Cell Structures

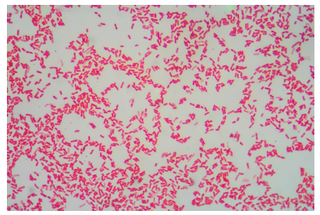
You must be able to:

- Describe how light microscopes and staining can be used to view cells
- Explain how the main subcellular structures are related to their functions
- Explain how electron microscopy has increased understanding of subcellular structures.

The Light Microscope

- Light microscopes are useful for viewing whole cells or large subcellular structures.
- The specimen is placed on a glass slide, covered with a cover slip and placed on the stage of the microscope.
- The eyepiece and objective lenses magnify the object.
- A lamp provides illumination.
- **Magnification** is calculated by multiplying the magnification of the eyepiece lens by the magnification of the objective lens.
- Typical magnification is between 40 and 2000 times larger with a **resolution** of about 0.2 micrometres (μm).
- **Stains** can be used to colour whole cells and structures within cells, e.g. the nucleus, to make them easier to see.
- Sometimes a **mordant** is used, which fixes the stain to the structures.

Stained Bacteria Viewed using a Light Microscope



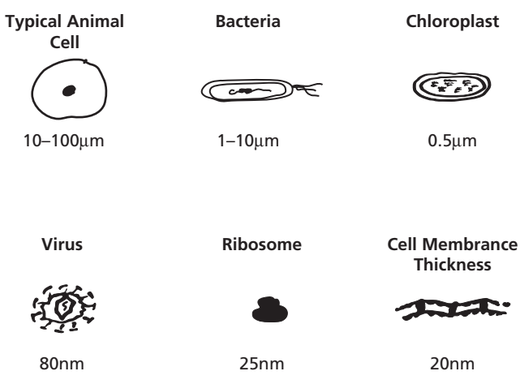
The Electron Microscope

- Electron microscopes are useful for viewing subcellular structures, such as ribosomes, mitochondrial membranes and nuclear membranes, in detail.
- They use a beam of electrons instead of a lamp.
- The specimen is placed inside a vacuum chamber.
- Electromagnets are used instead of lenses.
- The image is viewed on a TV screen.
- Typical magnification is 1 to 2 million times larger with a resolution of 2 nanometres (nm).

Bacteria Viewed using an Electron Microscope

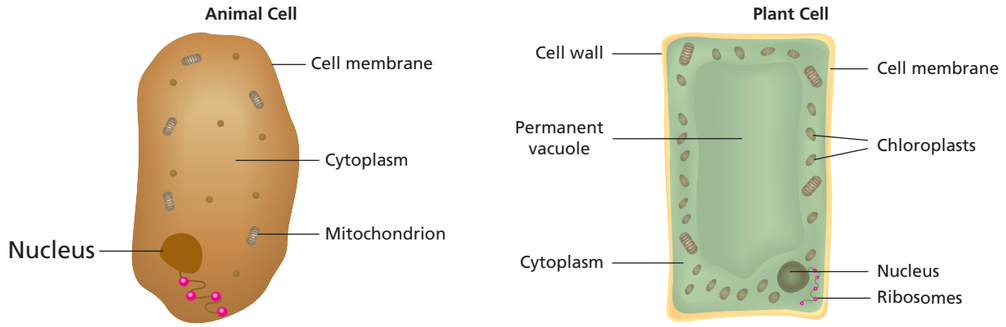
SI Units and Interconverting Units

1 metre (m) = 1 000 000 micrometres (μm)
1μm = 10^{-6}m
1 metre (m) = 1 000 000 000 nanometres (nm)
1nm = 10^{-9}m
To convert m to mm, multiply by 1000.
To convert mm to μm, multiply by 1000.
To convert μm to nm, multiply by 1000.



Subcellular Structures

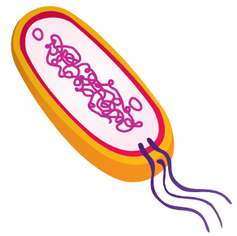
- The following structures are common to both animal and plant cells:
  - **nucleus** – controls the cell and contains genetic material in the form of chromosomes
  - **cytoplasm** – where most chemical reactions take place
  - **cell membrane** – a barrier that controls the passage of substances into and out of the cell and contains **receptor molecules**
  - **mitochondria** – contain the enzymes for cellular respiration and are the site of respiration.
- Additionally, plant cells contain:
  - **cell wall** – made from cellulose and provides structural support
  - **vacuole** – contains cell sap, which provides support
  - **chloroplasts** – contain **chlorophyll** and are the site of photosynthesis.



Types of Cells

- **Prokaryotes**, e.g. bacteria, have no nucleus – the nuclear material lies free within the cytoplasm.
- They may contain additional DNA in the form of a **plasmid**.
- **Eukaryotes**, e.g. human cheek cell, amoeba, plant cell, have a nucleus bound by a nuclear membrane.
- In eukaryotes, the cell wall is only present in plant cells.

A Prokaryote



Quick Test

1. The eyepiece lens of a light microscope is ×10 and the objective lens is ×4. What is the total magnification?
2. Which part of a cell is:
   a) the site of respiration?
   b) the site of photosynthesis?
   c) a barrier controlling what passes in and out of the cell?
   d) where most chemical reactions take place?
3. Name **two** structures found in plant cells, but not in animal cells.

Key Words

magnification
resolution
stain
mordant
receptor molecules
chlorophyll
prokaryote
plasmid
eukaryote