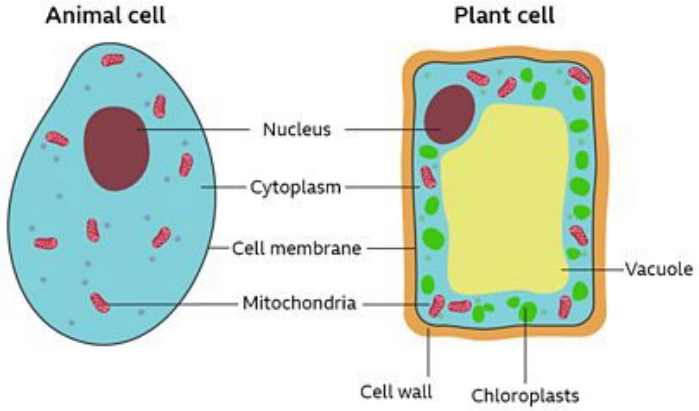
B1 – Cell Biology

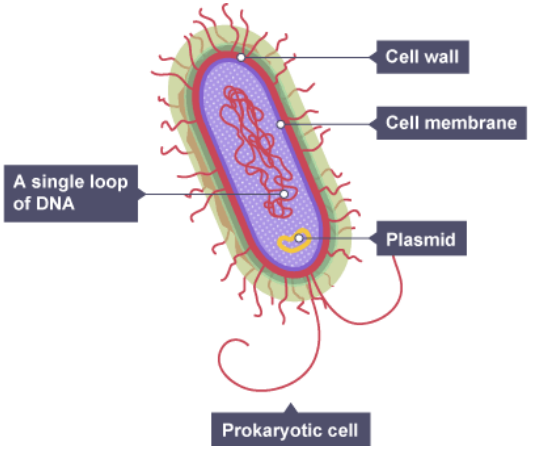
Eukaryotic Cells

They have a nucleus to contain the chromosomes. These can be animal, plant or fungus or protist cells. Animal and plant cells are shown below.



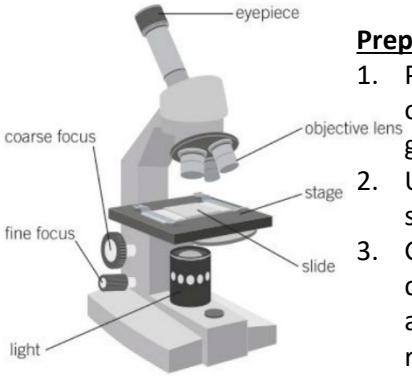
Prokaryotic Cells

They do not have a nucleus, they are usually a lot smaller and may contain plasmids.



Cell		Features
Animal	Sperm	High number of mitochondria Ribosomes that make enzymes in the head
	Nerve	Long Lots of branches (dendrites)
	Muscle	High number of mitochondria High Number of ribosomes Store glycogen
Plant	Xylem	Walls thickened with lignin to strength the cells into a tube
	Phloem	Sections between cells called sieves to help transport substances like dissolved sugars
	Root hair	Large surface area Lack of chloroplasts Large vacuole

RP1 – Microscopy; Observing Plant Cells



Preparing the slide:

1. Place a thin layer of onion membrane on a glass slide with forceps.
2. Use a drop of iodine to stain the cells.
3. Gently place a glass cover slip over the same and tap carefully to remove air bubbles.

Viewing the slide:

1. Place the slide on the stage and turn on the light.
2. Select the lowest magnification objective lens.
3. Look through the eyepiece and turn the coarse focus until the image can be seen.
4. Turn the fine focus until a clear image is formed.
5. Change the objective lens to another with a higher magnification and turn the fine focus re-focus the image.

Microscopes

The development of microscopes of the last 200 years has allowed us to study cells and the structures inside them in more and more detail.

Light Microscope	Electron Microscope
Low resolution Low magnification Cheap	High resolution High magnification Expensive

Calculating Magnification

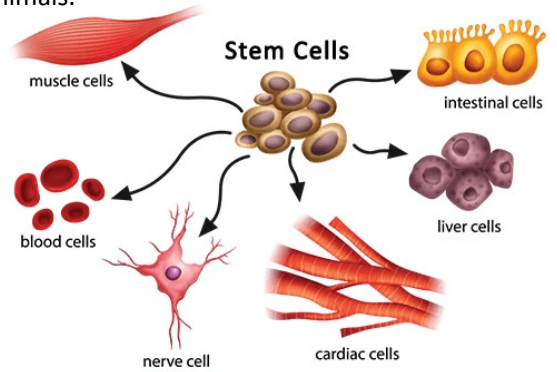
Units for image and actual size may need to be converted before using the equation below.

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

mm → µm **x 1000**
µm → mm **÷1000**

Cell Differentiation

As an organism develops, cells differentiate to form different types of cells. This is an example in animals.



B1 – Cell Biology

1. Name the three cell parts (organelles) found in a plant cell but not in an animal cell.
2. How can you identify an eukaryotic cells from its structure?
3. What is the role of a ribosome?
4. Which organelle releases energy through respiration?
5. What is the role of the cell wall?

1. What structures are only found in prokaryotic cells?
2. Which are larger; prokaryotic or eukaryotic cells?
3. What feature do some bacterial (and some animal) cells have that enable it to move?

1. How is a root hair cell specialised?
2. Why would a cell contain more mitochondria than usual?
3. How are nerve cells specialised?
4. Why does a sperm cell require a lot of mitochondria?
5. How are xylem cells specialised?

1. Which part of a light microscope is the glass slide placed on?
2. Which objective lens is selected first to produce a magnified image of a sample?
3. What is used to stain plant cells?
4. What is place on top of the slide, sample and stain?
5. What part of the microscope is used to focus the image and make it clear?

1. What are the advantages of using a electron microscope for viewing cells?
2. Convert 2.3mm into µm.
3. How would we calculate the actual size of a cell using the image size and magnification?
4. Convert 570µm into mm.

1. What does cell differentiation mean?
2. What are the cells that are unspecialised and can become any type of cell called?

B1 – Cell Biology

1. Name the three cell parts (organelles) found in a plant cell but not in an animal cell. Cell wall, vacuole, chloroplasts
2. How can you identify a eukaryotic cells from its structure? It has a nucleus
3. What is the role of a ribosome? Make proteins
4. Which organelle releases energy through respiration? mitochondria
5. What is the role of the cell wall? Strength and support

1. What structures are only found in prokaryotic cells? plasmid
2. Which are larger; prokaryotic or eukaryotic cells? eukaryotic
3. What feature do some bacterial (and some animal) cells have that enable it to move? tail

1. How is a root hair cell specialised? Large surface area
2. Why would a cell contain more mitochondria than usual? Needs lots of energy
3. How are nerve cells specialised? Cell membrane is long so it can connect with lots of cells
4. Why does a sperm cell require a lot of mitochondria? Energy to swim to the egg
5. How are xylem cells specialised? They have spirals of lignin to give them more strength

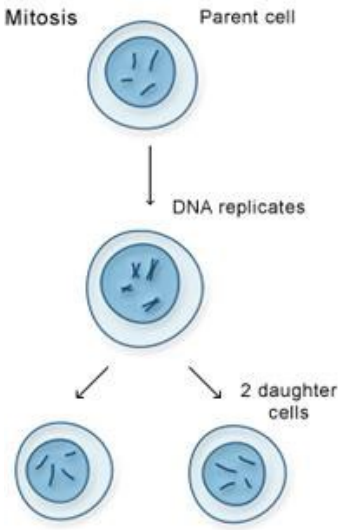
1. Which part of a light microscope is the glass slide placed on? stage
2. Which objective lens is selected first to produce a magnified image of a sample? lowest
3. What is used to stain plant cells? Dye / iodine
4. What is place on top of the slide, sample and stain? Cover slip
5. What part of the microscope is used to focus the image and make it clear? Focus wheel

1. What are the advantages of using a electron microscope for viewing cells? Higher magnifications
2. Convert 2.3mm into µm. 2300
3. How would we calculate the actual size of a cell using the image size and magnification? Actual size = image ÷ magnification
4. Convert 570µm into mm. 0.57

1. What does cell differentiation mean? When cells specialise to do particular jobs
2. What are the cells that are unspecialised and can become any type of cell called? Stem cells

B1 – Cell Biology

Mitosis

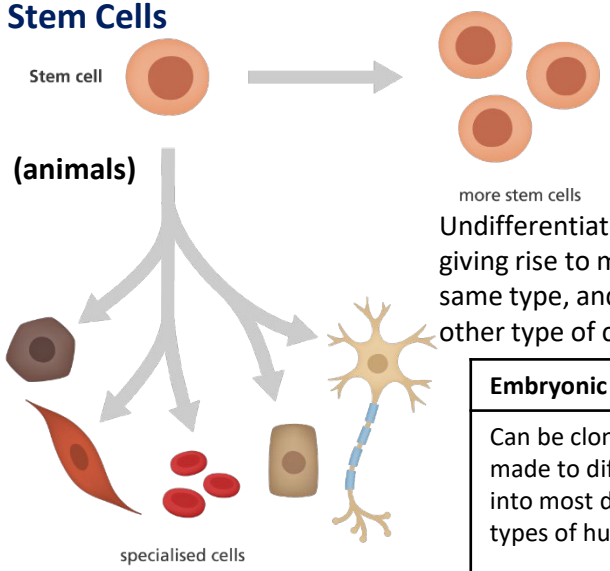


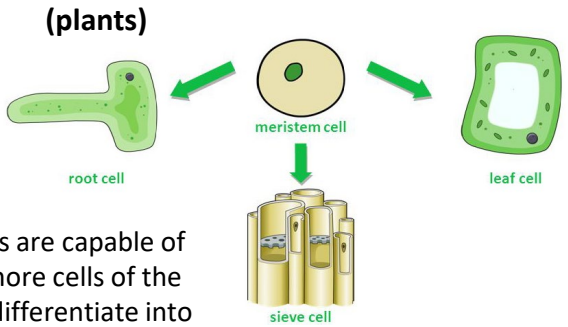
Before a cell can divide it needs to grow and increase the number of sub-cellular structures such as ribosomes and mitochondria. **The DNA replicates** to form two copies of each chromosome.

In mitosis one set of chromosomes is pulled to each end of the cell and the **nucleus divides**.

Finally the **cytoplasm and cell membranes divide** to form <u>two identical cells</u>.

Stem Cells

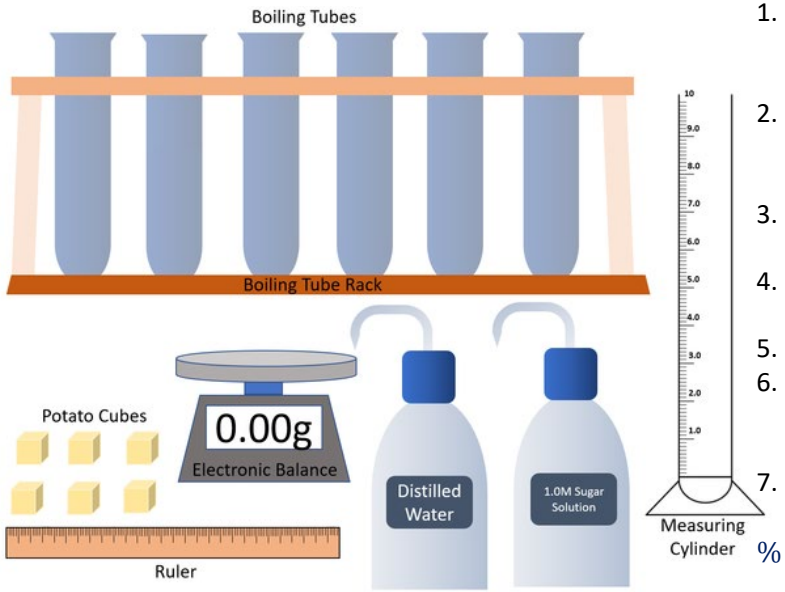




Undifferentiated cells are capable of giving rise to many more cells of the same type, and can differentiate into other type of cells.

Embryonic	Adult	Meristems
Can be cloned and made to differentiate into most different types of human cells	Bone marrow stem cells can form many types of cells including blood cells.	Can differentiate into any type of plant cell, throughout the life of the plant.

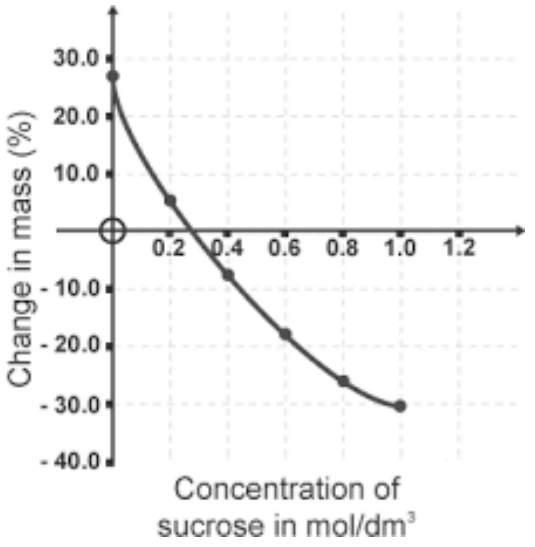
RP2 – Osmosis: The concentration of surrounding solution affects mass of plant tissue



1. Use a cork borer to create 5 cylinders of plant tissue (usually potato) and cut them all to the same length.
2. Measure the mass of each piece using a top pan balance and the length of each piece with a ruler. Record in a table.
3. Measure out 100cm^3 of each concentration of salt/sugar solution into labelled boiling tubes.
4. Place each piece of potato into a boiling tube for 24 hours.
5. Remove the pieces and blot with a paper towel.
6. Measure the mass of each piece using a top pan balance and the length of each piece with a ruler. Record in a table.
7. Calculate the percentage change in mass.

$$\%\ \boldsymbol{change\ in\ mass} = \frac{\boldsymbol{change\ in\ mass\ (g)}}{\boldsymbol{inital\ mass\ of\ potato\ (g)}}$$

<u>Results Graph</u>



B1 – Cell Biology

1. What has to be replicated (copied) before the cell can divide?
2. What happens in the third stage of mitosis?
3. What word is used to describe the similarity of the two cells formed?

1. Where type of organism contains meristems?
2. What is a stem cell?
3. Which type of animal stem cell can only become a small number of different cells rather than any type of cell?

1. What piece of equipment is used to ensure the surface area of each piece of potato is the same?
2. What piece of equipment is used to measure the mass before and after the experiment?
3. What happens to pieces of potato in dilute (high water concentration) solutions?
4. What should be done with the pieces of potato after then have been removed from the solution but before their mass is measured?

B1 – Cell Biology

1. What has to be replicated (copied) before the cell can divide? All of the DNA

2. What happens in the third stage of mitosis? The cell membrane and cytoplasm divide

3. What word is used to describe the similarity of the two cells formed? identical

1. Where type of organism contains meristems? plant

2. What is a stem cell? An unspecialised cell that can become any type of cell

3. Which type of animal stem cell can only become a small number of different cells rather than any type of cell? Bone marrow stem cells

1. What piece of equipment is used to ensure the surface area of each piece of potato is the same? Cork borer

2. What piece of equipment is used to measure the mass before and after the experiment? scale

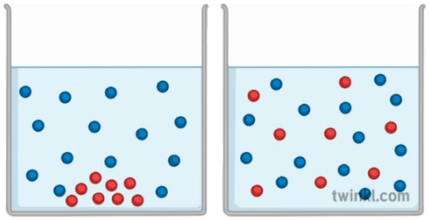
3. What happens to pieces of potato in dilute (high water concentration) solutions? They gain mass

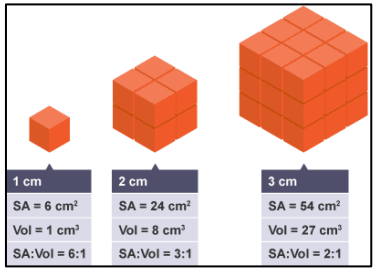
4. What should be done with the pieces of potato after then have been removed from the solution but before their mass is measured? Wipe the surface to remove any water on the potato piece

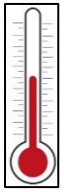
B1 – Cell Biology

Diffusion

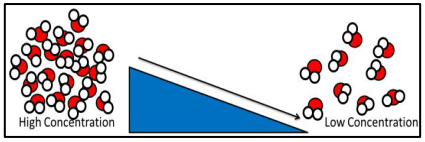
- Substances move a higher concentration of that substance (red particles pictured) to where there is a lower concentration of that substance. (High→ Low)
- This happens because of the random movement of the particles in a fluid (liquid or gas).







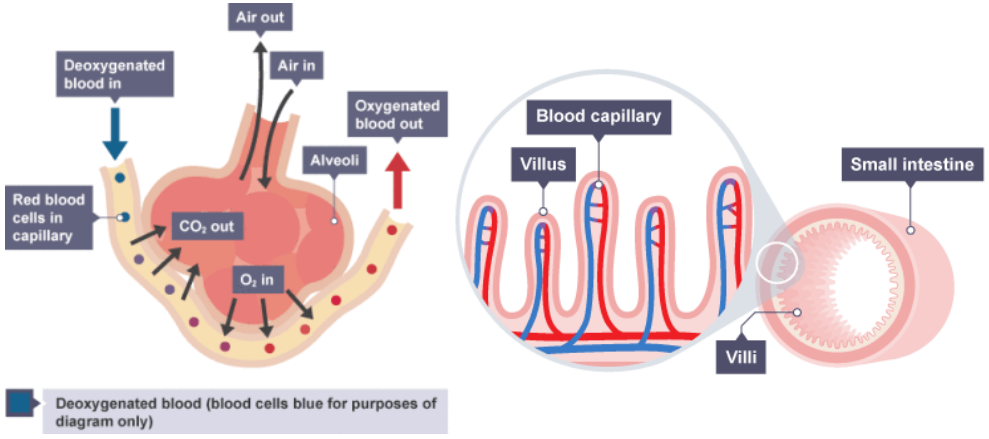
- There are ways the rate of diffusion can be changed:
  - the difference in concentrations (concentration gradient)
  - the temperature
  - the surface area of the membrane



Examples

Alveoli in the lungs and villi in the small intestine are both structured in similar ways so diffusion can happen at a high rate (fast).

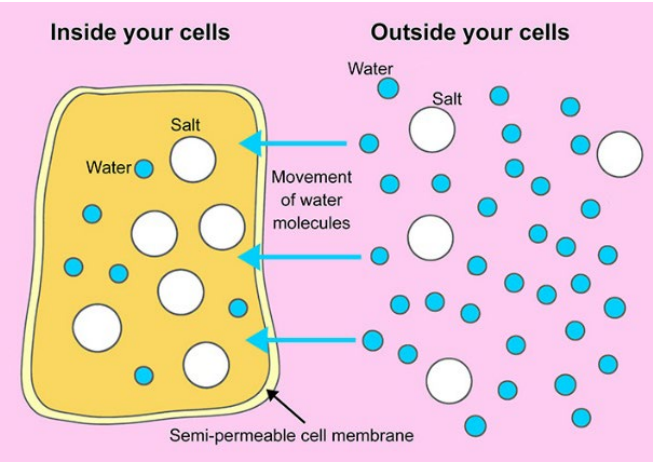
- having a large surface area
- a membrane that is thin, to provide a short diffusion path
- (in animals) having an efficient blood supply



Osmosis

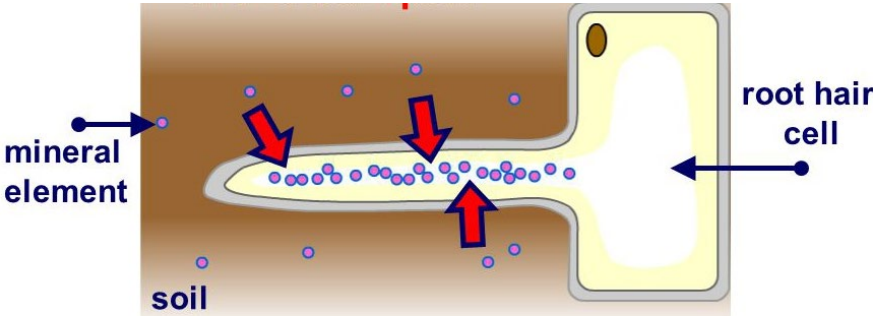
Water may move across cell membranes via osmosis.

Osmosis is the diffusion of water from a dilute solution to a concentrated solution through a partially permeable membrane (H→L).



Partially permeable means small molecules can move through but large molecules cannot.

Active Transport



- Active transport is moving substances against the concentration gradient (L→H) so requires energy. This energy comes from respiration.
- This means that cells that carry out a lot of active transport (root hair cells, epithelial cells on villi in the small intestine) contain a lot of mitochondria.

B1 – Cell Biology

1. What factors affect the rate of diffusion?
   -
   -
   -

2. Give an example in animals where diffusion would take place?

3. How are structures in organisms adapted for efficient diffusion?
   -
   -
   -

4. Do substances more from a low concentration to a high concentration

1. What substance is being transported by osmosis?

2. What does partially permeable mean?

1. How is active transport different to diffusion?

2. Give an example of where active transport happens often in organisms.

3. Why do cells that carry out active transport often have a lot of mitochondria?

B1 – Cell Biology

1. What factors affect the rate of diffusion?
   - temperature
   - concentration
   - surface area of the membrane

2. Give an example in animals where diffusion would take place? Lungs, small intestine

3. How are structures in organisms adapted for efficient diffusion?
   - large surface area
   - good blood supply
   - Thin membranes

4. Do substances more from a low concentration to a high concentration from high to low concentration

1. What substance is being transported by osmosis? water

2. What does partially permeable mean? Only molecules of a certain size can get through

1. How is active transport different to diffusion? It requires energy

2. Give an example of where active transport happens often in organisms. Roots of plants

3. Why do cells that carry out active transport often have a lot of mitochondria? To release energy