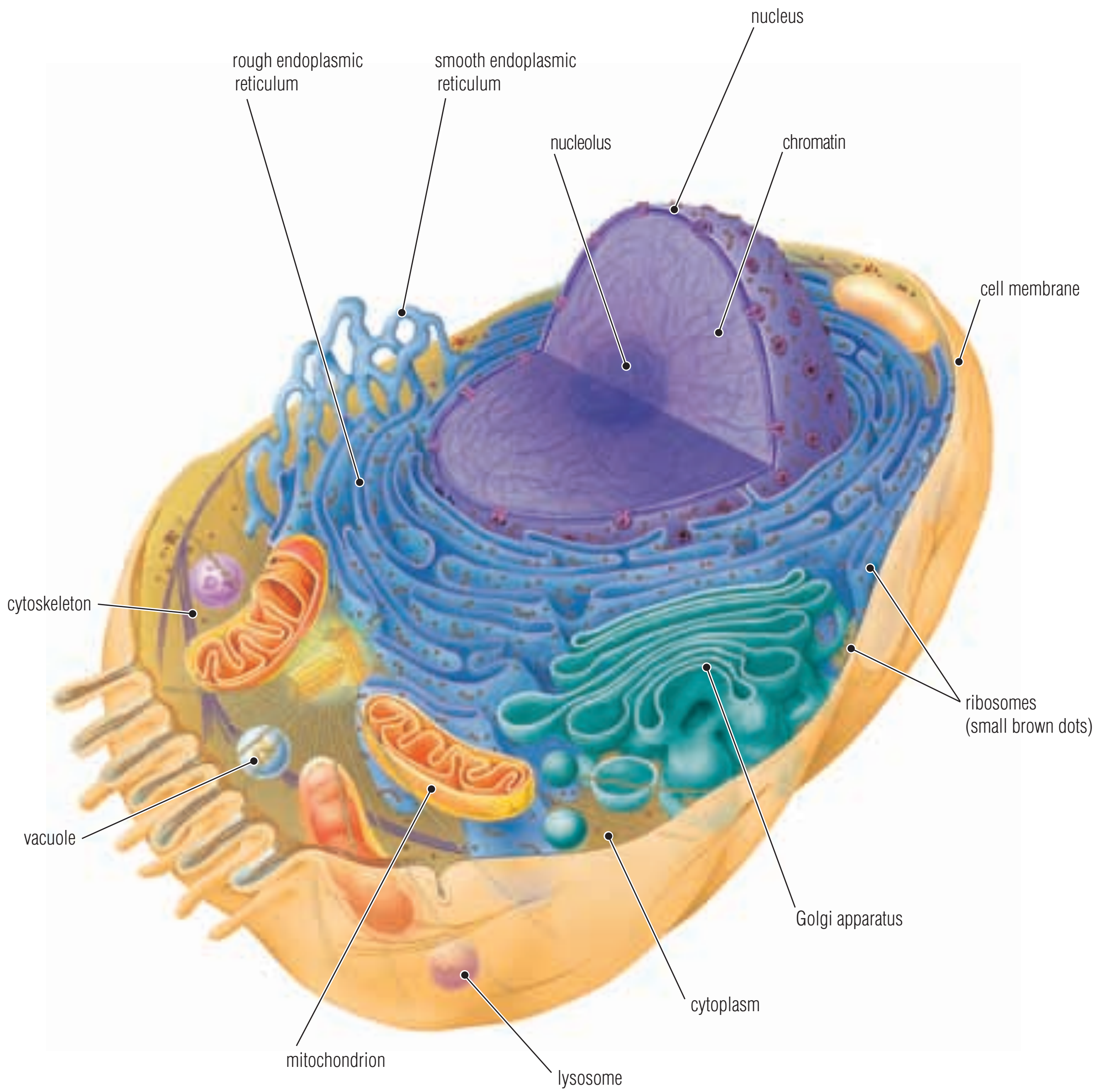

Figure 1.6 An animal cell

Structures and Organelles in Cells

A cell contains structures and organelles that carry out various functions. Although all cells must perform the tasks that maintain life, not all cells are identical. Therefore, some structures and organelles are the same in both plant and animal cells while other structures and organelles differ between plant and animal cells.

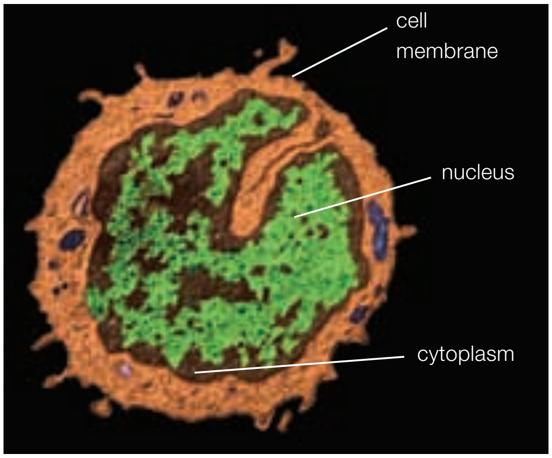

Figure 1.7 A cell showing the cell membrane, cytoplasm, and large nucleus (magnification 6000×)

Cell Membrane

Every cell has a **cell membrane** that forms a protective barrier around the cell (Figure 1.7). The cell membrane is made of a double layer of lipids. A lipid is a fat-like molecule that does not dissolve in water. The cell membrane is designed to allow different substances to move through it.

One process for moving substances across the cell membrane is called **diffusion**. Diffusion depends on the concentration of the substance on both sides of membrane. The amount of dissolved particles, called solutes, in a solution is the **concentration**. When a substance is present in different concentrations on either side of the cell membrane, the particles will diffuse, or move, from an area of high concentration to an area of lower concentration (Figure 1.8).

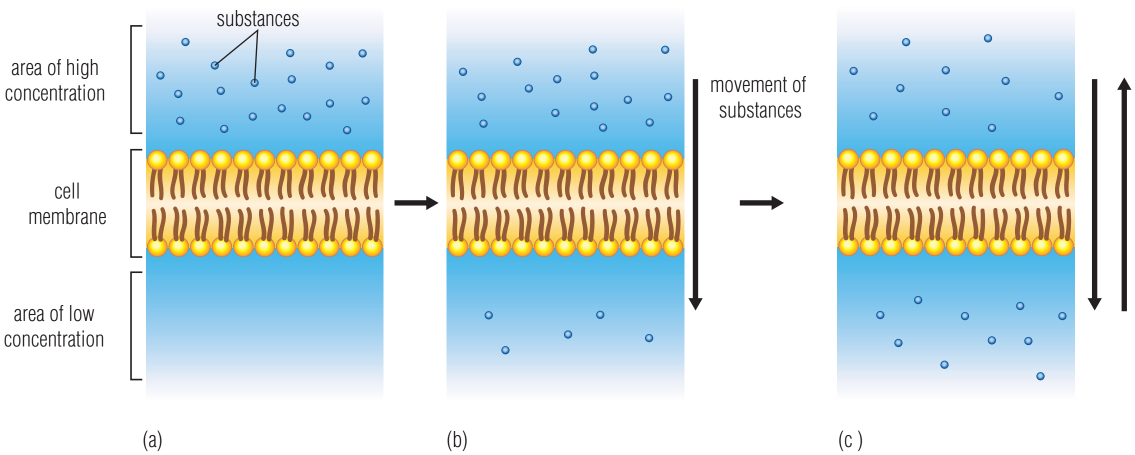

Figure 1.8 (a) There is a higher concentration of substances on one side of the cell membrane. (b) The substances move to the side that has a lower concentration until a balanced state, called equilibrium, is attained. (c) When equilibrium is reached, the substances diffuse across the cell membrane in both directions.

Cytoplasm

All cells contain **cytoplasm**, a jelly-like substance that fills the cell and surrounds the organelles (Figure 1.7). Cytoplasm contains the nutrients required by the cell to carry on its life processes. The organelles are suspended in the cytoplasm. The physical nature of the cytoplasm allows the nutrients and organelles to move within the cell.

Nucleus

The **nucleus** is the control centre organelle of the cell (Figure 1.7). It controls all the activities in a cell, including growth and reproduction. The nucleus is surrounded by the nuclear envelope, which contains pores to allow the transport of materials. Most nuclei also contain a small dense area called the nucleolus.

The nucleus contains nearly all of the cell's DNA. DNA stands for deoxyribonucleic acid. Most of the time, the DNA is bound to proteins and appears as a granular substance known as chromatin (Figure 1.9). However, when a cell divides, the chromatin condenses to form chromosomes.

DNA is very important to the cell because it contains the coded information for making proteins and other molecules. Proteins serve many purposes and are found in various locations in the cell.

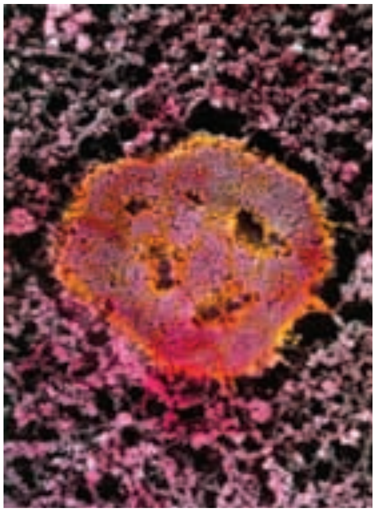

Figure 1.9 The nucleolus and chromatin in a human cell, as seen through an electron microscope

Vacuoles and Vesicles

Vacuoles and **vesicles** are membrane-bound organelles that store nutrients, wastes, and other substances used by the cell (Figure 1.10). In plant cells, the central vacuole stores water for the cell. When water enters the cell, the central vacuole swells, causing the plant cell to become firm. Vesicles transport substances throughout the cell.

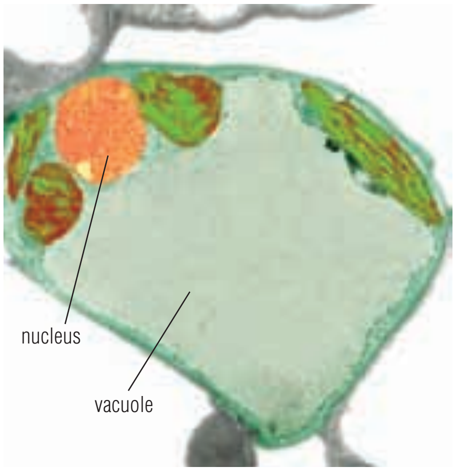

Figure 1.10 A leaf cell showing a large vacuole (pale green) and nucleus (orange) (magnification 11 000×)

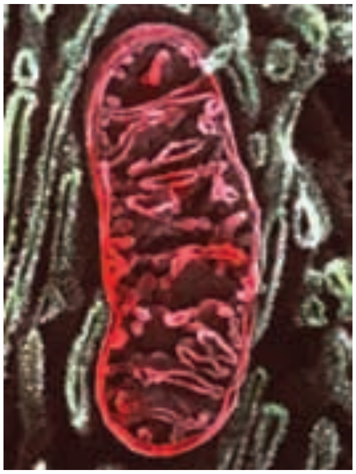

Figure 1.11 A mitochondrion, as seen through an electron microscope (magnification 80 000×)

Mitochondria

All cells require a source of energy: the organelles known as **mitochondria** supply that energy. Mitochondria are the powerhouses of the cell. Reactions occur in these organelles to convert the chemical energy in sugar into energy that the cell can use. Figure 1.11 shows a single mitochondrion.

Lysosomes

Lysosomes are organelles where digestion takes place. They are small organelles that are filled with enzymes. An enzyme is a protein that can speed up chemical reactions in the cell. Lysosomes also break down invading bacteria and damaged cell organelles. Essentially, they work as the clean-up system in the cell. Figure 1.12 shows a lysosome.

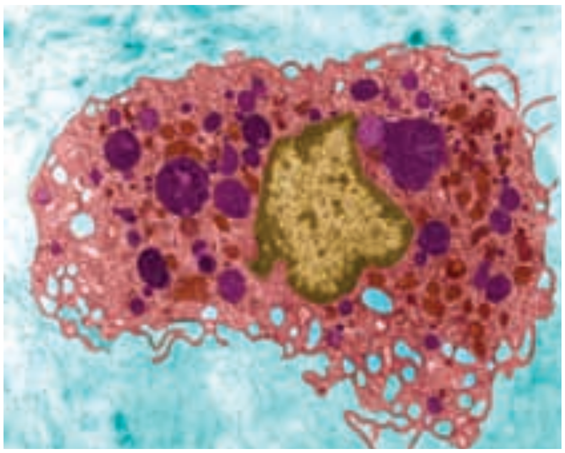

Figure 1.12 Lysosomes (purple) in a white blood cell. The cell's nucleus is light brown.

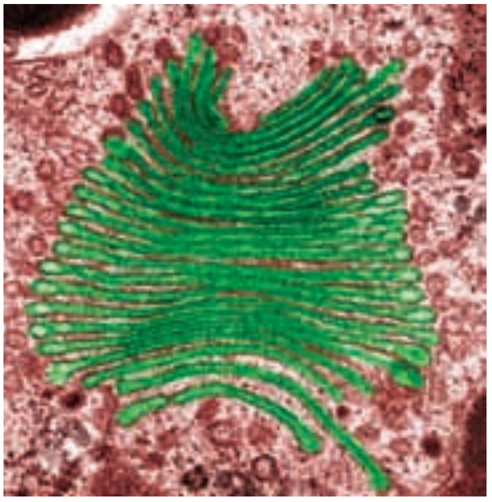

Figure 1.13 The Golgi apparatus is named after Camilio Golgi, who first identified it in 1898.

Golgi Apparatus

The **Golgi apparatus** receives proteins from the endoplasmic reticulum. The function of the Golgi apparatus is to modify, sort, and package these proteins for delivery throughout the cell or outside of the cell. The Golgi apparatus looks like a stack of flattened membranes (Figure 1.13).

Endoplasmic Reticulum

The endoplasmic reticulum is an organelle that is made of a series of interconnected small tubes that carry materials through the cell. **Rough endoplasmic reticulum** is associated with making proteins (Figure 1.14). **Ribosomes** are small, dense-looking organelles that may be attached to the rough endoplasmic reticulum or free in the cytoplasm. Ribosomes are the sites where proteins are assembled. **Smooth endoplasmic reticulum** is associated with the production of fats and oils (Figure 1.15). Smooth endoplasmic reticulum does not have ribosomes.

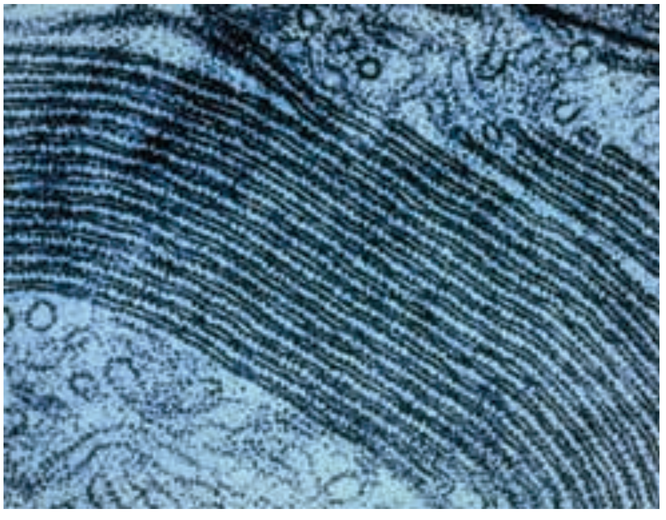

Figure 1.14 Rough endoplasmic reticulum and ribosomes

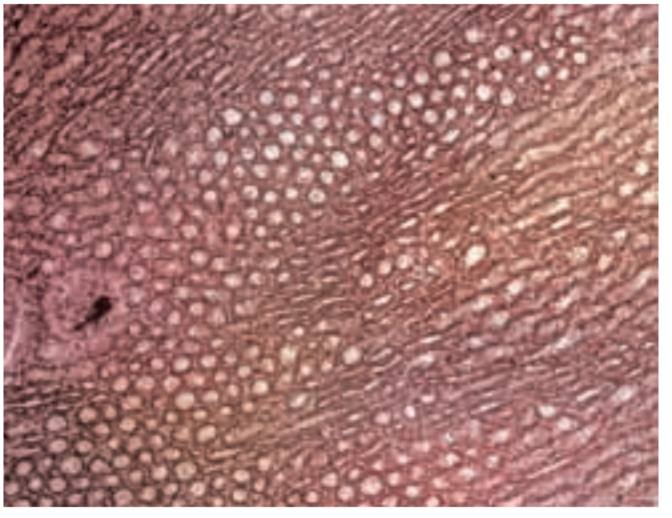

Figure 1.15 Smooth endoplasmic reticulum

Cytoskeleton

All cells have an internal network of fibres, called the **cytoskeleton**. The cytoskeleton is made up of protein filaments. It helps maintain the cell's shape.

Organelles in Plant Cells

Some organelles are found only in plant cells.

Cell Wall

Only plant cells, bacteria, fungi, and some algae have a cell wall. The **cell wall** is a rigid frame around the cell that provides strength, protection, and support (Figure 1.16).

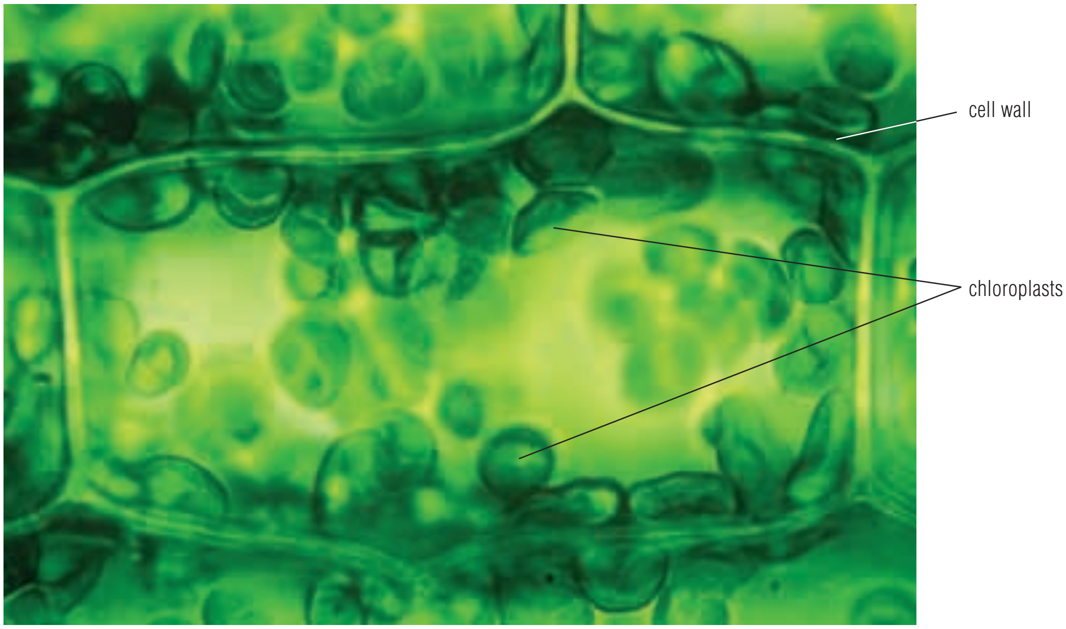

Figure 1.16 A leaf cell showing the cell wall and many chloroplasts (magnification 1000×)

Chloroplasts

Chloroplasts are found only in plant cells and some algae. These organelles contain a green substance called chlorophyll. Chlorophyll uses energy from the Sun to convert carbon dioxide and water into sugar and oxygen in a process called photosynthesis. Figure 1.17 shows the internal structure of a chloroplast. The chloroplast is made up of little sacs known as **thylakoids**. Thylakoids are stacked together in a way that resembles a stack of coins. They are surrounded by a thick fluid called stroma. A stack of thylakoids is called a **granum**; chloroplasts may have many grana. You can think of the thylakoids as being "solar collectors." They collect light energy from the Sun, which is used during the process of photosynthesis to produce carbohydrates. The carbohydrates are used for the growth of the plant.

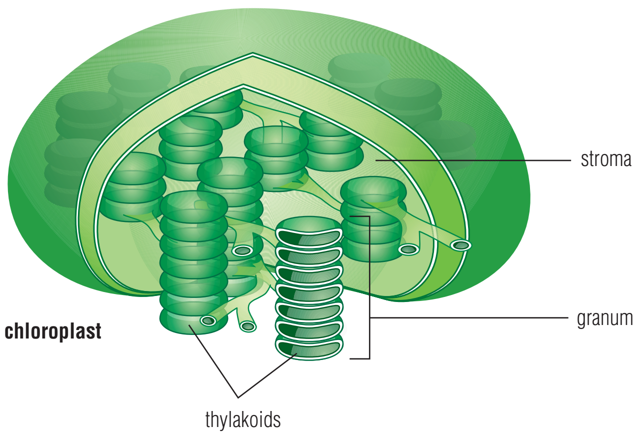

Figure 1.17 Photosynthesis takes place in the chloroplast in a plant cell.

During Reading Thinking Literacy

One Word Connects to Another Word

In the passage on chloroplasts, note the way in which each term is connected to another term. Create a concept map to show the connections. Begin with a top bubble with the term "chloroplast," and then connect the other terms as you read the paragraph. Try this strategy with another paragraph that contains new terms.

Suggested Activities
- A6 Inquiry Activity on page 24
- A3 Quick Lab on page 21
- A4 Quick Lab on page 21

Differences between Plant and Animal Cells

Cell walls and chloroplasts are only found in plant cells. However, there are other differences between plant and animal cells:

- Plant cells contain a specialized chemical compound called chlorophyll, a pigment that makes photosynthesis possible.
- Plant cells have a large central vacuole. Vacuoles in animal cells tend to be small.
- Some plant cells store energy in the form of starch or oils, such as cornstarch and canola oil. Animal cells store energy in the form of glycogen, a carbohydrate, or as lipids in the form of fats.
- Some animal cells have specialized compounds: for example, hemoglobin in red blood cells and cholesterol in other cells.
- Animal cells have **centrioles**, which are paired structures that are involved in cell division. Plant cells do not have centrioles.

Learning Checkpoint

1. What is an organelle?
2. What is the function of vacuoles and vesicles?
3. Describe the relationship between the functions of the endoplasmic reticulum and the Golgi apparatus.
4. Explain the role of the thylakoids in the process of photosynthesis.
5. State two similarities and two differences between plant and animal cells.

The Microscope as a Tool for Cell Research

The cell is very small — too small to be seen with the unaided eye. Once the microscope was developed, scientists were able to see and study the cell. Today, biologists use different types of microscopes to explore cell structure and function. This knowledge is useful in assessing our health because cells can be viewed under a microscope to look for abnormalities.

Compound Light Microscope

A compound light microscope uses light focussed through different lenses to form a magnified image of a specimen or object. Figure 1.18 shows a compound light microscope.

Table 1.1 Parts of a Microscope

Part	Function
1. Tube	Separates the ocular lens from the objective lens
2. Revolving nosepiece	Holds the objective lenses
3. Objective lenses	Magnify specimen; three lenses are usually 4×, 10×, and 40×
4. Stage	Supports the slide for observation
5. Diaphragm	Allows light to pass through the specimen
6. Condenser lens	Focusses light onto the specimen
7. Lamp	Supplies the light that passes through the specimen
8. Base	Provides a stable platform for the microscope
9. Fine adjustment knob	Sharpens an image
10. Coarse adjustment knob	Moves the stage up or down to focus on the specimen
11. Stage clips	Hold the slide in position on the stage
12. Arm	Holds the tube in place and is used to carry the microscope
13. Eyepiece or ocular lens	Magnifies the specimen, usually by 10×; single lens

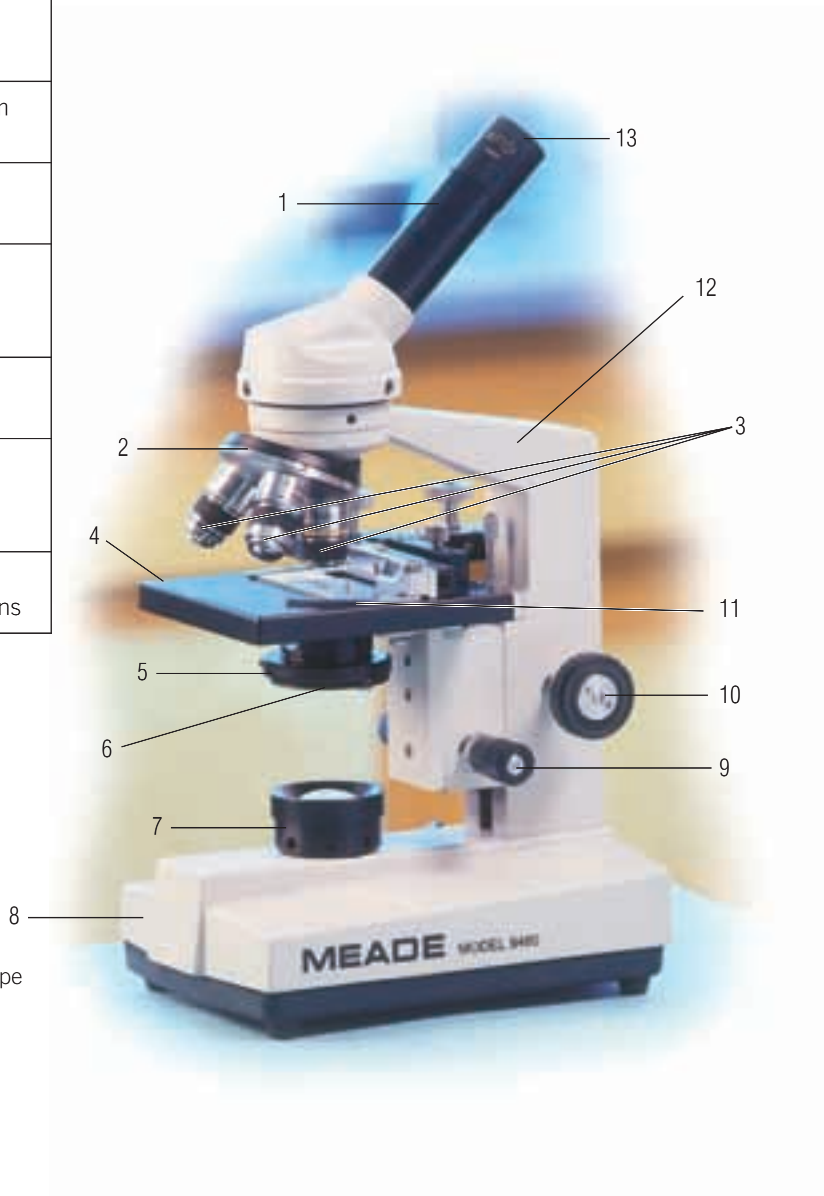

Figure 1.18 This compound light microscope is commonly found in science classrooms.

Magnification

The first microscope had a magnification of 20×, which meant that it produced an image that was enlarged by about 20 times. A compound light microscope has a series of lenses, which permits a higher level of magnification. For example, the compound light microscope has a maximum magnification of 1000× to 2000×; this means that the image is 1000 to 2000 times bigger than the actual object. To find the total magnification, you multiply the power of the objective lens by the power of the ocular lens (eyepiece).

A photo taken through a microscope is called a micrograph. A micrograph shows the magnified image of a specimen. To produce a micrograph, either a camera is attached to a microscope in place of the eyepiece or a special microscope that has a camera and an eyepiece is used.

Suggested Activity
A5 Inquiry Activity on page 22

Example Problem 1.1

Determine the total magnification of a microscope if the magnification of the objective lens is 10× and the magnification of the ocular lens is 10×.

Given
Magnification of objective lens = 10×
Magnification of ocular lens = 10×

Required
Total magnification = ?

Analysis and Solution
Multiply the magnification of the objective lens by the magnification of the ocular lens to get the total magnification.
(10×)(10×) = 100×

Paraphrase
Therefore, the total magnification is 100×.

Practice Problems

1. Determine the total magnification of a microscope with an objective lens of 100× and an ocular lens of 10×.
2. Determine the total magnification of a microscope with an objective lens of 4× and an ocular lens of 10×.
3. Determine the total magnification of a microscope with an objective lens of 40× and an ocular lens of 10×.

Resolution

Regardless of the magnification, being able to see clear detail in an image depends on the resolution, or resolving power, of the microscope. Resolution is the ability to distinguish between two objects that are very close together. For example, look at Figure 1.19. You may be able to see the individual dots in A and B, but it is hard to see the dots in D. This is because most people can only see dots that are 0.1 mm or larger. Using a compound light microscope, we can see individual objects that are closer together than 0.1 mm.

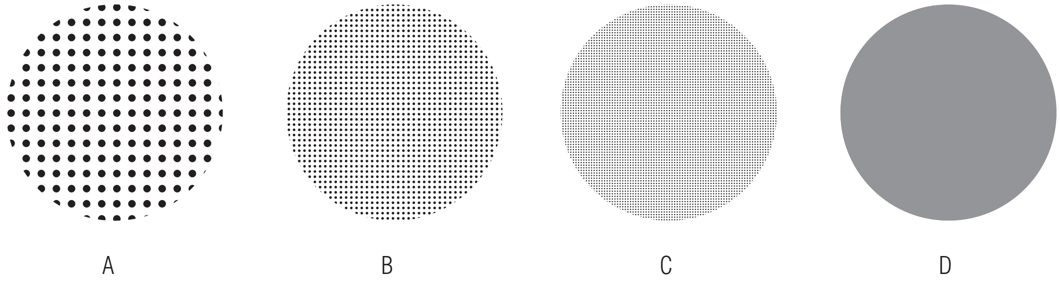

Figure 1.19 Can you see the individual dots that make up the circles in A, B, C, and D?

Contrast

It can be difficult to see the cell parts because both the cell and its background may be pale or transparent. Scientists use stains to improve the contrast between a cell's structures and the background and to produce better images. Two common stains are methylene blue and iodine. In fluorescence microscopy, fluorescent substances are added to the cells. When the cells are placed in ultraviolet light, the fluorescent substances glow (Figure 1.20).

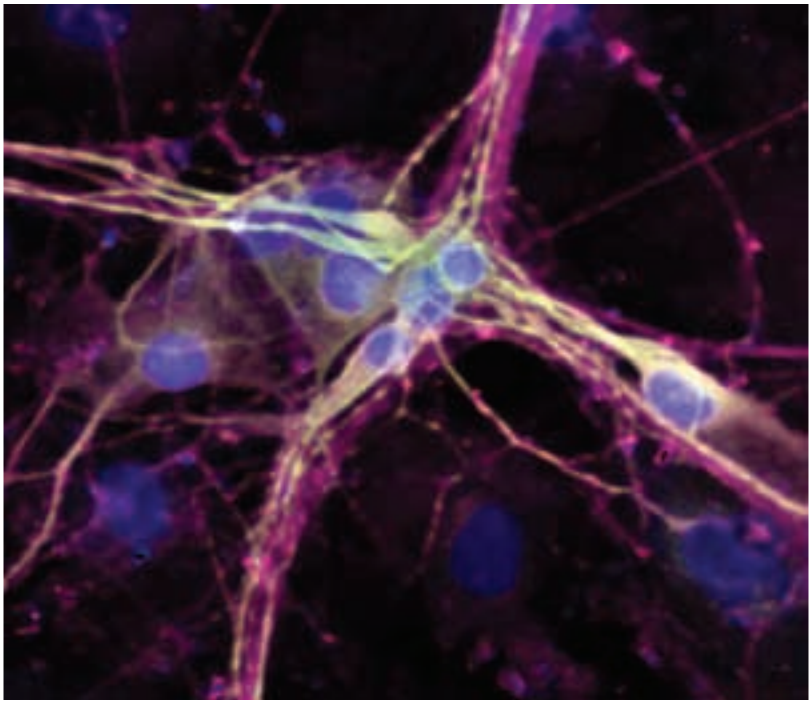

Figure 1.20 A micrograph showing nerve cells that have been stained with a fluorescent stain.

Electron Microscopes

An electron microscope uses a beam of electrons instead of light. The transmission electron microscope (TEM) is capable of magnifications of up to 1 500 000× (Figure 1.21). Since a beam of electrons can pass through thin slices, only thin sections of cells can be examined. This means that an electron microscope cannot be used to look at living cells — only dead cells can be observed.

A scanning electron microscope (SEM) provides information about the surface features of a specimen (Figure 1.22). The SEM operates up to a magnification of 300 000× and produces three-dimensional images of cells.

A photograph taken through either a TEM or an SEM is called an electron micrograph. An electron micrograph provides detailed information about the surface and texture of a cell, the shape and size of the particles in the cell, and the arrangement of the materials in a cell.

As a result of new technology, research on cells has led to major breakthroughs in medicine and industry. For example, the scanning tunnelling microscope (STM) and the atomic force microscope (AFM) produce images of molecules within cells, which help scientists understand the structure and function of molecules within the cell.

Take It **Further**

Take a closer look at either the mitochondrion or the lysosome. Briefly describe the function of the organelle. Find out how the electron microscope has improved the understanding of the structure and function of this organelle. Use a graphic organizer to record your thoughts and your sources. Begin your research at ***ScienceSource***.

Figure 1.21 In a transmission electron microscope, the electrons travel down the microscope column and pass through the specimen. An image forms on a fluorescent screen at the bottom of the column.

Figure 1.22 A researcher using a scanning electron microscope

A3 Quick Lab

Cells on Display

Purpose

To create a model of a plant or an animal cell

Materials & Equipment

- coloured modelling clay

Procedure

1. Select the type of cell — plant or animal — that you will model.
2. You will work in partners. Decide which of the cell parts you will include in your model. For each cell part, decide on the shape, size, and texture.
3. Create your model using the modelling clay, and share it with the class.

Questions

4. How do you think that the shape and structure of a specific cell part relates to its function? Explain your answer.
5. In this activity, you created a scientific model of the cell. What are some limitations of your model?

A4 Quick Lab

Practice Makes Perfect!

It is useful to record your observations when using a microscope. A sketch is a basic drawing that provides little detail but is accurate in scale and in proportion (Figure 1.23).

Purpose

To practise drawing sketches of cells

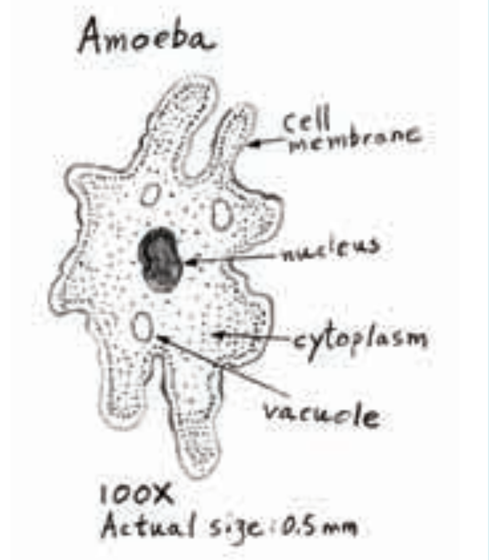

Figure 1.23 A labelled sketch of an amoeba

Materials & Equipment

- LCD projector
- prepared slides
- paper
- pen and/or pencil
- transparent ruler

Procedure

1. Your teacher will display a prepared slide on an LCD projector. Study the cell carefully.
2. Draw a sketch of the cell showing the external structures. Make sure that your sketch reflects accurate scale and proportion.
3. Repeat step 2 for the other slides. Be sure to include a title for each sketch.

Questions

4. What aspects of sketching did you find easy? What aspects did you find difficult?
5. What could you do to improve your sketches?

A5 *Inquiry Activity*

Skills References 2, 6, 10

SKILLS YOU WILL USE

- Using equipment, materials, and technology accurately and safely
- Communicating ideas, procedures, and results in a variety of forms

Creating Biological Diagrams of Plant and Animal Cells

A compound light microscope magnifies the image of a specimen. The magnification depends on the combination of lenses used. While it is interesting and informative to view objects under a microscope, it is difficult to know the actual size of the object being observed. To learn how to estimate the size of an object, you will compare it with something you already know — the diameter of the field of view, which is the entire area that you see when you look through the ocular lens. You will then estimate the size of plant and animal cells. You will record your observations in the form of a labelled biological diagram.

Question

How can a compound light microscope be used to estimate the size of a plant or animal cell?

Materials & Equipment

- compound light microscope
- pen and/or pencil
- paper
- transparent metric ruler
- prepared slides of plant and animal cells

CAUTION: Practise proper techniques in handling the microscope and slides.

Procedure

Part 1 — Determining the Size of the Field of View

1. Review the proper handling and use of the microscope in Skills Reference 10.
2. Copy Table 1.2 in your notebook. Record the magnification for each power.

Table 1.2 Microscope Magnification and Field Diameter

Field	Magnification	Field Diameter (mm)	Field Diameter (μm)
low power			
high power			

3. Set up your microscope and place a transparent metric ruler on the stage, so that it covers about half of the stage, as shown in Figure 1.24.
4. Observe the ruler under low power. Move the ruler so that you are measuring the diameter (width) of the low-power field of view from left to right. Set one of the millimetre divisions at the edge of the field of view, as shown in Figure 1.25.

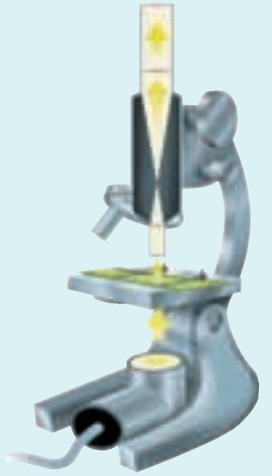

Figure 1.24 Set-up for measuring the diameter of the field of view

Figure 1.25 Move the ruler so that you can measure the diameter of the field of view. Line up a millimetre mark at the edge of the circle.

5. Measure the diameter of the low-power field of view to the nearest tenth of a millimetre. Record this measurement in your table. Convert the diameter from millimetres to micrometres, and record the measurement in your table. Remember that 1 mm = 1000 µm.
6. You cannot measure the diameter of the high-power (HP) field of view because it is less than 1 mm. However, you can use the following ratio to calculate the field diameter under high power.

$$\frac{\text{high-power field diameter}}{\text{low-power field diameter}} = \frac{\text{low-power magnification}}{\text{high-power magnification}}$$

   Show your work. Record the high-power field diameter both in millimetres and micrometres in your table.

Part 2 — Estimating Cell Size

7. Examine a prepared slide of a plant cell through the low- and high-power objective lenses.
8. Draw what you see in the field of view on low power. Calculate the scale of your drawing by comparing the diameter of the circle in your drawing with the field diameter that you obtained in step 5. For example, if the field diameter of the low-power objective was 3 mm and the diameter of the circle on your drawing was 3 cm (30 mm), the scale of the drawing would be 10:1.
9. Estimate the size of the cells that you view under the microscope by comparing them with the diameter of the field of view. For example, a cell that takes up $\frac{1}{5}$ of a field of view that is 500 µm has a size of about $\frac{1}{5}$ of 500 µm, or 100 µm, while a cell that takes up $\frac{1}{2}$ of a field of view that is 500 µm in diameter has a size of about $\frac{1}{2}$ of 500 µm, or 250 µm.
10. Examine a prepared slide of an animal cell through the low- and high-power objective lenses. Repeat steps 8 and 9.
11. Clean up your work area. Make sure to follow your teacher's directions for safe disposal of materials. Wash your hands thoroughly.

Analyzing and Interpreting

12. How many times is the magnification increased when you change from the low-power to the high-power lens?
13. State two observable characteristics that you can use to distinguish an animal cell from a plant cell based on what you saw using the compound light microscope.

Skill Practice

14. When using a microscope to view living cells, it is sometimes difficult to obtain a good image of the object. What two things can you do to ensure optimal viewing of the image?

Forming Conclusions

15. How can you use a compound light microscope to estimate the size of a plant or animal cell?
16. If an object under low power had an actual cell length of 30 µm, what would the cell length be under high power?
17. When you changed from low to high power, the image also changed. State three ways in which the image changed as the magnification was increased.
18. How would you estimate the size of an object viewed under the high-power objective lens (40×) if you were given the size of the field diameter when using the low-power objective lens (4×)?

A6 *Inquiry Activity*

Skills References 2, 6, 10

SKILLS YOU WILL USE

- Conducting inquiries safely
- Observing, and recording observations

Examining Plant and Animal Cells

There are some similarities and some differences between plant cells and animal cells that can be seen using a compound light microscope. You will look at cells from the human body and from an onion to see the similarities and the differences.

Question

What similarities and differences between plant and animal cells can be seen using a microscope?

Materials & Equipment

- clear adhesive tape
- compound light microscope
- methylene blue stain
- microscope slides and cover slips
- onion epidermis
- iodine stain
- paper
- paper towel
- pen and/or pencil
- tweezers

CAUTION: Practise proper techniques in handling the microscope and slides. Use care when staining. Cover your staining work area with a paper towel.

Procedure

Part 1 — Examining Animal Cells

1. Review the proper handling and use of the microscope in Skills Reference 10. Set up your microscope.
2. Take a small piece of clear adhesive tape, and stick it on the inside of your wrist. Remove the tape, and place it sticky side up on the slide.
3. Verify that cells are present by looking at your slide at low power and medium power.
4. Make a wet mount of your cells. Add a drop of methylene blue stain to the slide at one edge of the cover slip.
5. Place a piece of torn paper towel against the edge of the cover slip on the side opposite that of the stain. The stain should move under the cover slip toward the paper towel. When all of the cells are stained, remove the paper towel.
6. Place the slide on the microscope, and observe the cells.
7. Create a labelled diagram of your skin cells. Include the magnification and scale.

Part 2 — Examining Plant Cells

8. Obtain a small section of onion. Use the tweezers to pull off a thin transparent layer of cells.
9. Prepare a wet mount of the onion cells. Add a drop of iodine stain, and follow the staining procedure in step 5.
10. Place the slide on the microscope, and observe the cells.
11. Create a labelled diagram of the onion cells. Include the magnification and scale.
12. Clean up your work area. Make sure to follow your teacher's directions for safe disposal of materials. Wash your hands thoroughly.

Analyzing and Interpreting

13. Both the plant and animal cells used in this activity are specialized cells that form the outer layer of the organism. Describe how the appearance and shape of the cells enable them to accomplish their task of covering and protection.
14. Explain how the cells appeared to be different when viewed at different magnifications.
15. Explain why it is necessary to use onion membrane that is only one cell in thickness.

Skill Practice

16. Explain how the use of contrast (light levels and use of stain) improved your understanding of the cells that you were viewing.

Forming Conclusions

17. Describe the similarities and differences that you observed between the plant and animal cells.

1.1 CHECK and REFLECT

Key Concept Review

1. What five life processes do cells perform?
2. List the five organelles that are common to plant and animal cells. What are their functions?
3. What are three differences between plant and animal cells?
4. Why can the granum and thylakoid structures be described as "solar collectors"?
5. Prepare a table that summarizes the organelles and structures found in plant and animal cells.
6. Explain how fluorescence microscopy works.
7. Name two types of electron microscopes that are used by cell biologists.
8. What is the name of the image created by an electron microscope?
9. Explain why the cell can be considered to be the "building block" of life.
10. Explain the importance of contrast in microscopy.
11. What two things can you do to create contrast when you use a compound light microscope to study a specimen?

Connect Your Understanding

12. Explain why a cell biologist would choose to use an electron microscope rather than a light microscope. When would a light microscope be preferred?
13. What details of a microscope would you need to know to determine the total magnification of the system?
14. Explain why you would expect the cells of a desert plant, such as a cactus, to have thickened cell walls.
15. Think about the function of the mitochondria. You have been asked to view cells taken from the leg muscle of an athlete and cells taken from the skin of an elderly individual. What differences in the number of mitochondria would you see in the two samples? Explain your thinking.
16. Explain how a microscope may be used to assess human health.
17. Write a short paragraph that compares and contrasts plant and animal cells by considering structures, presence of specialized compounds, and forms of energy storage.
18. The scientist shown below is looking at cells through a fluorescent microscope. How has the development of technology aided our understanding of cells?

Question 18

Reflection

19. Describe three things about plant and animal cells that you did not know before you started working on this section.

For more questions, go to ***ScienceSource***.