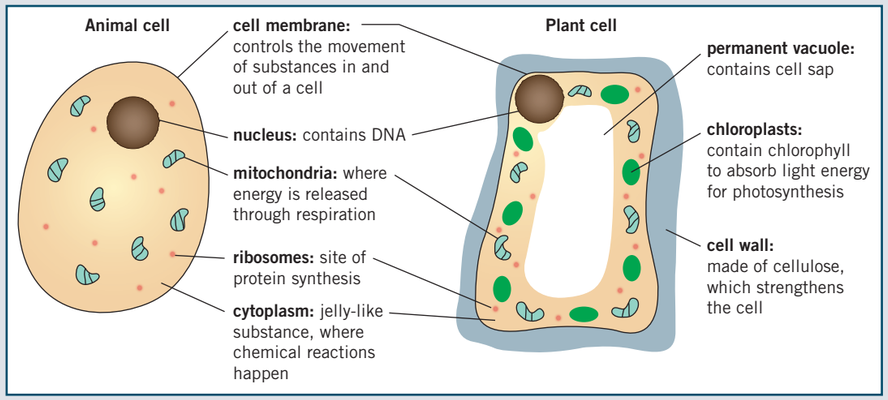
Chapter 1: Cell biology and transport

Knowledge organiser

Eukaryotic cells

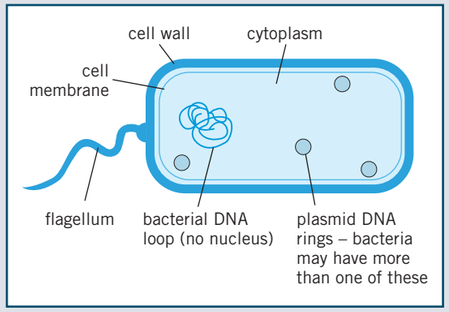
Animal and plant cells are eukaryotic. They have genetic material (DNA) that forms **chromosomes** and is contained in a **nucleus**.



Prokaryotic cells

Bacteria have the following characteristics:

- single-celled
- no nucleus – have a single loop of DNA
- have small rings of DNA called **plasmids**
- smaller than eukaryotic cells.



Microscopes

Light microscope	Electron microscope
uses light to form images	uses a beam of electrons to form images
living samples can be viewed	samples cannot be living
relatively cheap	expensive
low magnification	high magnification
low resolution	high resolution

Electron microscopes allow you to see sub-cellular structures, such as ribosomes, that are too small to be seen with a light microscope.

L To calculate the **magnification** of an image:

$$\text{magnification} = \frac{\text{image size}}{\text{actual size}}$$

Specialised cells

Cells in animals and plants differentiate to form different types of cells. Most animal cells differentiate at an early stage of development, whereas a plant's cells differentiate throughout its lifetime.

Specialised cell	Function	Adaptations
sperm cell	fertilise an ovum (egg)	• tail to swim to the ovum and fertilise it • lots of mitochondria to release energy from respiration, enabling the sperm to swim to the ovum
red blood cell	transport oxygen around the body	• no nucleus so more room to carry oxygen • contains a red pigment called haemoglobin that binds to oxygen molecules • flat bi-concave disc shape to increase surface area-to- volume ratio
muscle cell	contract and relax to allow movement	• contains protein fibres, which can contract to make the cells shorter • contains lots of mitochondria to release energy from respiration, allowing the muscles to contract
nerve cell	carry electrical impulses around the body	• branched endings, called dendrites, to make connections with other neurones or effectors • myelin sheath insulates the axon to increase the transmission speed of the electrical impulses
root hair cell	absorb mineral ions and water from the soil	• long projection speeds up the absorption of water and mineral ions by increasing the surface area of the cell • lots of mitochondria to release energy for the active transport of mineral ions from the soil
palisade cell	enable photosynthesis in the leaf	• lots of chloroplasts containing chlorophyll to absorb light energy • located at the top surface of the leaf where it can absorb the most light energy

Comparing diffusion, osmosis, and active transport

	Diffusion	Osmosis	Active transport
Definition	The spreading out of particles, resulting in a net movement from an area of higher **concentration** to an area of lower concentration. Factors which affect the rate of diffusion: difference in concentration, temperature, and surface area of the membrane.	The diffusion of water from a **dilute** solution to a concentrated solution through a **partially permeable membrane**.	The movement of particles from a more dilute solution to a more concentrated solution using energy from respiration.
Movement of particles	Particles move down the concentration **gradient** – from an area of *high* concentration to an area of *low* concentration.	Water moves from an area of *lower* solute concentration to an area of *higher* solute concentration.	Particles move against the concentration gradient – from an area of *low* concentration to an area of *high* concentration.
Energy required?	no – passive process	no – passive process	yes – energy released by respiration
Examples	**Humans** • Nutrients in the small intestine diffuse into the **capillaries** through the **villi**. • Oxygen diffuses from the air in the **alveoli** into the blood in the capillaries. Carbon dioxide diffuses from the blood in the capillaries into the air in the alveoli. • **Urea** diffuses from cells into the blood for excretion in the kidney. **Fish** • Oxygen from water passing over the gills diffuses into the blood in the **gill filaments**. • Carbon dioxide diffuses from the blood in the gill filaments into the water. **Plants** • Carbon dioxide used for photosynthesis diffuses into leaves through the **stomata**. • Oxygen produced during photosynthesis diffuses out of the leaves through the stomata.	**Plants** • Water moves by osmosis from a dilute solution in the soil to a concentrated solution in the **root hair cell**.	**Humans** • Active transport allows sugar molecules to be absorbed from the small intestine when the sugar concentration is higher in the blood than in the small intestine. **Plants** • Active transport is used to absorb mineral ions into the root hair cells from more dilute solutions in the soil.

Key terms

Make sure you can write a definition for these key terms.

cell membrane, cell wall, chloroplast, chromosome, concentration, cytoplasm, dilute, DNA, eukaryotic, gill filaments, gradient, magnification, mitochondria, nucleus, partially permeable membrane, passive process, permanent vacuole, plasmid, prokaryotic, resolution, ribosome, root hair cell, stomata

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Retrieval questions

Learn the answers to the questions below then cover the answers column with a piece of paper and write as many as you can. Check and repeat.

B1 questions	Answers
1 What are two types of eukaryotic cell?	animal and plant
2 What type of cell are bacteria?	prokaryotic
3 Where is DNA found in animal and plant cells?	in the nucleus
4 What is the function of the cell membrane?	controls movement of substances in and out of the cell
5 What is the function of mitochondria?	site of respiration to transfer energy for the cell
6 What is the function of chloroplasts?	contain chlorophyll to absorb light energy for photosynthesis
7 What is the function of ribosomes?	enable production of proteins (protein synthesis)
8 What is the function of the cell wall?	strengthens and supports the cell
9 What is the structure of the main genetic material in a prokaryotic cell?	single loop of DNA
10 How are electron microscopes different to light microscopes?	electron microscopes use beams of electrons instead of light, cannot be used to view living samples, are much more expensive, and have a much higher magnification and resolution
11 What is the function of a red blood cell?	carries oxygen around the body
12 Give three adaptations of a red blood cell.	no nucleus, contains a red pigment called haemoglobin, and has a bi-concave disc shape
13 What is the function of a nerve cell?	carries electrical impulses around the body
14 Give two adaptations of a nerve cell.	branched endings, myelin sheath insulates the axon
15 What is the function of a sperm cell?	fertilises an ovum (egg)
16 Give two adaptations of a sperm cell.	tail, contains lots of mitochondria
17 What is the function of a palisade cell?	carries out photosynthesis in a leaf
18 Give two adaptations of a palisade cell.	lots of chloroplasts, located at the top surface of the leaf
19 What is the function of a root hair cell?	absorbs minerals and water from the soil
20 Give two adaptations of a root hair cell.	long projection, lots of mitochondria
21 What is diffusion?	net movement of particles from an area of high concentration to an area of low concentration along a concentration gradient – this is a passive process (does not require energy from respiration)
22 Name three factors that affect the rate of diffusion.	concentration gradient, temperature, membrane surface area
23 How are villi adapted for exchanging substances?	• long and thin – increases surface area • one-cell-thick membrane – short diffusion pathway • good blood supply – maintains a steep concentration gradient
24 How are the lungs adapted for efficient gas exchange?	• alveoli – large surface area • moist membranes – increases rate of diffusion • one-cell-thick membranes – short diffusion pathway • good blood supply – maintains a steep concentration gradient
25 How are fish gills adapted for efficient gas exchange?	• large surface area for gases to diffuse across • thin layer of cells – short diffusion pathway • good blood supply – maintains a steep concentration gradient
26 What is osmosis?	diffusion of water from a dilute solution to a concentrated solution through a partially permeable membrane
27 Give one example of osmosis in a plant.	water moves from the soil into the root hair cell
28 What is active transport?	movement of particles against a concentration gradient – from a dilute solution to a more concentrated solution – using energy from respiration
29 Why is active transport needed in plant roots?	concentration of mineral ions in the soil is lower than inside the root hair cells – the mineral ions must move against the concentration gradient to enter the root hair cells
30 What is the purpose of active transport in the small intestine?	sugars can be absorbed when the concentration of sugar in the small intestine is lower than the concentration of sugar in the blood

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